



Effect of High Temperature on Structural Performance of Concrete

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Abstract:

In this study, the effect of temperature on the compressive strength of plain cement concrete (PCC) and Self Compacting concrete (SCC) is investigated. Plain cement concrete is a construction material generally used as binding materials of cement. SCC is a flowing concrete mixture that is able to consolidate under its own weight. It is being used in high rise buildings and industrial structures which may be subjected to high temperature during operation or in case of accidental fire. In experimental research casting of 40cubes of 100mm*100mm *100mm size of M20 and M25 grade. Cubes are subjected to different temperature of 100⁰ C,200⁰C, and 300⁰C. After 30 minutes it is tested by following methods (Sprinkling of water, hot condition, and air cooling) and it undergoes compressive testing to obtain their strength.

Keywords: Plain Cement Concrete, Self Compacting Concrete, Temperature, Furnace

I. INTRODUCTION

An accidental fire is a mishap that could be either man-made or natural. Accidental fire occurs frequently and can be controlled but may at times result in severe loss of life and property. The first ever major fire incident was at Lakshimki Talkies cinema in Tut. India has a history of fire incidents. Here we undertaken the research of about compressive strength of plain cement concrete and Self Compacting concrete during fire accident. M20,M25 grade of concrete are used here. For each grade of concrete 20 cubes of 100*100mm size are moulded. After 28 days of curing by different method of testing compressive strength at different temperature the strength of cubes are found. Self Compacting Concrete is a profoundly flowable sort of solid that spreads into the shape without the requirement for mechanical vibration. Self-Compacting Concrete is a non-isolation solid that is set by methods for possess weight The significance of Self Compacting Concrete is that keeps up all solid's solidness and qualities. "Enough water tossed into a fire puts it out on the grounds that it takes warm from fuel when vanishing and in this manner brings down the temperature, making it more troublesome for the fuel to consume; it makes it more troublesome for the fuel to be in contact with air, subsequently not giving oxygen and the fuel a chance to meet up"

II. SELECTION OF MATERIAL

CEMENT:

Cement is very important material for making concrete which act as a binding agents for other material. It is obtained by burning the mixer of calcareous material such as limestone and argillaceous material at high temperature and it is known as clinker.43grade cement that indicates the compressive strength of cement sand mortar cube in N\mm² at 28 days.IS 4031:1996 specifications are followed. It is also known as Ordinary Portland cement.

COARSE AGGREGATE:

Coarse aggregate used in construction, including sand, gravel, crushed stone, slag, recycled concrete. It may be natural or

manufactured, it provide compressive strength and bulk to concrete. The range is between 9.5mm and 37.5mm in diameter. Size of aggregate used in construction is 20mm.

FLY ASH:

Fly ash is group of materials that can vary, it is residue left from burning coal which is collected on electrostatic precipitator. It is used to improve the quality and durability of their products. Fly ash improves workability, durability finish, ultimate strength as well as solves many problems experienced in now-a-days. It must be used with care. Fly ash is added to structural concrete at 15-35percent by weight of the cement. The benefit is reduced permeability to water and aggressive chemicals.

FINE AGGREGATE:

Fine aggregate consists of natural or crushed stone with most particles passing through a 3/8inch sieve. The diameter ranges from 3/8 and 1.5inches. sand are usually dug or dredged from a pit ,river, lake or seabed. The code to be referred to understand the specification for fine aggregates is IS383:1970. It contributes the maximum to the covering up of surface area in concrete.

ADMIXTURE (SULPHONATED FORMALDEHYDE MELAMINE RESIN):

Super plasticizers are used as admixture in concrete technology to reduce the water. Suffocated Formaldehyde Melamine condensate high range of water reducer, high strength admixture, early setting and hardening concrete admixture.

PLAIN CEMENT CONCRETE:

Plain cement concrete is normal cement concrete consist cement ,sand, aggregate and other chemical components. The code for referral is IS456.

SELF COMPACTING CONCRETE:

Self -compacting concrete is highly flowable type of concrete that spreads into the form without the need for mechanical vibration. It is also known as self-consolidationconcrete. It is a

non-segregating concrete that is placed by means of its own weight.

III. EXPERIMENTAL TEST

SLUMP CONE TEST:



Figure.1. Slump Cone Test

The solid droop test measures the consistency of crisp cement before it sets. It is performed to check the workability of naturally made cement, and in this way the simplicity with which solid streams. It can likewise be utilized as a marker of a despicably blended cluster.

