EFFECT OF TEMPERATURE ON DIFFERENT PROPERTIES OF CONCRETE

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Abstract

In this research work, the effect of low and high temperature on various properties of concrete was investigated. The properties investigated were modulus of rupture of concrete beams, compressive strength and tensile strength of concrete. Three different temperatures were used for this purpose. These were low, room and high temperatures. The low temperature was 5°C, room temperature was 28°C and high temperature was taken as 55°C. For compressive strength calculations, cubes of sizes (6˝x6˝x6˝) were cast. Cylinders of sizes (6˝x12˝) were made for tensile strength measurement, and for modulus of rupture beams of sizes (4˝x4˝x18˝) were cast. Locally available material was used in casting these samples. After casting these samples, curing was carried out at low and high temperature along with room temperature. These samples were then tested after three, seven and twenty eight days of curing and a comparative study was carried out.

Keywords: Concrete, Tensile strength, Compressive strength, Modulus of rupture.

1. INTRODUCTION.

The effect of temperature on different properties of concrete is considerable and remained the subject of research activities of a lot of researchers. Different investigators moved in different ways and investigated temperature effect by changing different parameters such as w/c ratio, mix ratio, early change in temperature etc.

It has been found that high early temperature has negative impacts on later strength of concrete. Some researchers investigated the adverse effect on long term strength of concrete due to high initial temperature. High initial rate of hydration due to increased temperature retards the subsequent hydration and produces a non-uniform distribution of the products of hydration. Its reason is that at high initial rate of hydration, there is insufficient time available for the diffusion of the products of hydration away from the cement particle and for a uniform precipitation in the interstitial space. All this results in concentration of the products in the vicinity of the hydrating particles which causes subsequent retardation in hydration and effects strength.[1,2]

Another problem is that air entrainment is more difficult at higher temperatures, although this can be remedied by simply using larger quantities of entraining agent. A related problem is that, if relatively cool concrete is allowed to expand when placed at a higher air temperature, then the air voids expand and the strength of the concrete is reduced. All this indicates that concrete temperature disturbs its properties at all stages of the concrete.[3,4]

This temperature effect has been investigated using local material in this research work.

2. EXPERIMENTAL WORK.

In this research work the locally available material has been used. The aggregate used was ¾" down. Ordinary Portland cement was utilized for research work. Three different mix ratios along with two w/c ratios for each mix were used for this experimental work. For each mix ratio cubes, cylinders and beams were cast for these w/c ratios. A set of these specimens was cured at room temperature (28 °C) Another set was placed at a temperature of 55 °C for curing for 28 days while the last one was cured at 5 °C. Each set comprised of 9 cubes 9 cylinders and 9 beams for each W/C ratio. Three of these were tested after 3 days average while was taken. The some procedure was repeated for testing at the age of 7 and 28 days. A comparison of the results was made and following results were obtained.

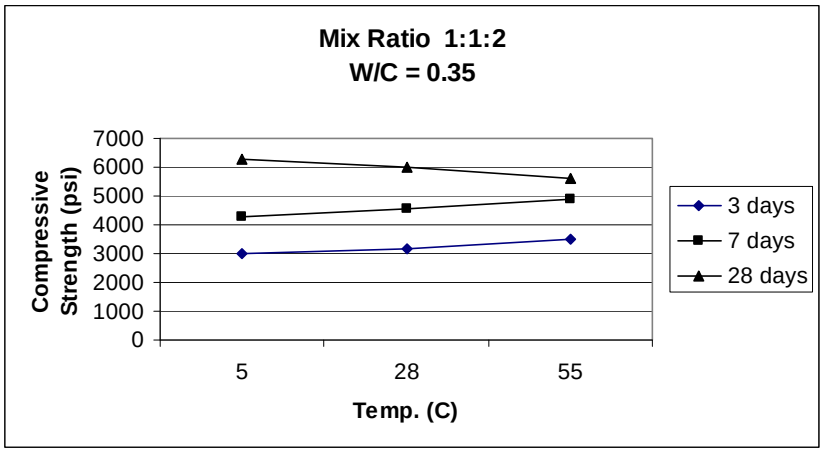
(i) The high temperature during curing causes an increase in initial compression strength of concrete that is, the initial compressive strength was lowest for 5 °C, high at room temperature while highest at 55 °C

(ii) The same trend was observed for 3 and 7 days. However an adverse effect on compressive strength was observed due to rising temperature at the age of 28 that is the compressive strength was maximum for 5 °C, low for 28 °C and lowest for 55 °C. This trend was observed for all mix ratios.

