International Journal of Advanced Technology in Engineering and Science
Vol. No.08, Issue No. 06, June 2020
www.ijates.com
ijates
ISSN 2348 - 7550

EXPERIMENTAL STUDY ON COMPRESSIVE STRENGTH OF CONCRETE BY USING DIFFERENT FIBERS AT VARIOUS REPLACEMENT LEVELS

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ABSTRACT

Concrete is the most widely used building material in the world. Fiber-reinforced concrete (FRC) is a concrete in which small and discontinuous fibers are uniformly dispersed. The fibers used in FRC can be of different materials such as steel, stainless steel, carbon, glass, aramid, asbestos, polypropylene, jute, etc.

Adding these fibers to the concrete mass can greatly increase the compressive strength, tensile strength, bending strength and impact strength of the concrete. The results of the strength properties of steel, glass and cement reinforced with polypropylene fiber were presented in this study. The compressive strength of concrete samples made with different fiber amounts between 0%, 0.25%, 0.5% and 1% was studied. Samples with added different fibers showed better results with increasing fiber content.

INTRODUCTION

Deterioration of concrete systems is one of the major issues of the construction enterprise these days. Because replacing poor centers takes quite a few money and time, strengthening has turn out to be the suitable manner to increase wearing capability and lifespan. Concrete is the most broadly used artificial building material inside the international, it is an monetary cloth and the maximum used substance within the construction area. It is acquired by using blending cementitious substances, water and aggregates and on occasion adding additives, within the required proportions. The combination, as soon as placed in forms and left to treatment, is fashioned right into a mass much like a rock known as cement. The strength, sturdiness and other traits of concrete depend on the homes of its ingredients, the proportions of the elements, the compaction method and other controls at some point of positioning, compaction and hardening.

Fiber-reinforced concrete (FRC) is a concrete that incorporates fibrous material that will increase its structural integrity. Fiber-bolstered concrete can be described as a composite fabric including combos of cement or cement mortar and discontinuous, discrete and uniformly dispersed fibers suitable. The normal fiber reinforced concrete is particularly used for floors and flooring, but can be considered for a wide variety of creation pieces (beams, pillars, foundations, etc.) by myself or

with hand-tied armor. Fiber-reinforced cement (that is generally steel, glass or plastic fibers) is much less high priced than hand-tied reinforcement bars, growing tensile strength in many instances. The form, length and period of the fibers are critical.

DIFFERENT TESTS ON CONCRETE

S.no	W/c Ratio	Slump Fall Ht (mm)
1	0.5	0
2	0.6	17

slump of concrete mix results

Description of work	Slump (cm)
Road work	2.5 to 5.0
Ordinary beams to slabs	5 to 10
Columns thin vertical section & Retaining walls etc.	7.5 to 12.5
Mass Concrete (Runway, Pavements)	2.5 to 5

Recommended slumps of concrete mix of various works.

Workability	Slump (mm)
No Slump	0
Very low	5-10
Low	15-30
Medium	35-75
High	80-155
Very high	160-collapse

Recommended values of slumps and types.

S.no (1)	W/c Ratio (2)	Cylinder wt with partially compacted concrete wt (w_2) kg (3)	Cylinder wt with fully compacted concrete wt (w_3) kg (4)	Weight of partially compacted concrete (w_2-w_1) (5)	Weight of fully compacted concrete (w_3-w_1) (6)	Compaction factor (5)/(6)
1	0.5	15.940	18.17	10.24	12.47	0.82
2	0.6	16.609	18.30	10.90	12.6	0.86
3	0.7	16.935	18.60	11.194	12.864	0.87

compaction factor test results

Mix Design for M35 Grade:

STIPULATIONS FOR PROPORTIONING

a) Grade designation : M35
b) Type of cement : OPC 53 Grade
c) Maximum nominal size of aggregate : 2O MM, 10MM
d) Minimum cement content : 340 kg/m³
e) Maximum water-cement ratio : 0.42
f) Workability (slump value) : 100mm
g) Exposure condition : severe
h) Method of concrete placing : pumping
i) Degree of supervision : good
j) Type of aggregate :crushed angular
k) Maximum cement content : 470kg/m³