Table.1. Pcc Slump Value

| water cement ratio | slump value obtained |
|--------------------|----------------------|
| 0.4 | 35 |
| 0.45 | 65 |
| 0.50 | 135 |
| 0.55 | COLLAPSED |

Table.2. Scc Slump Value

| water cement ratio | slump value obtained |
|--------------------|----------------------|
| 0.40 | 35 |
| 0.45 | 65 |
| 0.50 | COLLAPSED |

L-BOX TEST:

Around 14 liter of cement expected to play out the test, inspected typically. Its length is around 0.70m and its stature is 0.60m. Set the mechanical assembly level on firm ground, guarantee that the sliding entryway can open uninhibitedly and after that shut it.



Figure.2. L Box Test

Saturate within surface of the mechanical assembly, evacuate any surplus water, fill the vertical area of the device with the solid example. Abandon it remain for 1 minute. Lift the sliding door and enable the solid to stream out into the flat area. At the same time, begin the stopwatch and record the ideal opportunity for the solid to achieve the solid 200 and 400 imprints. L box test<1.

CASTING AND TESTING CONCRETE CUBES M20, M25(PCC& SCC):

M20 and M25 grade of concrete in plain cement concrete and self-compacting concrete at different temperatures (100⁰C, 200⁰ C and 300⁰C) and different cooling regions (Water sprinkling, hot condition and Air cooling). A total number of 40 cubes of 100*100*100mm size.

FURNANCE:

After 28 days of curing, the cubes of 100*100*100mm size are heated at 100⁰C,200⁰C,300⁰C. The specimens were kept for 30 minutes in electric furnace and later three specimens were water sprinkling and other three specimen for air cooling than tested in compressive strength.



Figure. 3. Furnace

COMPRESSIVE STRENGTH:

Compressive quality of cement relies upon numerous variables, for example, water bond proportion, bond quality, nature of solid material, quality control amid creation of cement. For 3D shape trial of example 100mm*100mm are utilized, by various strategies for testing the 3D squares compressive test.



Figure.4. Compressive Testing Machine

Table.3. M20 Grade of Compressive Strength of Pcc with different temperature and different cooling regimes

| Temperature(°C) | Plain Cement Concrete(PCC) N/mm ² | | |
|---------------------|--|---------------|-------------|
| | Water Sprinkling | Hot Condition | Air Cooling |
| Without Temperature | 25 | 25 | 24 |
| 100 | 25.92 | 26 | 25.16 |
| 200 | 26.71 | 26.12 | 26 |
| 300 | 20.17 | 21.19 | 21 |

Table.4. M20 Grade of Compressive Strength of Scc with different temperature and different cooling regimes

| Temperature(°C) | Self Compacting Concrete(SCC) N/mm ² | | |
|---------------------|---|---------------|-------------|
| | Water Sprinkling | Hot Condition | Air Cooling |
| Without Temperature | 20.12 | 20.12 | 20.12 |
| 100 | 15 | 14 | 14 |
| 200 | 12.54 | 11.32 | 9 |
| 300 | 6.34 | 5.12 | 5 |

Table.5. M25 Grade Of Compressive Strength Of Pcc with different temperature and different cooling regimes

| Temperature(°C) | Plain Cement Concrete(PCC) N/mm ² | | |
|---------------------|--|---------------|-------------|
| | Water Sprinkling | Hot Condition | Air Cooling |
| Without Temperature | 29.12 | 29.12 | 29.12 |
| 100 | 26.15 | 25.61 | 29 |
| 200 | 20.00 | 25 | 24.12 |
| 300 | 19.19 | 20.61 | 20.16 |

Table.6. M25 grade of Compressive Strength of SCC with different temperature and different cooling regimes

| Temperature(°C) | Self Compacting Concrete(SCC) N/mm ² | | |
|---------------------|---|---------------|-------------|
| | Water Sprinkling | Hot Condition | Air Cooling |
| Without Temperature | 25.62 | 25 | 25 |
| 100 | 18.52 | 17.65 | 17 |
| 200 | 15.45 | 13.54 | 13.67 |
| 300 | 9 | 8.56 | 8 |