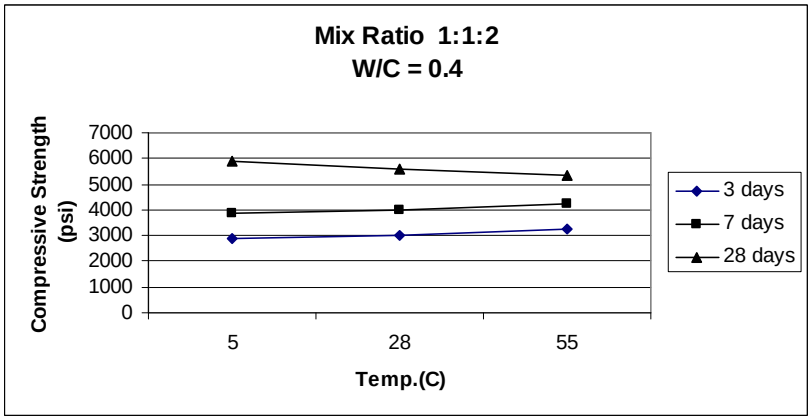
A little effect on tensile strength and modulus of rupture has been observed due to this change in temperature.

Table: **Effect of Temperature on different properties of concrete**

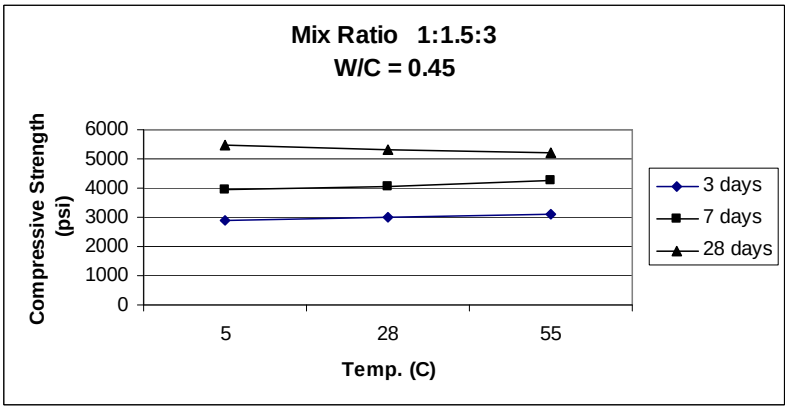
Sr. No.	Mix Ratio	W/C ratio	Temp. (C°)	Compressive Strength(psi)			Tensile Strength(psi) 28 days	Modulus of Rupture(psi) 28 days
				3 days	7 days	28 days		
1	1:1:2	0.35	05	2978	4262	6275	645	1092
		0.35	28	3143	4531	5974	650	1150
		0.35	55	3500	4875	5614	691	1285
		0.40	05	2890	3880	5889	562	995
		0.40	28	3005	4012	5586	580	1012
		0.40	55	3262	4265	5312	604	1028
2	1:1.5:3	0.45	05	2900	3925	5489	503	951
		0.45	28	2990	4050	5300	543	976
		0.45	55	3100	4256	5200	590	1001
		0.50	05	2780	3650	5470	471	842
		0.50	28	2950	3895	5200	482	870
		0.50	55	3180	4090	5010	514	887
3	1:2:4	0.55	05	2812	3746	4616	495	805
		0.55	28	3024	3965	4580	500	845
		0.55	55	3545	4256	4012	520	840
		0.60	05	2624	3616	4660	419	704
		0.60	28	2812	3889	4550	410	730
		0.60	55	3120	4140	4418	449	773



