EXPERIMENTAL STUDY ON MESH CONFINED CONCRETE SUBJECTED TO HIGH TEMPERATURE

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***Abstract*:-** Concrete is a widely used construction material in buildings and several structures for a quite long time. Concrete can be defined as a composite binding material having constituents as aggregate, finer sand and fine cement and water in predefined proportion so as to achieve required strength .Concrete is a composite having properties that change with time. Durability of concrete depends on many factors including its physical and chemical properties, the service environment and design life. Plain concrete is strong in compression while weak in tension. The idea of reinforcing concrete with steel bars gave rise to a new composite called Reinforced Concrete which is capable of withstanding both compression and tension simultaneously. Thus reinforced concrete has become the most commonly used construction material.

Keywords: binding materials, mesh materials, mesh confined concrete.

1. INTRODUCTION

Concrete is a widely used construction material in buildings and several structures for a quite long time. Concrete can be defined as a composite binding material having constituents as aggregate, finer sand and fine cement and water in predefined proportion so as to achieve required strength .Concrete is a composite having properties that change with time. Durability of concrete depends on many factors including its physical and chemical properties, the service environment and design life. Plain concrete is strong in compression while weak in tension. The idea of reinforcing concrete with steel bars gave rise to a new composite called Reinforced Concrete which is capable of withstanding both compression and tension simultaneously. Thus reinforced concrete has become the most commonly used construction material.

2. LITERATURE REVIEW

Title- Behaviour of concrete subjected to high temperature
Author- Abhinandan Gupta

This paper discussed about the behavior of concrete at various temperature and changes in its compressive strength and physical properties. He was designed for normal M20 grade of concrete subjected to various temperatures. The specimens were casted and heated to a temperature of about 600°C. Based on experimental results he was summarized that at 150˚C the strength increases by 9.03% and at 300˚C it got decreased by 12.23% and at 450˚C the strength was decreased by 0.80% and at 600˚C the concrete got poorly damaged. He was concluded that up to 150˚C, the strength of concrete increases to some extend after that strength decreases.

Title - Performance of high strength concretes at elevated temperatures
Author – Bastami

This paper investigated about the effect of temperature on compressive strength, spalling and mass loss of High Strength Concretes (HSCs). The materials used for casting the specimens are cement, coarse aggregate, silica fume and fine aggregate. The specimens were casted and heated to a temperature of about 800°C at 20°C/min. Based on results they were summarized about the sf (silica fume)had an important role on normal compressive strength but did not affect the relativestrength of the heated specimens, while it controls spalling ratio significantly.

Title - Compressive strength of conventional concrete and high strength concrete with temperature effect
Author – Pathan

This paper discussed about the effect of sustained temperatures on strength properties of High Strength Concrete and its comparison with ordinary Conventional Concrete. The specimens were casted and heated to a temperature of about 250°C. Based on experimental results they were concluded that High Strength Concrete and ordinary concrete is dropped considerably up to 200ºC and the compressive strength loss in High Strength Concrete is higher than the ordinary concrete because of the quantity of cement required is about 5-20% less than that of ordinary concrete.