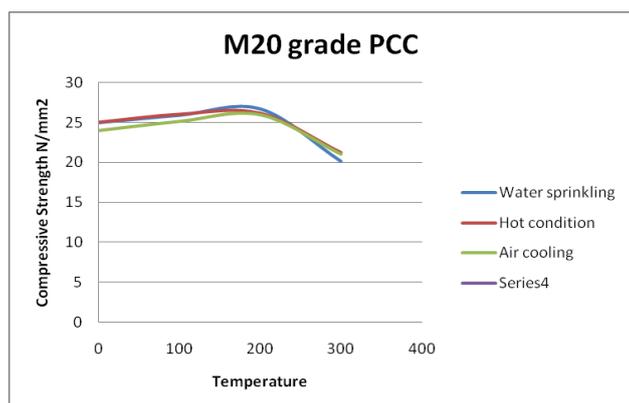


Figure.5. M20 grade Plain cement concrete with different temperature with different cooling regimes

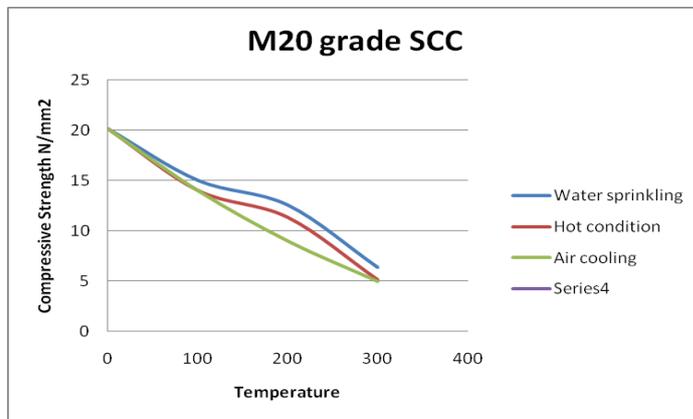


Figure.6. M20 grade Self Compacting concrete with different temperature with different cooling regimes

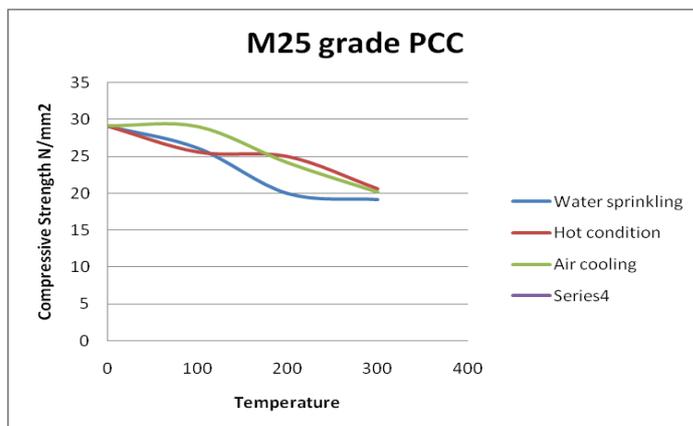


Figure.7. M25 grade Plain cement concrete with different temperature with different cooling regimes

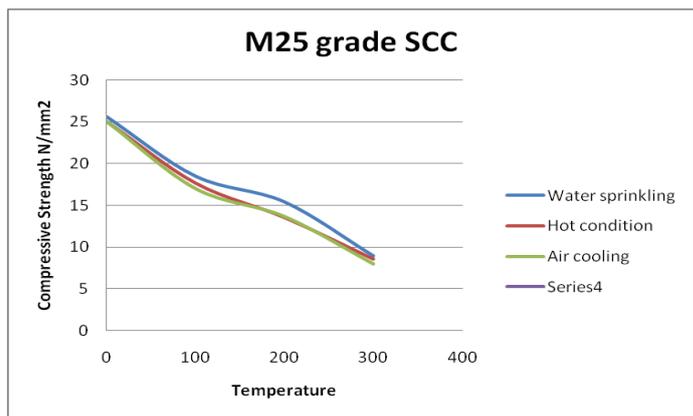


Figure.8. M25 grade Self Compacting concrete with different temperature with different cooling regimes

IV. CONCLUSION:

The loss in compressive strength is high in self compacting concrete than plain cement concrete. Compressive strength of concrete is reduced with increases in temperature. Decrease in compressive strength is more in 300°C self compacting concrete. Decrease in more compressive strength in M25 grade self compacting concrete water sprinkling than Air cooling. Plain Cement Concrete had obtained more compressive strength when compared to Self-Compacting Concrete with increase in temperature. In presence of Sunlight, Plain Cement Concrete had obtained more strength than self compacting concrete.

IV. REFERENCES

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