"EXPERIMENTAL INVESTIGATION ON BLAST RESISTANCE CONCRETE"

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Abstract - Fiber Reinforced Cementitious Composite Is Increase Performance of Ordinary Concrete In Teams Its Tensile Strength Stiffness And Creak Resistance. Therefore Ensuring FRCC For Public Building, Power Plant Military Threats, and Importance Structure for their Safety Against Accident Explosions &Terrorist Bomb Attack. We Have Peformed Concrete Testing & Blasting Test For Both Normal Concrete &FRCC .The Result Of Experimental Investigating Indicate 35%, 30% And 20% Plastic Fiber By Volume Of Matrix Respectively Concrete Cube Posses Excellent Performance Among Other Concrete Cube In All Respects.

Keyword: FRCC, Super plasticizer, Normal concrete, Blasting

1. INTRODUCTION

1.1 BACKGROUND

Fiber reinforced cementitious composite (FRCC) has been greatly improve since the1970 FRCC is known to increase. The performance of ordinary concrete for example its tensile strength stiffness and crack resistance. With these advantages, FRCC has been applied in the world of civil engineering structures.

Fiber reinforced cementitious composite (FRCC) is one of the automatic healing materials. FRCC has mechanical characteristics that can control crack propagation. In the cement matrix through bridging with short fibers.

In addition to conventional FRCC, slurry infiltrated fiber concrete is inverted by lankard (1984). Concrete is made by pouring slurry containing Portland cement, water, and super plasticizer over a bed of fiber. Concrete is distinguished over a bed of fiber FRCC by its high volume ratio of fiber (4% to15%), which is far beyond that of typical steel FRCC(less than 2%).

Since 1990s, new synthetic fiber have prosperously been developed, which have better mechanical characteristics than conventional fibers. Among them, high molecular weight polyethylene fiber is expected to be utilized as a defensive material, because of its good balance between the tensile strength and the elongation.

Strength and other mechanical properties of concrete has been tries to be improved with the help of various additives as an additive various chemical have been use be sides various size of fiber. It is known that when the compressive strength of concrete increase.

The concrete absorbs less energy during the failure. However, when fiber is added to concrete with fiber show more ductile behavior during the failure. Due to this property the demand of concrete with fiber increases.

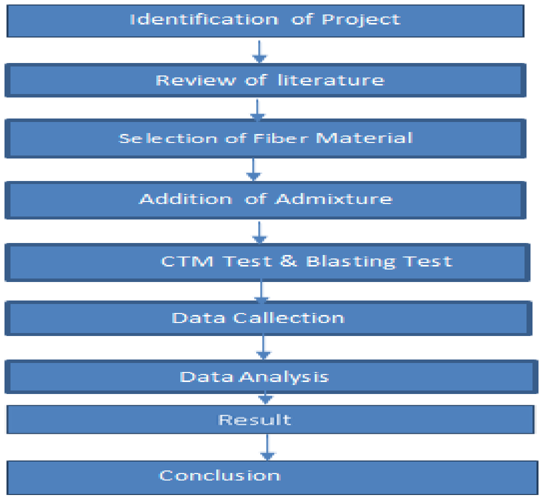
In the last few decades, the behavior of construction material under blast loading has been a subject of growing interest because of the huge increase in the number of nuclear power plant, terrorist threats, and military threat. With the above described features, concrete has considerable promise as a blast proof material.

The position of the explosive with relation to the concrete is classified into three locations:

1. A position close to the structure (study of detonation),
2. A position on the surface of the structure (contact detonation), and
3. A position inside the structure.

2. METHODOLOGY

Flow chart of experimental study on explosion resistance concrete.



The materials used for making fiber reinforced concrete (FRC) like as cement, fine aggregate, coarse aggregate, admixture & fiber. Binding fiber, 30mm (approximate) in length, was used to make the FRC. In order to compensate for decrease in slump due to the surface area effects of mixed fibers, ground granulated super plasticizer were used. High-early strength Portland cement was also used, in view of the intended application of FRC to precast concrete. For comparison, normal ready-mixed concrete with a nominal strength of 20 Mpa and a specified slump of 18 cm was employed.