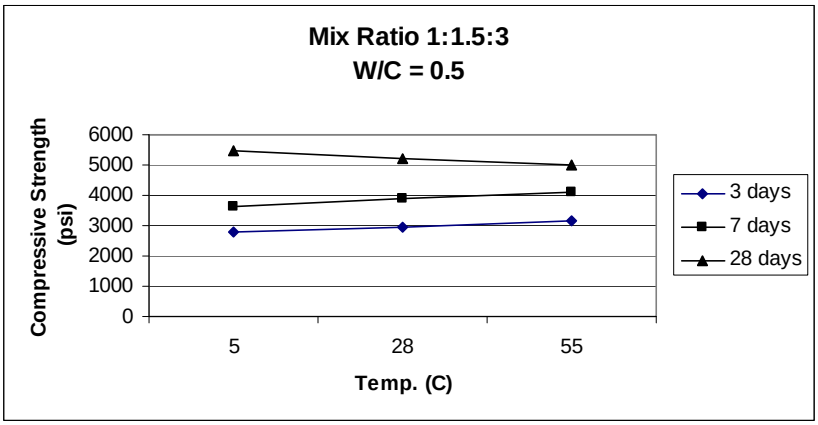
Graph 1: Effect of Temperature on Compressive Strength of concrete.



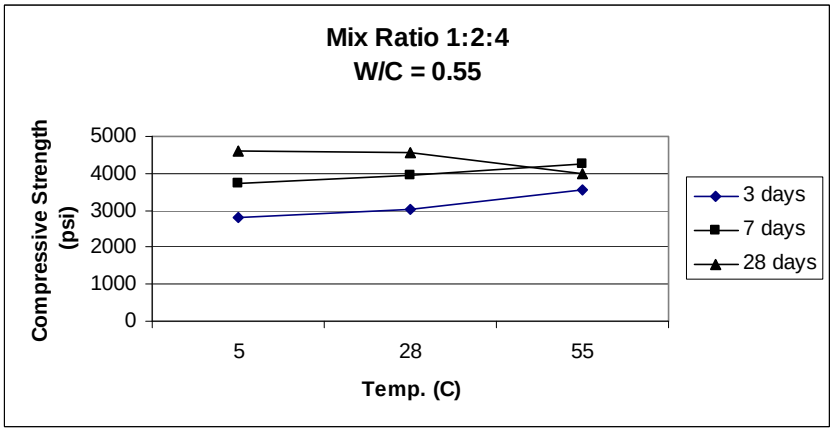
Graph 2: Effect of Temperature on Compressive Strength of concrete.



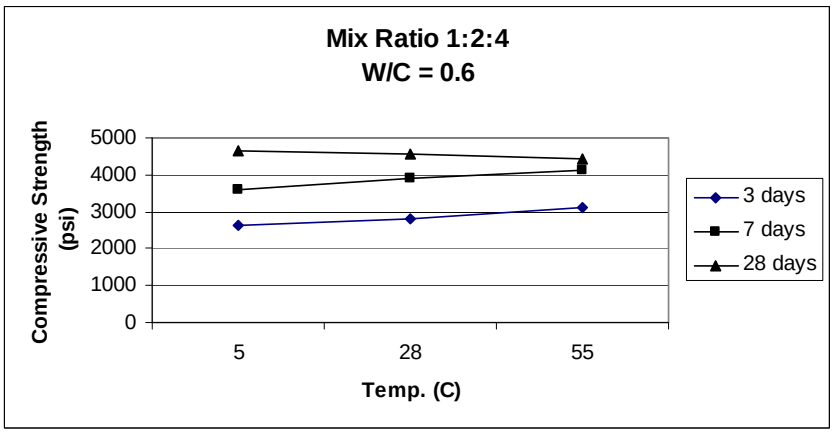
Graph 3: Effect of Temperature on Compressive Strength of concrete.



