EXPERIMENTAL INVESTIGATION ON EFFECT OF FIRE ON CONVENTIONAL CONCRETE

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Abstract: **The present study reports give the result on the effect of fire on strength of conventional concrete. Fire damages life, homes and livelihoods. Concrete has fire resistive properties over other building materials. Concrete structure still is able to withstand dead and imposed loads without collapse even though the temperature rises. The rise in the temperature causes decrease in strength and modules of elasticity for concrete. The effect of elevated temperature at 200^{O}c, 400^{O}c, 600^{O}c for the exposure of 1 hour is studied. Compressive strength is obtained after exposure to elevated temperature. Also reduction in weight is obtained.**

KEYWORDS: - Elevated temperature, conventional concrete, compressive strength.

I. INTRODUCTION :-

Concrete is material which is used in high rise buildings and other special purpose. Concrete is a composite materials that mainly consist of mineral aggregate bounded by a matrix of the hydrated cement paste. A matrix is highly porous Concrete expose to high temperature, it undergoes change in its chemical composition, physical structure and water content. This change occurs primarily in the hardened cement paste in unsealed condition. Such change is reflected by changes in the physical and mechanical properties of concrete that are associate with temperature increases. High temperature can causes cracks which decreases the service life of structure. Concrete temperature up to 95^{O}C has little effect on strength and other properties of concrete. Above this temperature concrete structure losses its strength due to expansion of concrete.

Benefits of concrete under fire

- It does not burn or add to fire load.
- It has high resistance to fire; preventing it from spreading thus reduces resulting environmental pollution.
- It does not produce smoke or toxic gases.
- It reduces the risk of structural collapse

The objective of present study are

- To improve strength of concrete

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- To investigate effect of fire on conventional concrete at age of 28.

II. MATERIAL USED:

i. Cement

Ordinary Portland cement (53 grade) is used cement is affine, grey powder. It is mixed with water and materials such as sand and aggregate to make concrete. The cement and water forms a paste that binds the other materials together as the concrete hardens.

ii. Fine aggregate

The sand used for the experimental program of sieve analysis. The sand was sieved through 4.75 mm to remove any particles greater than 4.75 mm and then wash washed to remove the dust. The sand confirming to zone II as per IS 383:1970 was used for making concrete.

iii. Coarse aggregate

All types of aggregate are suitable. The normal maximum size is generally 10-20mm. The characteristics of different types of aggregates, crushed aggregates tend to improve the strength because of the interlocking of the angular particles, whilst rounded aggregates improve the flow because of lower internal friction.

at elevated temperatures.

III. METHADOLOGY

The steps and the procedure of complete the experiment is as follow

- Decide the material which are used in the experiment.
- All the necessary test is done with the material
- Mix design for the garde of concrete which are used in the experiment.
- Calculate the no. Of sample which are required for the experiment.
- Casting of specimen.
- Curing the specimen for 28 days.
- Testing of specimen without heats after 28 days curing.
- Testing of specimen with the effect of heat after 28 days curing.
- Result .
- Conclusion
- Referances

IV. TESTING OF MATERIAL:

i. Cement

OPC 53 grade cement is used for this whole experimental study. The physical test results on OPC are as follows

Table 1, testing of cement

Sr. No.	Name of test	Result
1.	Fineness of cement	1.45%
2.	Standard consistency of cement	35%
3.	Initial and final	54 min and

	setting time of cement	600 min
4.	Soundness of cement	6 mm

ii. Fine aggregate

Table 2, testing of fine aggregate

Sr. No.	Name of test	Result
1.	Fineness modulus of fine aggregate	2.51
2.	Specific gravity of fine aggregate	2.5
3.	Bulking of fine aggregate	6%
4.	Measuring bulk density at site	1500kg\m3

iii. Coarse aggregate

Table 3, testing of coarse aggregate

Sr. No.	Name of test	Result
1.	Fineness modulus of coarse aggregate	7.246
2.	Specific gravity of coarse aggregate	2.76
3.	Flakiness index	42.62%
4.	Elongation index	40.53%

iv. Testing of 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.

- Slump Test=65mm
- Vee-Bee = 15sec.
- Compaction factor =0.95
- Flow Test =79 %.