The flexural toughness might be an important mechanical characteristic against detonation loadings, because the spall damage is due to the tensile stress wave being reflected from the back side of the concrete. Furthermore, for rapid construction of blast-resistant concrete structures against sudden terrorist bomb attacks, it is necessary to apply FRC to precast concrete walls, which needs almost 10 cm slump of fresh concrete.

For mixing the FRC: first, the cement and aggregates were dry mixed for 15 seconds; secondly, the water, super plasticizer were added and mixed for 90 seconds; finally, the fibers were added and mixed for 3 minutes.

Table 1. Material for concrete

MATERIALS	
Cement	Portland cement (53 Grade)
Fine aggregate	River sand
Coarse aggregate	Crushed stone
Admixture	Super plasticizer
Water	Tap water

2.2 MIX DESIGN OF CONCRETE

Mix design is known as the selection of mix ingredients and their proportions required in a concrete mix. In the present study method for mix design is the Standard Method. The mix design involves the Indian Standard Method. The mix design involves the calculation of the amount of cement, fine aggregate and coarse aggregate in addition to other related parameters dependent on the properties of constituent material. The modifications are made and quantities of constituent materials used to cast Fly Ash Fiber Reinforced concrete.

Table-2 Mix Design Of Concrete [M=25 (1:1:2)]w/c=0.46

MATERIAL	WEIGHT(KG)
Cement	1.32 Kg(2 bag)
Coarse aggregate	66.94 Kg.
Fine aggregate	138.61 Kg.
Water	6.46 Lit.
Admixture	200ml

Table -3 Properties of Plastic fiber

Diameter	0.5mm
Length	12mm
Material	Plastic fiber

Table – 4 Description of Plastic fiber

Description	KDM FIBER	POLYESTER	POLYPROPYLENE
Number of fiber	132 million / m^3	108 million / m^3	13.5 million / m^3
Tensile strength	1700 mpa (250KSI)	550mpa (80KSI)	400 mpa (60KSI)
Elastic modulus	73 Gpa (10500KSI)	10Gpa (1450KSI)	3.5 Gpa (500KSI)
Dosage	600 gms / m^3 85 gms / Bag	900 gms / m^3 125 gms / Bag	900 gms / m^3 125 gms / Bag
Disprsion	High dispersion	Float up and form bunches	Float up and form bunches
Softening point	775 C	230 C	150 C
Elongation at break	2.4 %	15 %	20 %

3. DESCRIPTION OF TESTS

3.1. Specimen

Concrete and high strength concrete specimens were fabricated for the blasting test. The mix proportion of these specimen are water, cements, fine aggregate, course aggregate, super plasticizer and fiber. The properties of the fibers in concrete are diameter, length, material.

Fabrication processes of the concrete specimens the plywood mold of concrete was carefully sealed to prevent leaks because the flow ability of slurry is much higher than that of ordinary concrete.

Slurry was carefully poured from corner in gradual manner, and this lowed the or inside to escape from the other corner. The age of specimens at testing was more than 28 days so s to alleviate the effect of initial hydration development. During the curing period, the specimens were covered by insulation to keep the temperature constant.

The specimen size is standard cubes of 150mm x 150mm x 150mm, standard cylinders of150mm x 300mm and standard beams of 100mm x 100mm x 500mm for compressive tests, split tensile strength tests and flexural strength tests respectively.

3.1.1 Procedure for concrete cube test

- Remove the specimen from water after specified curing time and wipe out excess water from the surface.
- Take the dimension of the specimen to the nearest 0.2m
- Clean the bearing surface of the testing machine
- Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
- Align the specimen centrally on the base plate of the machine.
- Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
- Apply the load gradually without shock and continuously at the rate of 140 kg/cm^2/minute till the specimen fails Record the maximum load and note any unusual features in the type of failure.

