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Near Surface Characteristic: Hybrid Fiber Reinforced Concrete With Different Aspect Ratio

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Abstract: ***The present work is enhancement of near surface characteristics for hybrid fiber reinforced concrete (aspect ratio 40+100). Here in this research work an attempt has made to study water absorption values for different types of fiber reinforced concrete, which are having different aspect ratios like 40, 100 and 40+100. Concrete mix along with fibers are casted and cured for 28days. Both water absorption test and sorptivity tests carried on hardened concrete. The main objective is to check variation in absorption values due to addition of different types of fibers. Here totally five different types of fibers are considered like steel fiber, Galvanized iron fibres, High density polyethylene fibres, waste plastic fiber and polypropylene fibers Experimental investigation shows that except polyprolene hybrid mix concrete other hybrid mixes has showed good results. But as compared to mono fiber reinforced concrete hybrid fiber reinforced concrete has showed better results. This research was aimed to provide benchmark for future research works on near surface characteristics of hybrid fiber reinforced concrete.***

Key words: Aspect ratio, water absorption and hybrid fiber

I. INTRODUCTION

A. General

Concrete is an important building materials which will be used in all types of construction works. Since concrete as a building material plays a major role, so many research works has been made to increase the durability, quality, toughness and strength of the concrete. Along with these properties, it is very important to have economical material so efforts were being made to achieve this. Concrete is porous material and highly susceptible when exposed to atmosphere, durability properties of concrete material depends on movement of gas and water molecules. Here an attempt made to study near surface characteristics of hybrid fiber reinforced concrete like sorptivity, water absorption capacity etc.

II. OBJECTIVES OF PROPOSED RESEARCH WORK

• To obtain the near surface characteristics of HFRC produced using fibers of different aspect ratios.

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The foremost objective of this proposed research work is to study the characteristic properties of hybrid fiber reinforced concrete produced by using fiber of different aspect ratios. In this research work, intended to use steel fibers, GI fibers, HDPE fibers, waste plastic fibers and polypropylene fibers of different aspect ratios. To attain the above objective; the subsequent experimental works are planned.

III. MATERIALS AND METHODOLOGY

A. Materials

Cement: In the current research work, 43 graded ordinary Portland cement has been used followed by code IS: 8112 - 1989. The locally available ingredient has been used.
The standard properties of cement are as shown in table 1

Table 1: Properties of Cement (OPC 43)

Material Property	Results obtained
Specific gravity	3.15
Fineness	4%
Normal consistency	34%
Initial setting time	30 minutes
Final setting time	5 hrs 45 minutes

Fine aggregates: River sand is used as fine aggregate, which is followed to zone II of IS 383-1970. Basic tests are performed on the fine aggregate. The sieve analysis data and properties of fine aggregates used are shown in table 2.

Table 2: Physical Properties of Fine Aggregate

Material Property	Results obtained
Specific gravity	2.58
Bulk Density	1752 Kg/m3
Water absorption	1%

Coarse aggregates: Coarse aggregate as per IS 383-1970 are used in this dissertation. The physical test like sieve analysis data and physical properties of coarse aggregates in table 3

Table 3: Physical Properties of Coarse Aggregate

Material Property	Results obtained
Specific gravity	2.61

Bulk Density	1782 Kg/m3
Water absorption	0.6 %

Types of fibers:
Based on literature survey, fibers of aspect ratio 40, 100, 300, 600 and combination of 40+100, 300+600 is used for reseach work

Table 4: Properties of fibers

Type of Fiber	Density in kg/m^3
Steel fibers	7850
Galvanized iron fibers	7850
High density polyethylene fibers	900
Waste plastic fiber	280
Poly propylene fiber	930

Steel fibres (SF)
Crimped shaped steel fibers are used and suitable aspect ratio selected from literature studies. All crimped steel fibers are obtained from stewools india (p) ltd. Nagpur.

Fig 1: Steel fibers

Galvanized iron fibers (GIF)
This type of galvanized iron fibers are commercially available and are generally used for electrical work.

Fig 2: Galvanized iron fibers

High density polyethylene fibers (HDPEF)
Locally available oil cans are used to get high density polyethylene fibers, these oil cans are acquired from local petrol pumps.

Fig 3: High density polyethylene fibers

Waste plastic fibers (WPF)
From waste plastic buckets these fibers are obtained by cutting them into small pieces of required size.

Fig 4: Waste plastic fibers

Poly propylene fibers (PPF)
This type of fibers are readily available in the market with standard dimensions. For concrete work, 6mm and 12mm length fibers are used

Fig 5: Poly propylene fibers

B. Mix Design for M30 grade concrete

Table 4: Mix Proportion for M30 grade concrete

Grade of concrete	Cement	Fine aggregate	Coarse aggregate	W/C
M 30	1.00	1.58	2.71	0.45

Mixing, casting and curing
Dry mixing of cementitious material, fibers, and fine aggregate and coarse aggregate are carried out initially then, calculated quantity of water is added to the dry mix to get homogeneous mix.

C. Near surface characteristic test

i) Water absorption test

In order to know the moisture absorption capacity of concrete samplings, water absorption test was conducted. To carry out this assessment we have taken three specimens, dried at room temperature of about 24-28 degrees for 24hours and specimens weights were considered as first reading (weight). After taking primary reading, the samples are kept in water bath for 24hours and final reading is recorded (i.e. saturated weight).

Water absorption = Final reading – Initial reading

ii) Sorptivity test

This test gives a solution to all complication arrived in the water absorption tests like permeability tests.

With the help of capillary action, the absorption rate was obtained, when the unsaturated sample is kept in contact with water.

