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Experimental Studies On Fiber Reinforced Concrete

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Abstract*:* The concepts of using fibres in order to reinforce matrices weak in tension is more than 4500 years old.since Portland cement concrete started to be used widely as a construction material attempts were made to use fibres for arresting cracks enhance the strength etc. The development of fibre reinforcement for concrete was very slow before 1960's. Fibers are generally used as resistance of cracking and strengthening of concrete. In this project we are going to compare the compressive strength of 3, 7 and 28 days of aramid fibres to the ordinary concrete and fibre reinforced concrete i.e. glass fibres and steel fibres. The concrete is design for M20 grade of concrete. According to various research papers, it has been found that steel fibers give the maximum strength in comparison and glass fibre is used for crack resistance but aramid simultaneously gives strength and can be used for crack resistance. Now a days there exists many reinforcement techniques for improving the strength of those materials which lacks load carrying and less durable capacity. Fiber reinforced concrete has been successfully used in slabs on grade, shotcrete, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. This review study is a trial of giving some highlights for inclusion of aramid fibers especially in terms of using them with new types of concrete.

Keywords: Compressive strength, ductility, flexural strength, aramid fibres, Fibre Reinforced Concrete, Split tensile strength, toughness, workability.

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I. INTRODUCTION

Application of Fibre Reinforced Concrete (FRC) is continuously growing in various application fields. FRC is widely used in structures. Due to the property that fibre enhances toughness of concrete, FRC is used on large scale for structural purposes. The fibre is described by a convenient parameter called aspect ratio. The aspect ratio of the fiber is the ratio of its length to its diameter. The principle motive behind incorporating fibers into a cement matrix is to increase the toughness and tensile strength and improve the cracking deformation characteristics of the resultant composite. For FRC to be a valuable construction material, it must be able to compete economically with existing reinforcing system. FRC composite properties, such as crack resistance, reinforcement and increase in toughness are dependent on the mechanical properties of the fiber, bonding properties of the fiber and matrix, as well as the quantity and distribution within the matrix of the fibers. It improves fatigue resistance makes crack pattern distributed. By making crack pattern distributed, it is meant that it decreases the crack width. Aramid fibre gives more compressive strength and crack resistance to concrete as compare to glass and steel fibre.

II. MATERIALS

i.	Cement	Pozzolana Portland cement of [53 grade]
ii.	Coarse aggregate	Size 20mm
iii.	Fine aggregate	Size 10mm
iv.	Sand	Less than 4.75mm
v.	Admixture	Super plasticizers
vi.	Fibres	Glass fibre, steel fibre and Aramid fibre.
vii.	Water	Potable water

III. METHODOLOGY

Concrete ingredients are firstly collected from various location. As per IS specification material is tested i.e. test which are usually performed to check the material's physical properties. The proportioning of quantity of cement, materials like fine aggregate, coarse aggregate and fibres like Glass fibre, Steel fiber and Aramid fibre has been done by weight as per the mix design . Water, super plasticizer were measured by volume. Concrete was design for M20 grade as per IS 456-2000 and IS 10262.

The mixing process is carried out in concrete mixture. The materials are laid in uniform layers, one on the other in order – fine aggregate, coarse aggregate and fibres as per the percentage like 0.3%, 0.5% and 0.7% respectively. Dry mixing is done, then cement is added and in last water is added. Fresh concrete is tested to check the slump of concrete, as addition of different percentage of fibres may change the slump of concrete, then concrete is filled in empty moulds and kept for 24 hours. After 24 hours cubes are de-mould and placed in curing tank for curing. After that compressive testing was done after 3, 7, and 28 days of curing.

IV. RESULT

RESULTS FOR M-20 GRADE OF CONCRETE IN COMPRESSION TEST OF 3, 7 AND 28 DAYS

ORDINARY CONCRETE

M20 PCC			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	176	17600	7.82 N/SQ.MM
7 days	292	29200	12.98 N/SQ.MM
28 days	492	49200	21.87 N/SQ.MM

Table no.1

GLASS FIBER

M 20 [0.3 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	188	18800	8.35 N/SQ.MM
7 days	279	27900	12.4 N/SQ.MM
28 days	496	49600	22.04 N/SQ.MM

Table no. 2

M 20 [0.5 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	227	22700	10.08 N/SQ.MM
7 days	269	26900	11.95 N/SQ.MM
28 days	630	63000	28.00 N/SQ.MM

Table no. 3

M 20 [0.7 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	198	19800	8.8 N/SQ.MM
7 days	337	33700	14.98 N/SQ.MM
28 days	652	65200	28.98 N/SQ.MM

Table no.4

STEEL FIBER

M 20 [0.3 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	283	28300	12.57 N/SQ.MM
7 days	343	34300	15.24 N/SQ.MM
28 days	630	63000	23.24 N/SQ.MM

Table no.5

M 20 [0.5 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	300	30000	13.33 N/SQ.MM
7 days	373	37300	16.57 N/SQ.MM
28 days	521	52100	24.31 N/SQ.MM

Table no.6

M 20 [0.7 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	312	31200	13.87 N/SQ.MM
7 days	364	36400	16.17 N/SQ.MM
28 days	624	62400	27.73 N/SQ.MM

Table no.7

ARMID FIBER

M 20 [0.3 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	543	54300	24.13 N/SQ.MM
7 days	573	57300	25.67 N/SQ.MM
28 days	660	66000	29.33 N/SQ.MM