Test data for materials:

a) Cement used : OPC 53 grade
b) Specific gravity of cement : 3.15
c) Specific gravity of:
1) Coarse aggregate : 2.74
2) Fine aggregate : 2.55
e) Water absorption:
1) Coarse aggregate : 0.5 %
2) Fine aggregates : 1.0 %
f) Free (surface) moisture
1) Coarse aggregate : Nill
2) Fine aggregate : Nill

TARGET STRENGTH FOR MIX PROPORTIONING

f‟ ck = fck + 1.65 s (From table 1, IS 10262:2009 standard deviation, S=5N/mm²) Target strength = 35+1.65*5 = 43.25 N/mm²

SELECTION OF WATER-CEMENT RATIO

From table 5, of IS 456, maximum water- cement ratio = 0.45

Based on experience adopt water-cement ratio = 0.35, 0.35< 0.42, Hence ok.

International Journal of Advanced Technology in Engineering and Science
Vol. No.08, Issue No. 06, June 2020
www.ijates.com
ijates
ISSN 2348 - 7550

SELECTION OF WATER CONTENT

From table 2, maximum water content for 20mmaggregates = 186litre

10mm aggregates = 208liter

Estimated water content for 100 mm slump = (60/100)186+ (40/100)208

= 195litres

CALCULATION OF CEMENT CONTENT

- Water – cement ratio = 0.42
- Cement content = 195/0.42

  = 470 kg/m³
- From table 5 of IS 456 , minimum cement content for „severe" exposure condition

  = 340 kg/m³

  470kg/m^3 > 340 kg/m^3. Hence, ok.

PROPERTIES OF VOLUME OF COARSE AND FINE AGGREGATE CONTENT

Volume of coarse aggregate = (60/100)0.64+ (40/100)0.48

= 0.576

Volume of fine aggregate = 1-0.576

= 0.424

MIX CALCULATIONS

a) Volume of concrete = 1m³

b) Volume of cement = mass of cement/specific gravity of cement*1/1000

= 470/3.1*1/1000

= 0.1516 m³.

c) Volume of water = mass of water/specific gravity of water*1/1000

= 195/1*1/1000

= 0.195m^3

d) Volume of all in aggregates = (a-(b+c+d))

= 1-(0.1516+0.195)

= 0.6534 m³

e) Mass of coarse aggregate = e*volume of coarse aggregate*specific gravity of coarse aggregate*1000

= 0.6534*0.57*2.74*1000

= 1025 kg

f) Mass of fine aggregate = e*volume of fine aggregate * specific gravity of fine aggregate*1000

= 0.6534*0.42*2.55*1000

= 700 kg

MIX PROPORTIONS REQUIRED FOR COMBINED MIX

GRADE	**PROPORTIONS**	**CEMENT(Kg/m³)**	**F.A(Kg/m³)**	**C.A(Kg/m³)**	**WATER(LT)**
M35	**1:1.61:2.48**	**470**	**760**	**1170**	**195**

Mix design

Grade	Type of Fiber	Proportions	Cement (Kg/m³)	F.A (Kg/m³)	C.A (Kg/m³)		%Water	%fiber (kg)
					20mm	10mm		
M35	Normal	0%	14.32	23.04	21.33	14.22	5.92	0
M35	Steel	0.25%	14.32	23.04	21.33	14.22	5.92	0.595
		0.5%	14.32	23.04	21.33	14.22	5.92	1.191
		1%	14.32	23.04	21.33	14.22	5.92	2.384
M35	Glass	0.25%	14.32	23.04	21.33	14.22	5.92	0.140
		0.5%	14.32	23.04	21.33	14.22	5.92	0.280
		1%	14.32	23.04	21.33	14.22	5.92	0.561
M35	Polypropylene	0.25%	14.32	23.04	21.33	14.22	5.92	0.073
		0.5%	14.32	23.04	21.33	14.22	5.92	0.147
		1%	14.32	23.04	21.33	14.22	5.92	0.294