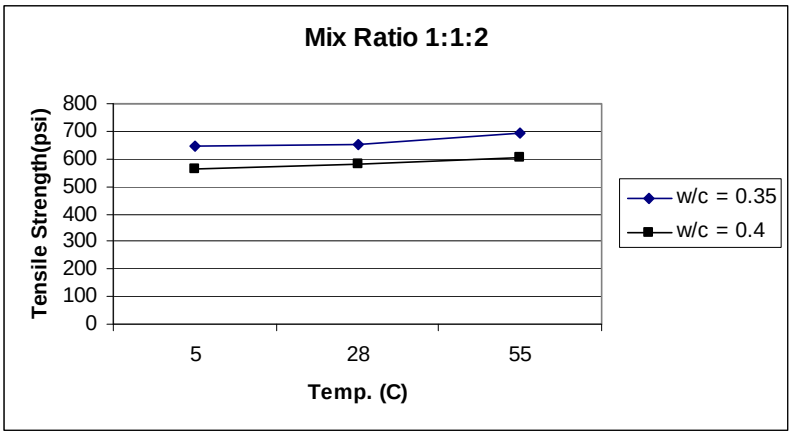
Graph 4: Effect of Temperature on Compressive Strength of concrete.



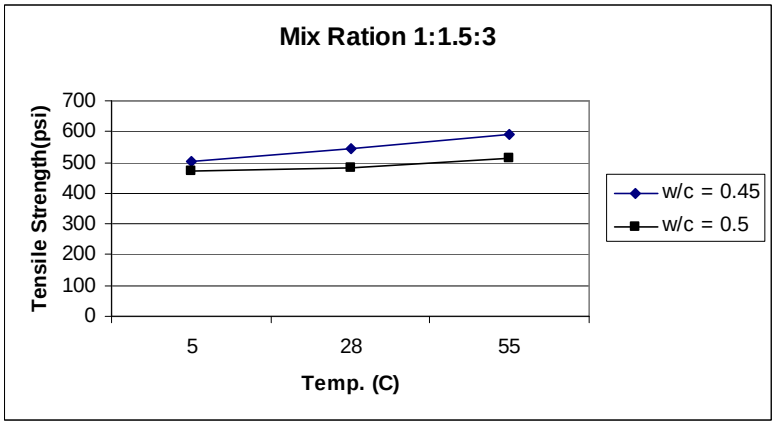
Graph 5: Effect of Temperature on Compressive Strength of concrete.



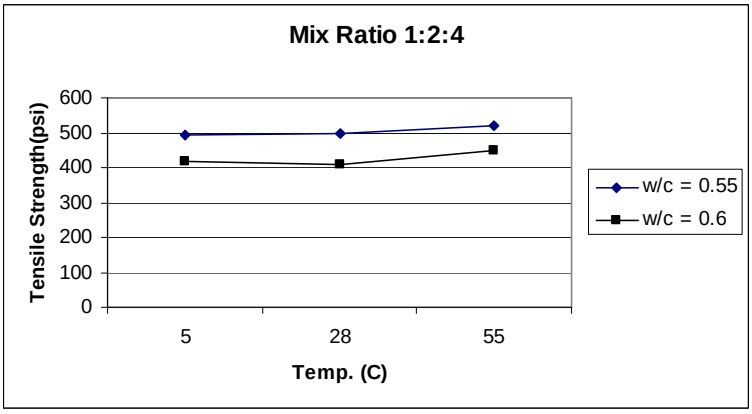
Graph 6: Effect of Temperature on Compressive Strength of concrete.



