Effect of Temperature on the Rate of Gain of Strength of Concrete

Misba Gul, Riyaz Ahmad Qasah, J.A. Naqash, Iqra Shafi, Khurshid Yaqoob,Mudasir Ahmad Bhat

Abstract: ***This paper presents the effect of temperature on the rate of gain of strength of concrete. Different samples of concrete were cast at different temperatures and various properties of concrete in fresh and hardened state were determined. It was observed that the three strength parameters viz. the compressive strength, the split tensile strength and the flexural strength of concrete are adversely affected when the temperature during first 24 hours is less than or equal to zero degree Celsius. The compressive strength of concrete was determined using 100mm and 150 mm cubes and a comparison was made between the two. It was observed that the strength of 100 mm cubes was greater than that of 150 mm cubes. Later a relationship was developed between 7 days,14 days and 28 days strength.***

Index Terms: ***Age of concrete, cold weather, maturity of concrete, strength, temperature.***

I. INTRODUCTION

Concrete is widely used because of its compressive strength. The compressive strength of concrete gives an overview about the quality of concrete as it is related to the structure of hydrated cement paste (Neville, 1997).This strength can be achieved by concrete only when hydration reaction takes place. For this hydration reaction temperature acts as a catalyst. So higher the temperature faster is the hydration reaction and vice versa.

The temperature of concrete effects its different properties and this topic has remained a subject of research for many researchers. The hydration of Portland cement gets affected by many variables e.g., specific surface area, fineness, chemical composition of cement, grade, temperature and relative humidity of mixing and curing conditions (Garcia and Sharp, 1998). Different researchers worked in different ways and investigated the effect of temperature on the properties of concrete. From the literature it is clear that the variation in temperature has positive as well as negative impact on the properties of concrete. According to Neville an increase in curing temperature increases the rate of hydration reaction and the hydration products are formed early. Although a higher casting temperature increases the initial strength of concrete,it may adversely affect its long term strength (Neville, 1997).

Revised Manuscript Received on August 22, 2019.

Misba Gul, Assistant Professor Department of Civil Engineering, Islamic university of Science & Technology, Awantipora J&K.
Riyaz Ahmad Qasah. Assistant Professor Department of Civil Engineering, Islamic university of Science & Technology, Awantipora J&K.
J.A. Naqash, Associate Professor, Department of Civil Engineering, National Institute of Technology, Srinagar.
Iqra Shafi, Junior Engineer PWD R&B Kashmir
Khurshid Yaqoob, Junior Engineer PWD R&B Kashmir not Junior Engineer JKSPDC, Kashmir
Mudasir Ahmad Bhat, Junior Engineer JKSPDC, Kashmir

This is because at high initial temperature the hydration reaction will be fast, resulting in non uniform distribution of the hydration products with a poorer physical structure, consisting of more unfilled pores. Since the voids do not contribute to the strength of concrete, a low temperature with cause hydration at a slow rate, thus resulting in a uniform distribution of hydration products within the interstitial space and high strengths at latter ages.

Price (1951) and Klieger (1958)separately investigated that concrete cast at 4°C had 28-day compressive strength 22% lower than concrete cast at 21°C.

At extremely low temperature the strength of concrete is again affected, as the water which was added for hydration of cement is frozen. At low temperature the water gets converted into ice lenses which in turn apply some pressure inside the concrete resulting in the formation of cracks. Later melting of these ice lenses results in the formation of pores inside the concrete which further reduces its strength. So in order to avoid the negative impact of very high temperature or extremely low temperature concrete should be cast at an ambient temperature.

II. EXPERIMENTAL PROGRAM

In this experimental investigation nine casting were done at different temperatures with an interval of almost one week. In each casting four different types of moulds viz 100 mm cubes, 150mm cubes, 150mm X 300 mm cylinders and 100 mm X 100mm X 500mm prisms were used. For all the casting the mix proportion of various ingredients was kept constant.. Slump tests and compaction factor tests were performed to examine the effect of casting temperature on the properties of fresh concrete. The various concrete samples were cured in the curing tank. Compressive strength tests, split tensile strength test and flexural strength tests were performed at different ages on hardened concrete to investigate the effect of temperature on the rate of gain of strength of concrete. Further a comparison was made between the compressive strength of 150 mm cubes and 100 mm cubes and a relationship was established between the 7 days, 14 days and 28 days strengths (Compressive strength, split tensile strength and flexural strength) of concrete.