International Journal of Emerging Trends in Engineering and Basic Sciences (IJEEBS)
ISSN (Online) 2349-6967
Volume 2, Issue 4 (Jul-Aug 2015), PP.55-59

Structural behavior of concrete under elevated thermal conditions

Mr. H.G.Mundle
(Department of Civil Engineering, SDMP, Nagpur/RTMNU, India)

Abstract :- The influence of elevated temperatures on mechanical properties of concrete is of very much important for fire resistance studies and also for understanding the behavior of containment vessels, chimneys, nuclear reactor pressure vessels during service and ultimate conditions structures like storage tanks for crude oil, hot water , coal gasification, liquefaction vessels used in petrochemical industries, foundation for blast furnace and coke industries, furnace walls industrial chimney, air craft runway etc., will be subjected to elevated temperatures. So that the variation of compressive strength, performance are some of the important parameters to be investigated when concrete structures are subjected to temperatures.
Keywords: - Elevated Temperature, ordinary Conventional Concrete, and compressive Strength**.**

I. INTRODUCTION

Concrete is a material often used in the construction of high rise buildings and special purpose. Concrete in case of unexpected fire, the concrete properties are changes after fire. Hence, it is important to understand the change in the concrete properties due to extreme temperature exposures. As the concrete used for special purpose, the risk of exposing it to high temperature also increases. To be able to predict the response of structure after exposure to high temperature, it is essential that the strength properties of concrete subjected to high temperatures be clearly understood. High temperature can cause the development of cracks. These cracks like any other cracks propagation may eventually cause loss of structural integrity and shorting of service

II. THE OBJECTIVES AND SCOPE OF PRESENT STUDY ARE

The objectives of this topic are to investigate the effects of high temperatures on concrete performance. High temperature resistance is defined as the ability of a structural element to withstand its load-bearing function under high temperature condition.

The concrete behavior at high temperature is of concern in predicting the safety of building and construction in response to certain accidents or particular service conditions. The behavior of concrete with respect to high temperature where tested on groups of specimens to identical testing condition.

III. EXPERIMENTAL PROGRAMME

A baseline is needed to establish an experimental design to conduct testing and observations for future development and research. All the baseline concrete material used in this study is shown in table 1. OPC 43 grade cement is used for this whole experimental study. The physical test results on OPC are as follows.

1) Normal consistency = 22%
2) Initial Setting time = 30 min.
3) Final Setting Time = 10 hrs.
4) Specific Gravity = 3.15.

- **Test on Concrete**

An M25 mix is designed as per guidelines in IS 10262, 1982 based on the preliminary studies conducted in the constituent materials. Tests on fresh concrete are obtained as follows.

1) Slump Test=65mm
2) Vee-Bee = 15sec.
3) Compaction factor =0.95
4) Flow Test =79

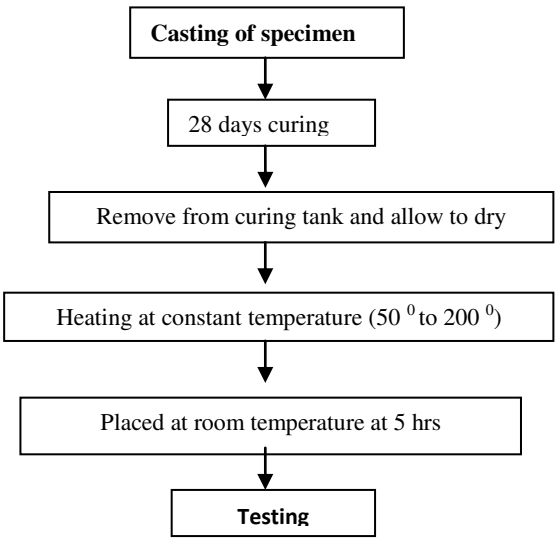
❖ **Mixture Proportioning**

The mixture proportioning was done according the Indian Standard Recommended Method IS 10262- 1982.The target mean strength was 32.1 Mpa for the OPC control mixture, the total binder content was 435.45 kg/m ,fine aggregate is taken 476kg/m and if any, the influence of plasticizer on the properties of hardened concrete coarse aggregate is taken 1242.62kg/m the water to binder ratio was kept constant as 0.44, cube moulds were used for casting. Compaction of concrete in three layers with 25 strokes of 16 mm rod was carried out for each layer. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de-moulded and placed in curing tank. The concrete cubes were cured in the tank for 28days.