3.2 TEST SETUP

Before testing, the specimen is given numbering with help paper so that the craters formed after the blast could be easily observed and measured.

The heat of explosion of the blasting material is 1152kcal/kg, which is similar to TNT(1150kcal/kg). The emulsion explosive was fully charged and the charge hole was filled with clay and sand; therefore the decoupling effect can be neglected in this blasting test. The quantity of gelignite used was determined by referring to the basic quantity of explosives derived from Hauser's blasting equation.

L=C*W 3……………………..1

Where,

L (kg): the basic quantity of explosive in the charge to blow up

W (m): the length of least resistance burden, which was 0.116m.

C (kg/m3)

C=g*e*d……………………...2

Where,

g: coefficient of resistance
e: coefficient of explosive
d: coefficient of tamping.

The coefficient e is 1 when blasting material gelignite is used and the coefficient g is assumed to be 9.5kg/m 3 for FRC and 1.2kg/m 3 for high strength concrete.

By substituting these coefficients into eg1 and was roughly derived as 14.8g for FRC and1.9g for simple concrete. Taking these materials is determined as 15g to 35g simple concrete.

Note that the number of specimens is not necessary enough because the test is very dangerous never the less test as shown in the next section evaluation the higher blast resistance of FRC over conventional high simple concrete well in a quantitative manner.

3.3 BLASTING PROCESS IN CUBES

First, in this process required material,

1. Superpower 90 explosive class2 (25mm * 125g)
2. Blasting cap
3. Battery 12 watt
4. Iron wire (supply power to blasting cap)

The required quantity of blasting material is roughly derived as 15g to 30g for FRC and Simple concrete. Now, take 15g of superpower 90 and blasting cap put intosuperpower90. Blasting cap is connected with iron wire which is connected to battery (12watt). In outside of battery one type of rotator handle is given to rotate this handle for supply power in blasting cap. Due to process cap is heated and hence blast is occurred.

In this process safety measure is required at a distance of approximate 40 to 50met from test setup to battery.

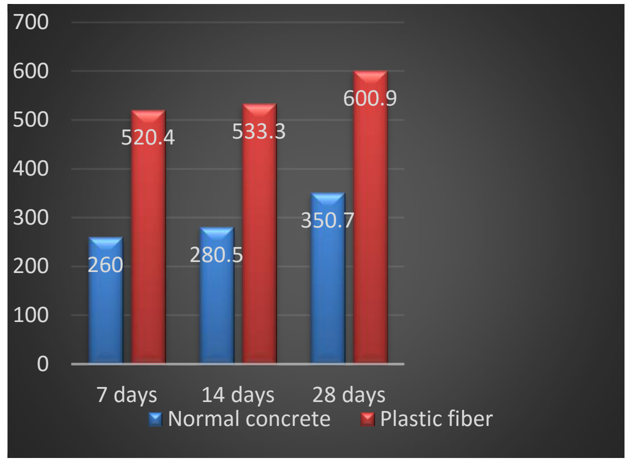
4. RESULTS

Table-5 Test result of comprasive strength test

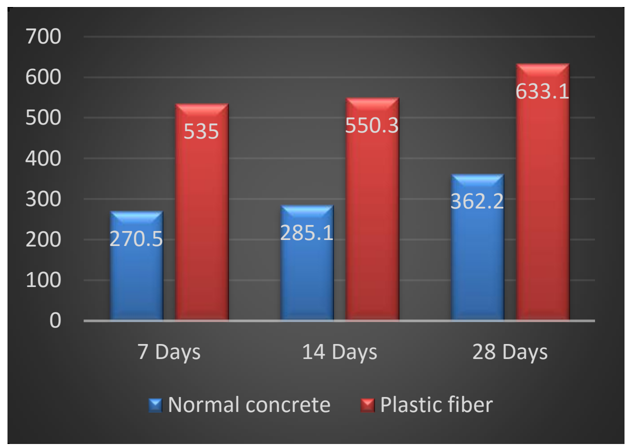
Sr .no.	Weight of P.F.	7 DAY	14 DAY	28 DAY
1	NIL	260KN	280.5KN	350.7KN
2	NIL	270.5 KN	285.1KN	362.2KN
3	NIL	285.3 KN	300.6KN	380.4KN