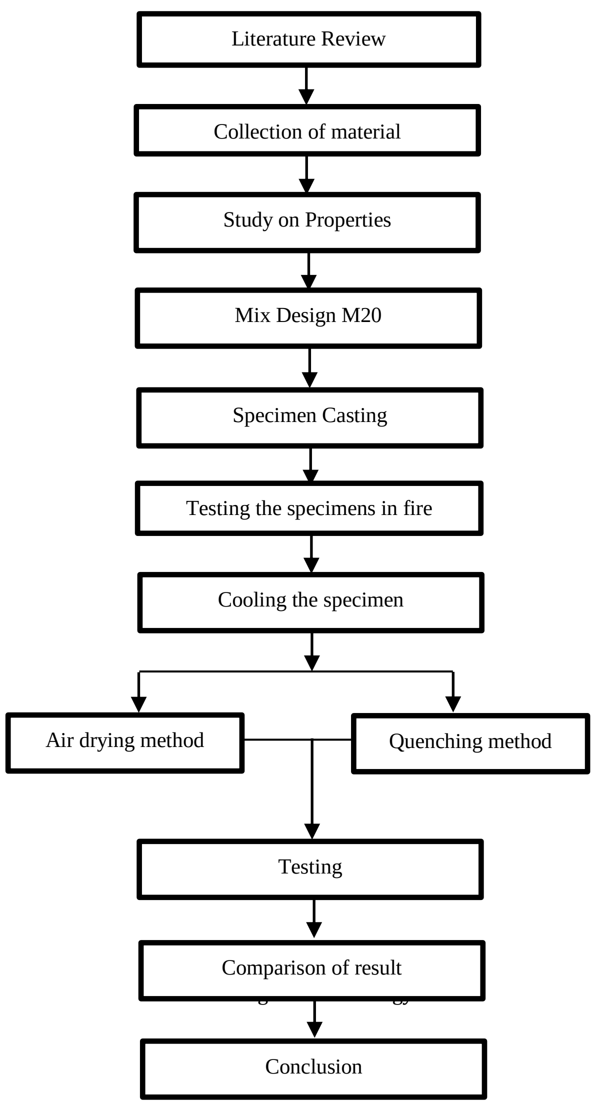
3. OBJECTIVES

The objective of the project work is to study the properties of ordinary conventional concrete (OCC) and mesh confinement concrete exposed to temperature and cooled the specimens by quenching method and air-drying method.

4. METHODOLOGY

The first step in this study was review the literature and collects the materials for experimental work. Here the four types of meshes such as glass, wire, GI weld and nylon type were used as confinement materials in the cylindrical specimens. In this study a normal strength concrete (NSC) of M20 was considered and a total of 45 numbers of NSC cylinders with and without mesh confinement were cast. After 28 days of curing the specimens were exposed to a temperature of about 300°C.After the fire testing, the specimens were cooled for 24 hours in air-drying method and quenching method and allowed to dry for one day and these specimens were tested for finding the mechanical properties.

The following flowchart indicates methodology adopted for the project



Methodology

5. PROPERTIES OF MESH

TABLE 1 PROPERTIES OF MESH

Parameters	Specifications			
Type of mesh	Glass type	GI weld type	Nylon type	Wire type
Material	Glass	Steel	Nylon	Steel
Mesh shape	Square	Square	Square	Square
Mesh opening(mm)	2.5 x 2.5	12.7 x 12.7	0.5 x 0.5	0.5 x 0.5
Width(m)	1	1	1	1
Thickness(mm)	1	1	1	1
Diameter of mesh(mm)	0.2	1	0.3	0.3
Density(kg/m^3)	0.160	7850	0.271	7850
Melting temperature	600°C	900°C	160°C	800°C

6. CEMENT TESTING

Laboratory tests were conducted to determine fineness, standard consistency, Initial and final setting time and compressive strength as per IS 269-1976 & IS 4031.

6.1 STANDARD CONSISITENCY OF CEMENT

Standard consistency of cement paste is defined as that consistency which will permit the Vicat plunger to penetrate to a point 5 to 7mm from the bottom of the Vicat mould, when tested as detailed below

For testing consistency of cement take 300gm of cement in a pan and a known quantity (about 30% of weight of cement) of water in the measuring jar. Water was added to cement to prepare a paste and stopwatch was started simultaneously. The gauging time shall be counted from the time of adding water to dry cement until commencing to fill the mould. The gauging time shall not be less than 3 minutes and not more than 5 minutes. A plunger of 10mm diameter was attached to the moving rod of Vicat apparatus. Cement paste was filled in the Vicat mould, which is resting on a nonporous plate within the gauging time. After completely filling the mould, surface of the paste was smoothed off and making it level with the top of the mould. Slightly shake the mould to expel the air. Place the mould under the Vicat plunger and lower the plunger gently to touch the surface of the paste. Then quickly release it, allowing it to penetrate into the paste under its own weight. Note the penetration of plunger on the scale provided in the Vicat apparatus. If the penetration is between 5 to 7 mm from the bottom of mould, the water added was correct.