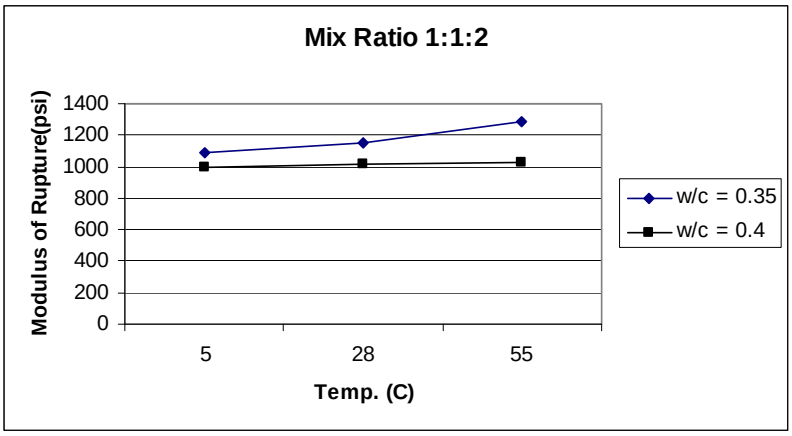
Graph 7: Effect of Temperature on 28 days Tensile Strength of concrete.



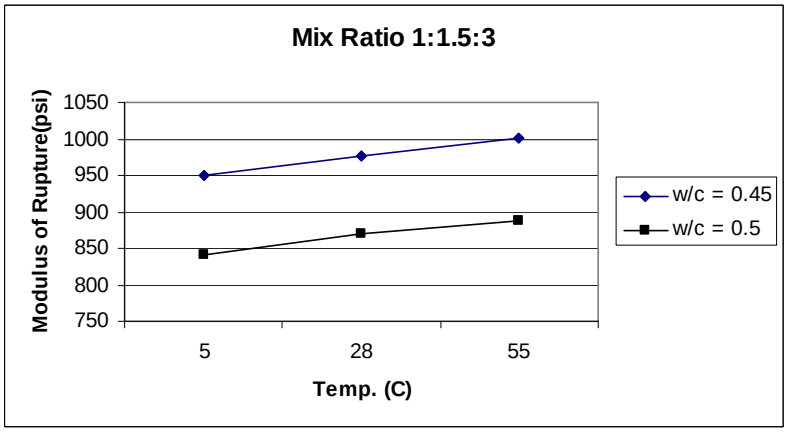
Graph 8: Effect of Temperature on 28 days Tensile Strength of concrete.



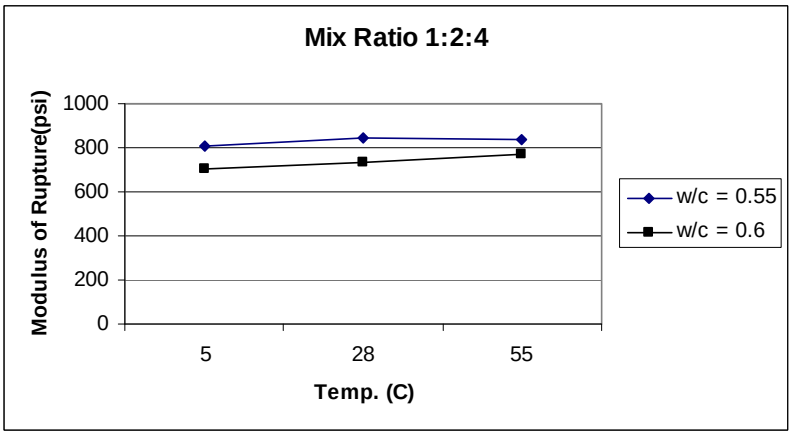
Graph 9: Effect of Temperature on 28 days Tensile Strength of concrete.



Graph 10: Effect of Temperature on Modulus of Rupture of concrete.



Graph 11: Effect of Temperature on Modulus of Rupture of concrete.



Graph 12: Effect of Temperature on Modulus of Rupture of concrete.

3. CONCLUSIONS.

It has seen that the temperature variation results in both positive and negative impacts on different properties of concrete. It also yields good results but keeping in view the demand of concrete's strength the temperature of the environment under which it is mixed, cast, cured and finally tested must be controlled. Increase in temperature increases initial strength while at the same time it reduces the long term strength.

4. REFERENCES.

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