Sr .no.	Weight of P.F.	7 DAY	14 DAY	28 DAY
1	85 gm	520.4 KN	533.1KN	600.9KN
2	85 gm	535.0 KN	550.3KN	633.1KN
3	85 gm	560.1KN	585.1KN	650.7KN

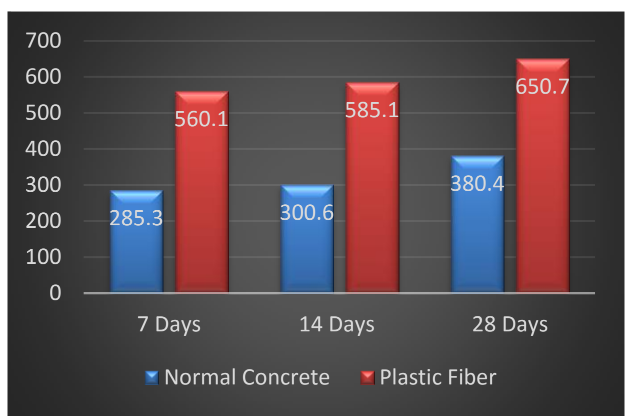
CUBE-1



CUBE-2



CUBE-3

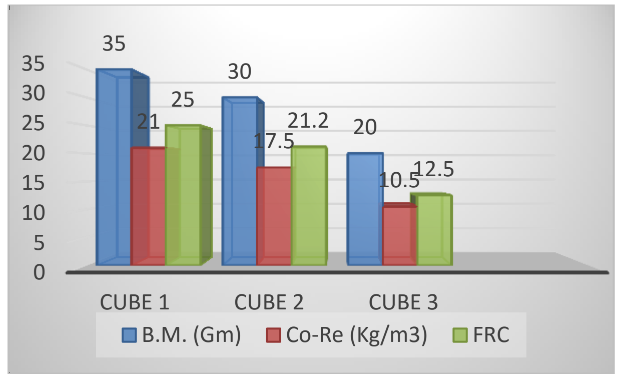


QUANTITY OF EXPLOSIVE & CO-EFFICIENT OF RESISTANCE		
SPECIMENS	**QUANTITY OF BLASTING MATERIAL (gm)**	**CO-EFFICENT OF RESISATNCE (kg/m3)**
Simple concrete		
Cube-1	35	21
Cube-2	30	17.5
Cube-3	20	10.5
Fiber reinforced concrete		
Cube-4	35	25
Cube-5	30	21.2
Cube-6	20	12.5

6. CONCLUSION

In this study, the blast behavior of FRC is experimentally investigated and compared to that 6 of simple concrete. A series of contact blasting tests were conducted with varying quantities of blasting material. It found that FRC has much higher blast resistance than simple concrete. FRC did not break even when 35g blasting material are used, through the simple concrete is totally smashed with only 15g of blasting material. In the test, it is observed that the FRC specimens expanded, especially when the quantity of blasting material is more than 15g, and this proves the superb ductility and energy absorption of FRC, which transfer the stress across cracks.

- In addition, the diameter of the crater and the charge hole inlet were measured from scale.
- It is found that these diameters had a linear relation to the quantity of blasting material, and the crater size of FRC is much smaller than that of simple concrete.
- In addition, the coefficient of resistance g in Hauser's blasting equation is estimated for FRC and simple concrete from the blasting test results.
- It is found that the coefficient of resistance of FRC is greater than that of simple concrete.
- The observation results of the top surface also indicate the excellent blast resistance of FRC.
- Hence it is responsible to say that FRC is suitable for structure which may be subjected to blast loading.
- These achievements will help us to design and provide safer structure by FRC.
- FRC is more effective in reducing the spall damage and the launching of concrete fragments due to contact detonation as compared with normal concrete.



GRAPH OF BASTLING TEST

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