6.2. SETTING TIME OF CEMENT

a) Initial setting time

For checking initial setting time take 300gm of cement in a pan and take 0.85 times the water required to produce a cement paste of standard consistency. Stopwatch was started at the instant when water is added to cement and a cement paste was prepared within the gauging time. The cement paste was filled in the Vicat mould, which is resting on a non-porous plate. After completely filling the mould the surface of the paste was smoothed off, making it level with the top of the mould. The mould should be slightly shaken to expel entrapped air. Square needle of cross-section 1mm x 1mm was attached to the moving rod of Vicat apparatus. Place the test block under the rod bearing the needle. The needle was gently lowered to touch the surface of the paste and quickly release it, allowing the needle to penetrate into the paste and note the penetration. In the beginning, the needle completely pierces the test block. Repeat the procedure at regular interval until the needle fails to pierce the block beyond 5 ± 0.5 mm measured from the bottom of the mould. The interval between the time when water is added to cement and the time at which the needle fails to pierce the block beyond 5 ± 0.5 mm measured from the bottom of the mould is the initial setting time.

b) Final setting time

For checking final setting time a cement paste was prepared and it was filled in the Vicat mould replace the needle with the needle having annular attachment. Cement is considered as finally set when upon applying the needle gently to the surface of the test block, the needle makes an impression there on, while the annular attachment fails to do so. The period elapsing between the times, when water is added to the cement and the time at which the needle makes an impression on the surface of the test block while the attachment fails to do so shall be the final setting time.

6.3 FINENESS TEST

This test is used for checking the proper grading of cement. For testing fineness of cement. For testing fineness of cement take 100gm of cement and this continuously passed through standard sieve No. 9 for 15 minutes. According to IS: 269-1976 this weight should not be more than 10%.

TABLE 2 FINENESS TEST OF CEMENT

S.No.	Weight of cement (g)	Weight retained on sieve (g)	% weight of residue $(W_2/W_1) * 100$
1	100	5.1	5.1
2	100	4.8	4.8

Percentage weight of residue = (5.1+ 4.8) x 100

This test is used for detecting the dete

= 4.95

6.4 SPECIFIC GRAVITY

Pycnometer was used for determining specific gravity. Take mass of empty Pycnometer (M_1). Then put 200 to 400gm of oven dried sample in the Pycnometer and take the mass (M_2). Pycnometer was then filled with water to the top and shaken well to remove entrapped air. Take its mass (M_3). Then empty the Pycnometer and fill with distilled water alone and take mass (M_4).

Weight of Pycnometer (W_1) = 400 g

Weight of Pycnometer + sample (W_2) = 650 g

Weight of Pycnometer + sample + water (W_3) = 1273.4 g

Weight of Pycnometer + water (W_4) = 1115.8 g

Specific gravity = $(w_2-w_1) / ((w_2-w_1) - (w_3-w_4))$

=2.7

TABLE 3 PROPERTIES OF FINE AGGREGATES

S.No	Particulars	Values
1	Specific Gravity	2.7
2	Fineness Modulus	2.37

7. CONCLUSION

The main objective and the environment of this research project are described in the opening chapters of this thesis. The experimental program performed during the research project to achieve the objective is explained in chapters 1 to 6.

SALIENT CONCLUSIONS

The compressive strength of GI weld mesh specimen is higher compared to conventional specimen in before and after fire at a temperature of about 300°C.

The specimens under air drying cooling method has higher load carrying capacity, energy absorption, compressive strength, ductility factor and stiffness compared to quenching cooling method.

The GI weld mesh specimen has less deformation compared to conventional specimen.

In air-drying cooling method, the load carrying capacity of GI weld mesh specimen is higher compared to the conventional specimen by the amount of 1.35 times respectively.

In air-drying cooling method, the energy absorption and stiffness of GI weld mesh specimen is higher than that of conventional specimen by the amount of 1.64 and 1.96 times respectively.

In air-drying cooling method, the ductility factor of GI weld mesh specimen is 17.25% higher than that of conventional specimen.

The nylon mesh type specimen has higher weight loss and there is a presence of more cracks.

When cylindrical specimens exposed to 300°C temperature, the color of the concrete became light yellow.

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