Table no. 8

M 20 [0.5 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	564	56400	25.07 N/SQ.MM
7 days	700	70000	31.11 N/SQ.MM
28 days	847	84700	37.64 N/SQ.MM

Table no.9

M 20 [0.7 %]			
BLOCK	LOAD(KN)	LOAD(KG)	STRESS=LOAD/AREA
3 days	562	56200	24.98 N/SQ.MM
7 days	686	68600	30.49 N/SQ.MM
28 days	692	69200	30.75 N/SQ.MM

Table no.10

Comparison between Aramid fibre to Glass fibre and steel fibre on basis of Percentage increased in strength of 28 days

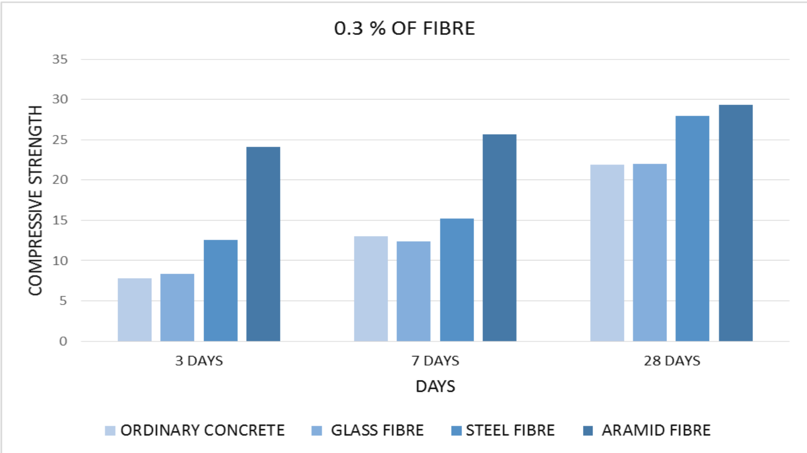
Grade of concrete	% of fibre	Aramid fibre	Glass fibre	% of increased
		Stress (N/SQ.MM)	Stress (N/SQ.MM)	
M20	0.3	29.33	23.04	26.45 %
M20	0.5	37.64	28.00	48.2 %
M20	0.7	30.75	28.98	8.85 %

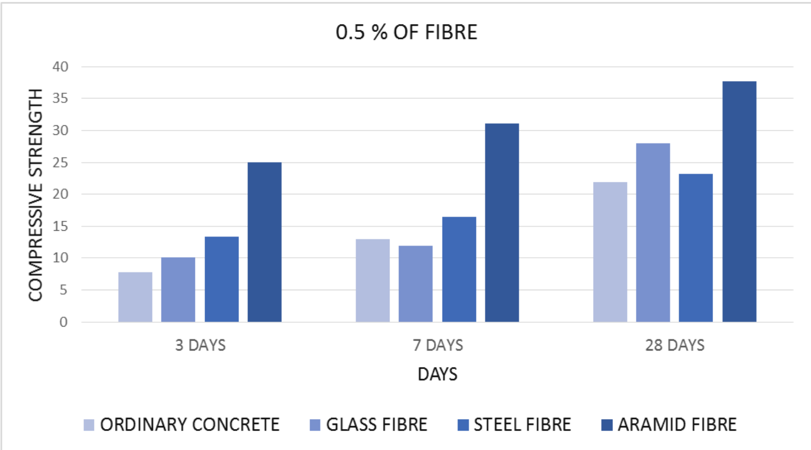
Table no.11

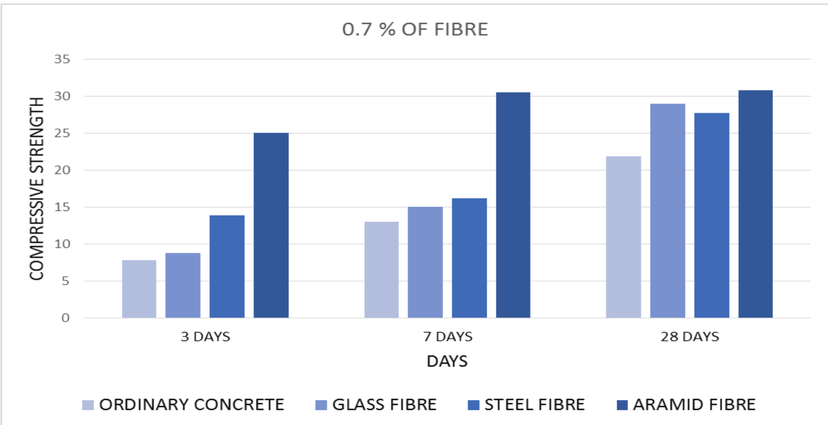
Grade of concrete	% of fibre	Aramid fibre	Steel fibre	% of increased
		Stress (N/SQ.MM)	Stress (N/SQ.MM)	
M20	0.3	29.33	23.24	30.45 %
M20	0.5	37.64	24.31	66.65 %
M20	0.7	30.75	27.73	15.1 %

Table no. 12

BAR GRAPH







V.CONCLUSION

For glass and steel reinforcement, strength of concrete increased with, increased in fibre dosage up to 0.5 % as compared to glass fibre, aramid fibre gives 48% more compressive strength, whereas when comparing aramid and steel fibre, aramid gives 66% increased compressive strength. Aramid reinforced concrete produce massive compressive strength as here, the aramid reinforced concrete is introducing compressive strength as equal to M35 grade in design of M20 grade.

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