❖ **Testing methods**

Testing is done as per following IS code. The testing done for compressive strength of cubes were measured 28 curing as per IS: 516 – 1959 with both cases air dried and with effect of temperature varying from 50 0to 2000.
For each mix, a set of three standard cubes were casted to determine compressive strength of concrete at different constant temperature for duration one day and three days after 28 days of curing.

Flow chart for lab work



Cement	:	PPC
Size of Specimen	:	(150 X 150 X 150) mm
Area of Specime	:	0.0225 sq. m
Volume of specimen	:	3.375 X 10^-3 cu. M
Temperatures	:	50,100,150,200^0 C
Curing age	:	28 days

Temperatures duration

After 28 days curing : one day & three day.

The test is to be performed on Compression testing machine. The load at failure is recorded in kN.

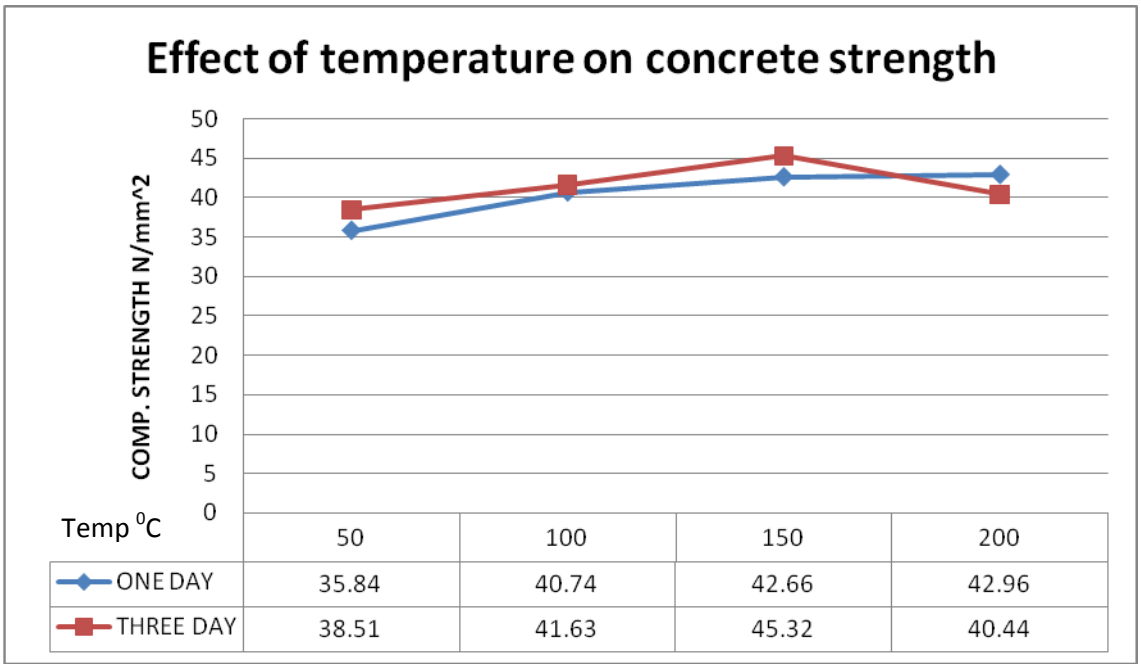
IV. FIGURES AND TABLES

S. N.	Baseline Element	Type
1	Cement	Ultra-tech 53 grade PPC.
2	Sand	Standard Sand and Vainganga Sand.
3	Coarse Aggregate	20mm- 4.75 mm size course aggregate.