Figure shows 4.19 the arrangement of the cubes for the water absorption, here the capillary- rise with respect to time is noted down. All the specimens are supported, in such a way that only 30mm height is submerged inside the water. The relation between sorptivity value and time is given by,

S = i/t^(0.5)

Where,

S = sorptivity in mm/min0.5.

i = height of water raised by capillary action

t = Time noted down with respect to the height of water raised.

Fig 6 Sorptivity test on cube specimens

D. Water absorption test results

Following are tabulations for the representation of outcomes obtained for hybridized concrete for different aspect ratios.

Table 5. Water absorption test results

Description of fibers	Aspect ratio	Initial weight (gms)	Final weight (gms)	% Water absorption
Steel fiber	40	8710	8775	0.75
	100	8430	8490	0.71
	40+100	8395	8450	0.66
GI fiber	40	8470	8550	0.94
	100	8470	8540	0.83
	40+100	8400	8460	0.71
HDPE fiber	40	8070	8145	0.93
	100	7895	7955	0.76
	40+100	7910	7965	0.70
Waste plastic fiber	40	8220	8295	0.91
	100	8265	8320	0.67
	40+100	8245	8290	0.55
Polypropylene fiber	300	7725	7875	1.94
	600	7728	7870	1.84
	300+600	7920	8040	1.52

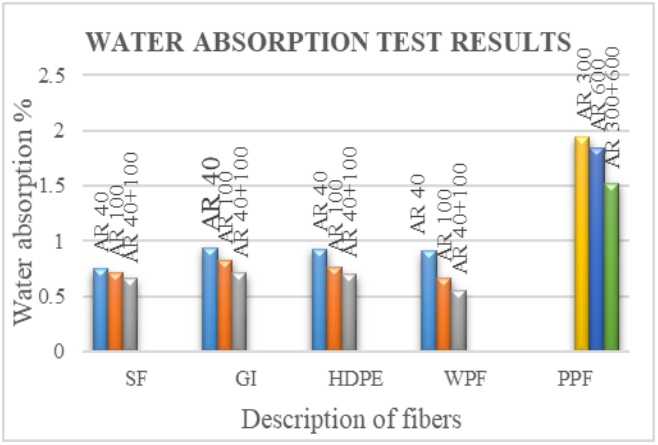

Fig 7 Variations of values obtained by Water absorption values

E. Sorptivity test results

Following are tabulations for the representation of outcomes obtained for hybridized concrete for different aspect ratios.

Table 6 Sorptivity test outcomes

Description of fibers	Aspect ratio	Height (mm)	Sorptivity (S) mm/min$^{0.5}$
Steel fiber	40	40	1.05
	100	35	0.92
	40+100	25	0.66
GI fiber	40	55	1.45
	100	40	1.05
	40+100	35	0.92
HDPE fiber	40	45	1.19
	100	40	1.05
	40+100	35	0.92
Waste plastic fiber	40	35	0.92
	100	30	0.79
	40+100	25	0.66
Polypropylene fiber	300	110	2.90
	600	85	2.24
	300+600	70	1.84

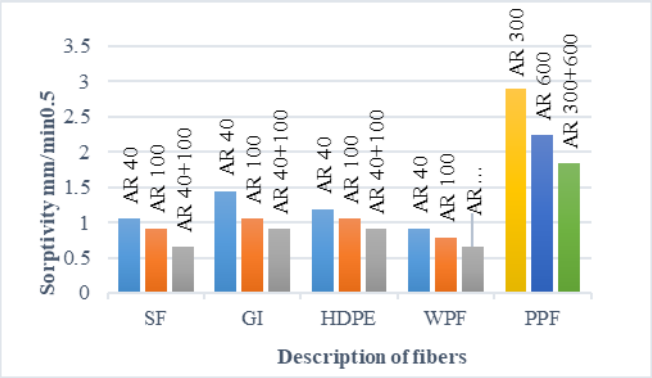

Figure 8 Graphical representation of Variations of values obtained by Sorptivity test

IV. OBSERVATION AND DISCUSSIONS

1. The water absorption of steel fiber reinforced concrete for 40 aspect ratio, 100 aspect ratio and hybrid steel fiber are 0.75, 0.71 and 0.66 respectively. As the aspect ratio increases water, absorption decreases and for hybrid steel fiber water absorption reduces, even more compared to 40 and 100 aspect ratio.
2. The water absorption for GI, HDPE, Waste Plastic and Polypropylene also decreases with increase in aspect ratio and further water absorption reduces for hybrid fibers.
3. The sorptivity of steel fiber reinforced concrete for 40 aspect ratio, 100 aspect ratio and hybrid steel fiber are 1.05mm/min$^{0.5}$, 0.92mm/min$^{0.5}$ and 0.66mm/min$^{0.5}$ respectively. As the aspect ratio increases sorptivity decreases and for hybrid steel fiber sorptivity reduces even more compared to 40 and 100 aspect ratio.
4. The sorptivity for GI, HDPE, Waste Plastic and Polypropylene also decreases with increase in aspect ratio and further sorptivity reduces for hybrid fibers.

V. CONCLUSIONS

1. The water absorption capacity of hybrid fiber reinforced concrete mix (i.e. 40+100 AR) is lesser as compared to 40AR and 100AR of mono fiber reinforced concrete. As the aspect ratio increases water, absorption decreases and for hybrid steel fiber water absorption reduces, even more compared to 40 and 100 aspect ratio.
2. The sorptivity of hybrid fiber reinforced concrete mix (i.e. 40+100 AR) is lesser as compared to 40AR and 100AR of mono fiber reinforced concrete. As the aspect ratio increases sorptivity decreases and for hybrid steel fiber sorptivity reduces even more compared to 40 and 100 aspect ratio.

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