V. MIX DESIGN

The mixture proportioning was done according the Indian Standard Recommended Method IS 10262- 1982.
The target mean strength was 31.6 N\mm2 for the OPC control mixture, the total binder content was 413 kg/m, fine aggregate is taken 682 kg/m and if any, the influence of plasticizer on the properties of hardened concrete coarse aggregate is taken 1022.39 kg/m the water to binder ratio was kept constant as 0.45, 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 molded and placed in curing tank. The concrete cubes were cured in the tank for 28days.

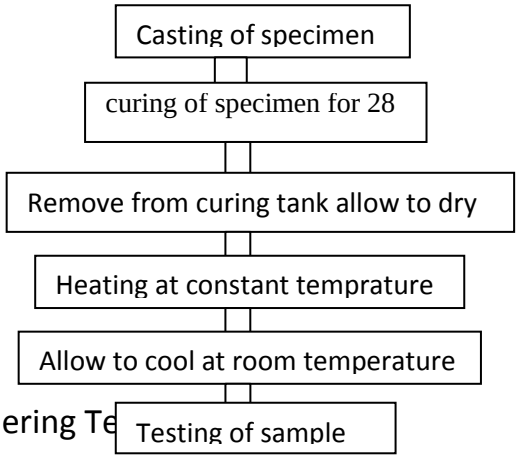
Table 4, adapted mix design

Cement	**Water**	**Fine Aggregate**	**Coarse Aggregate**
413	185	682	1022.39
1	0.45	1.65	2.47

VI. TESTING METHOD

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 200^{O}C to 600^{O}C.

1. Flow Chart for Lab Work



- **Casting schedule of conventional concrete for fire effect**

Table 5,casting of conventional concrete

Specimen	**No. Of specimen**	**Curing period**
Cube (15×15×15) Cm	2	7 days
	2	14 days
	2	28days

2. Casting schedule of conventional concrete for effect of fire

Curing period=28 days

Exposure time =1 hour

Table 6,Casting Schedule of conventional concrete

Sr. No.	Specimen	Temperature
1	Cube	200^{O}c, 400^{O}c, 600^{O}c.

VII. TESTING REPORT AND RESULT

After 28 days curing, The test is to be performed on Compression testing machine. The test results are as follow

1. Result of sample without heating.

Table 7,sample without heat

Sr. No.	Specimen	Curing period	Compressive strength (N\mm2)
1.	Cube	7 days	17.38
2.	Cube	14 days	21.16
3.	Cube	28 days	32.06

Fig. 2 compression test

2. Result of sample with heating

Table 8 sample with heating

Sr. No.	Specimen	Temperature ^{O}c	Compressive strength (N\mm2)
1.	cube	200	30.30
2.	cube	400	28.55
3.	cube	600	23.86

Fig. 3 sample in furnance

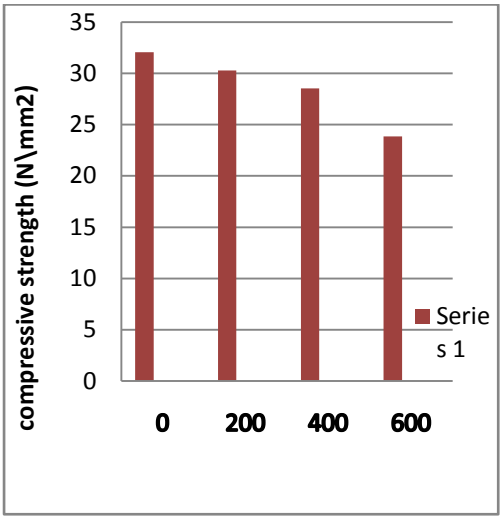


Fig 4, graph of compressive strength verses temperature.

From above graph it is clear that the compressive strength of concrete decreases at elevated temperature except around 200 °C. This is due to the evaporation of the free water content which accelerates the hydration and hence increases the compressive strength till 200°C. For temperatures higher than 200°C, the compressive Strength concrete starts to decrease. This decrease is attributed to the fact that chemically-bound water starts to disintegrate and evaporate at this stage.

VIII. CONCLUSION

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

1. After elevated temperature test and analysis it was found that with increasing temperature the compressive strength decreases.
2. As temperature and exposure time increases the effect of fire on concrete increases.
3. Between 400-600^{O}C temperature, concrete starts loosing its strength.
4. At 600^{O}C temperature whitish colour appears on the surface of cubes.

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