Table 1. Experimental Baseline

Sr no.	*Temperature in °C*	*Compressive Strength in N/mm^2(Day 1)*	*Compressive Strength in N/mm^2 (Day 3)*
1.	50	35.84	38.51
2.	100	40.74	41.63
3.	150	42.66	45.32
4.	200	42.96	40.14

Table 2 Compressive strength result



V. RESULT AND DISCUSSION

The observed values of the compressive strength for the concrete mix (M25) at elevated temperatures are,

The compressive strength of concrete with 24 hours (one day) & 72 hours (three day) of temperature after 28 days curing at 50°C,100°C, 150°C, 200°C was 35.84MPa ,40.74MPa, 42.66MPa, 42.96 MPa (one day).

For three days 38.51MPa,41.63MPa,45.32MPa,40.14 Mpa respectively, while the compressive strength of normal air dried specimen with 24 hours (one day) & 72 hours (three day) after 28 days curing is 34.95MPa ,35.558MPa, 41.48MPa, 37.88 MPa (one day) and 36.3MPa ,37.47MPa, 40.16MPa,41.03 MPa (three day) respectively .

VI. CONCLUSION

Based on the results presented above, the following conclusions can be drawn:

- The compressive strength was found to increase after 72 hours of exposure to an elevated temperature up to 1500 C after that the compressive strength of concrete decreases with increasing temperature.
- The peak value in the ratio of the compressive strength at high temperature is observed around 1500 C.
- This peak value obtained due to the evaporation of free water inside the concrete.
- The compressive strength was found to increase after 24 hours of exposure to an elevated temperature up to 200 0 C after that compressive strength of concrete will decrease with increasing temperature after the peak point

REFERENCES

[1] A non-destructive estimation on engineering properties of slag concrete beams after elevated temperature by wang, helsin1, chen, shin-jr2, chen, bo-tsun3, and chang, ta-peng4.

[2] Comparative study of effect of sustained high temperature on strength properties of self compacting concrete and ordinary conventional concrete by luma fadhil h.

[3] The effect of elevated temperature on concrete materials and structures a literature review by d. J. Naus

[4] Structural behaviour of high strength concrete columns exposed to fire by kodur, v.R.; Sultan, m.A.

[5] Explosive spalling of normal strength concrete slabs subjected to severe fir By faris ali ,ali nadjai and abid abu-tair.

[6] Study of high strength concretes at raised temperature up to 200 °c thermal by gradient and mechanical behaviour ,albert noumow61), christophe gall6 2.

[7] Effects of elevated temperature on high-strength by concrete materials,f. E. Linck.

[8] Effect of heat on laterised concrete by e. Ikponmwosa* and musbau a. Salau.

[9] Mechanical properties of high-strength concrete subjected to high temperature by stressed test by gyu-yong kim, young-sun kim, tae-gyulee.

[10] Effect of elevated temperature on mechanical properties and microstructure of silica flour concrete by m. S. Morsy, s. H. Alsayed and m. Aqel.

[11] Improvement of physical and chemical properties of concrete with brazilian silica rice husk (srh) fernanda giannotti da silva, jefferson b. L. Liborio, paulo helene.

[12] Improvement of physical and chemical properties of concrete with brazilian silica rice husk (srh) fernanda giannotti da silva, jefferson b. L. Liborio, paulo helene.

[13] Properties of reinforced concrete steel rebars exposed to high temperatures by ilker Bekir Topcu & Cenk Karakurt.

[14] Fire performance of high strength concrete:research needs by long T. Phan and nicholas J. Carino.

[15] Effect of elevated temperature on the concrete compressive strength by H. A. M. Bishr, sana'a university, yemen

[16] Comparative study of effect of sustained high temperature on strength properties of self compacting concrete and ordinary

[17] A guide to evaluate Thermal effects in concrete pavements by idom.

[18] Design of reinforced concrete elements under fire by M.PETRU.

[19] The effect of addition of fiber reinforcement on fire resistant composite concrete material.

[20] The importance of concrete temperature control during concrete pavement construction in hot weather conditions by Anton k.Schindler.