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EFFECTS OF TEMPERATURE ON CONRETE

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ABSTRACT

This paper is to study effect different Temperature on concrete strength by partial replacement of fine aggregate. Concrete structure is submitted to various temperature changes during its time life. In this paper, the heat degradation of the concrete is measured in terms of compressive and tensile strength of various specimens. To understand the behaviour of concrete under high temperature, it is necessary that several factors be taken into account for each experiment such as Strength of concrete, type of cement, aggregate, water cement ratio, density of concrete, Reinforcement detailing and cover to the reinforcement are some of the important factors that affect the performance of concrete at high temperature.

Keywords: compressive strength, tensile strength, weight losses, elevated temperatures, exposure duration.

INTRODUCTION

Concrete containing mineral admixtures is used extensively throughout the world for Eco-friendly, good performance and for ecological than other materials. Concrete in case of unexpected fire, the concrete properties are changes after fire. The most common cementations materials that are used as concrete constituents, in addition to Portland cement, are fly ash materials, ground granulated blast furnace waste, silica fume, copper slag and rice husk ash. R.C.C normally offers high fire resistance at low cost. The engineer building should design for structure can withstand high temperatures and also mainly for fire exposures. During exposure to high temperatures such as during fire, the mechanical properties of the concrete such as strength, elastic modulus and volumetric stability are significantly reduced. A concrete structure is subjected to high temperatures, it will fail in many of different ways such as colour, compressive strength, elasticity, and concrete density and surface appearance are affected by high temperature.

LITERATURE STUDY

According to Cioni *et al.* 2001; during exposure to high temperatures such as during fire event, the mechanical properties of concrete (strength, elastic modulus and volumetric stability) are significantly reduced. When a concrete structure is subjected to extreme temperatures, it may fail in many of different ways.

According to Castillo and Durrani 1990; Cho-Liang *et al*. 2005, in addition, elevated temperature will reduce the strength in both HSC and NSC. The degree of strength-loss is dependent on the temperature reached and the exposure duration.

According to Knaak *et al*. 2010, Influence the strength loss is the aggregate type and the strength of the concrete at room temperature. HSC is much more likely than NSC to fail through spalling at very high temperatures.

According to Arioz 2007; Further, when exposed to high temperatures, the physical structure and chemical composition of concrete change. The likelihood of concrete spalling has been seen to increase with concrete that has a lower water to cement ratio and a lower permeability. It was also found that concrete containing higher volumes of silica fume is likely to fail in violent explosions.

According to Chan *et al*. 2000 it should also be noted that the likelihood of spalling is dependent on the rate at which the temperature is applied. A rapid temperature rise, such as in the case of a fire, is much more likely to cause spalling or explosive spalling in concrete rather than a gradual increase in temperature. The likelihood of spalling also depends on many other factors such as the mineral constituents of aggregates, thermal stresses, the density of the concrete and the moisture content.

According to Khoury 1992; despite a lot of research conducted in this area, it can be seen that there are inconsistencies between similar studies. Differences in mix proportions and environmental conditions of the concrete lead to differences in results. At 150°C, the residual strength can range from as low as 30% to as high as 120% of the original strength.

According to Khoury 1992; there are many different environmental factors that lead to these discrepancies. Differences in the heating and cooling rate can cause variations. Rapid rates of heating and cooling can also cause thermal stresses. The relative humidity of the environment has also been attributed to these variations in results, as it is believed that after cooling the cement gel will absorb moisture from the surrounding medium .In view of the above, an experimental study was undertaken to quantify the effect of elevated temperatures of 60, 75, 100, 200, 400 and 600°C with various exposure durations of 4, 8, 12, 72 hours and one month on HSC 100 × 200 mm test cylinders. HSC cylinders made of two strengths, namely 80 and 100 MPa are used. For comparing their performance with NSC, cylinders made using 40 MPa concrete are also investigated. Residual tensile and compressive strengths of concrete as well as weight loss values after high temperature exposures were determined. A total of 114 cylinders were tested.

According to S.H. Chowdhury; High strength concrete (HSC) is a material often used in the construction of high rise buildings. Incase of unexpected fire, building

elements such as columns, slabs and walls will be subjected to extreme temperatures. In order to assess the performance of high-rise concrete members to such exposure, it is important to understand the changes in the concrete properties due to extreme temperature. This paper presents an experimental study undertaken to quantify the effect of elevated temperatures of 60, 75, 100, 200, 400 and 600°C with various exposure durations of 4, 8, 12, 72 hours and one month on HSC cylinders. HSC cylinders made of two strengths, namely 80 and 100 MPa are used. The maximum reduction was about 44% in compressive strength for 80 MPa mix. Exposed to 400°C for 12 hrs. Tensile strengths were not measured for higher temperature exposures for lack of enough cylinders. However, there was a reduction of about 18% in tensile strength for 80 MPa mix exposed to 60°C for 72hrs.

According to Ghani; 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. 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.

CAUSES OF TEMPERATURE EFFECTS ON CONCRETE

In the modern days of constructions the engineer should design the structure with all important features. Basically for multi - storey structure the design of the structure should be designed for all categories like seismic force, wind force, fire resistance etc. The main cause of temperature effects on structure is improper design of the structure or non-engineered structure. The concrete should be designed for the effects of high temperature on mechanical properties of concrete and has been investigated.

REMEDIAL OF TEMPERATURE EFFECTS ON CONCRETE

Following remedial measure for reduce the effect of temperature on concrete. In the construction industry most common remedies is adding some admixture or partial replacement of cement and Fine Aggregate in concrete such as silica fume, copper slag, fly ash etc. Through this study, failure plane of concrete at various temperatures has been investigated. By trial mix with various mix proportion, temperature effect is estimated.

ADVANTAGES AND DISADVANTAGES

- **Advantage of studying temperature effect on concrete**

1. To know the amount strength during exposure of heat.
2. To know the bearing capacity of concrete during heat exposure.
3. To know the failure plane in concrete during exposure of heat.
4. To know the safety level.

- **Disadvantage of studying temperature effect on concrete**

1. It is suitable only for prototype or trial mix or model.
2. It is applicable low temperature on concrete.
3. Cost of testing is so high.
4. Time taken also too high.
5. Loss of weight in concrete

CONCLUSION

Through Study were carried out to know the temperature effects on concrete during exposure of heat, fire, climatically changes occurs seasonal variation has been investigated by reviewing some international journals. To investigate the effect of elevated temperatures of 100, 200 and 300°C with various exposure durations of 4, 8, 12and 72 hours on trial mix specimen.

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