Quantities of materials

RESULTS AND DISCUSSIONS

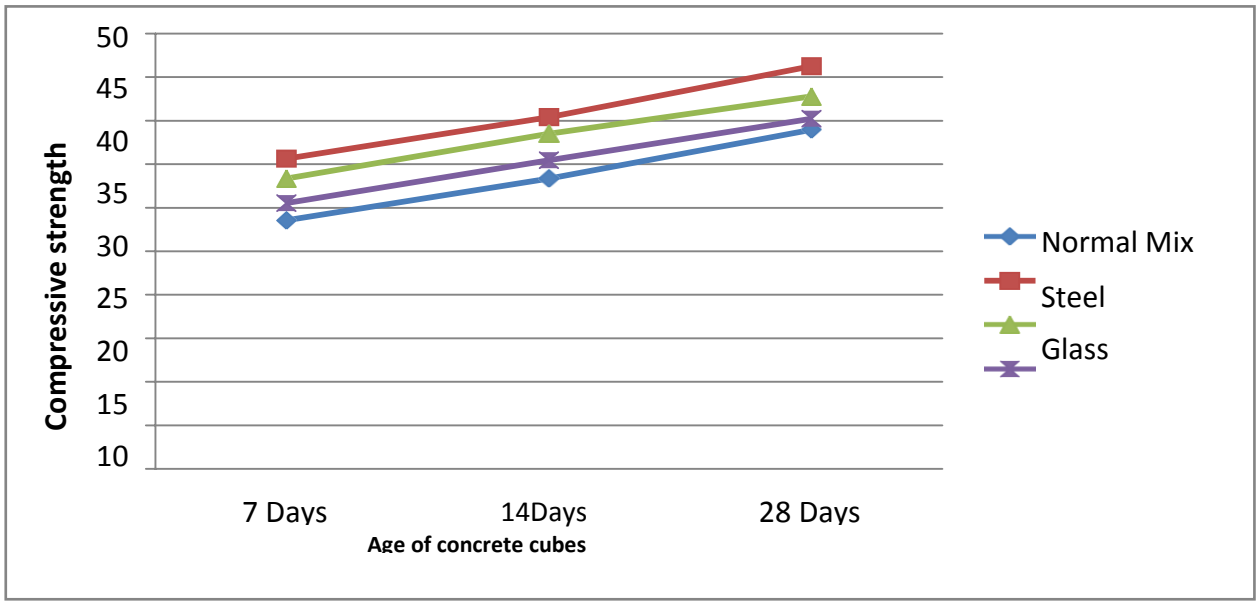
The cubes were tested on the CTM under load rate control. All the cubes were tested under the load rate control. A photograph of the test setup. To understand the behavior of concrete cubes with and without fibers the following graphs were drawn, compressive strength Vs Age of concrete

for 0%, 0.25%, 0.5%, and 1%fibers. The, maximum load and amount of fiber content added for the cubes subjected to loading were calculated and reported as follows.

S.no	Mix	% of fibers added	7 days	14 days	28 days
1	Normal mix	0%	28.56 N/mm^2	33.35 N/mm^2	38.96 N/mm^2
2	Steel fibre	0.25%	35.65 N/mm^2	40.43 N/mm^2	46.26 N/mm^2
		0.5%	38.5 N/mm^2	43.60 N/mm^2	50.25 N/mm^2
		1%	42.85 N/mm^2	46.87 N/mm^2	55.36 N/mm^2
3	Glass fibre	0.25%	33.35 N/mm^2	38.52 N/mm^2	42.80 N/mm^2
		0.5%	36.53 N/mm^2	40.85 N/mm^2	45.65 N/mm^2
		1%	39.46 N/mm^2	43.45 N/mm^2	49.83 N/mm^2
4	Polypropylene Fibre	0.25%	30.55N/mm^2	35.45 N/mm^2	40.23 N/mm^2
		0.5%	32.65 N/mm^2	38.21 N/mm^2	42.85 N/mm^2
		1%	35.34 N/mm^2	39.35 N/mm^2	45.65 N/mm^2

Compressive Strengths of Different Fiber Concrete Cubes

Compressive strength vs. age of concrete (0.25%)

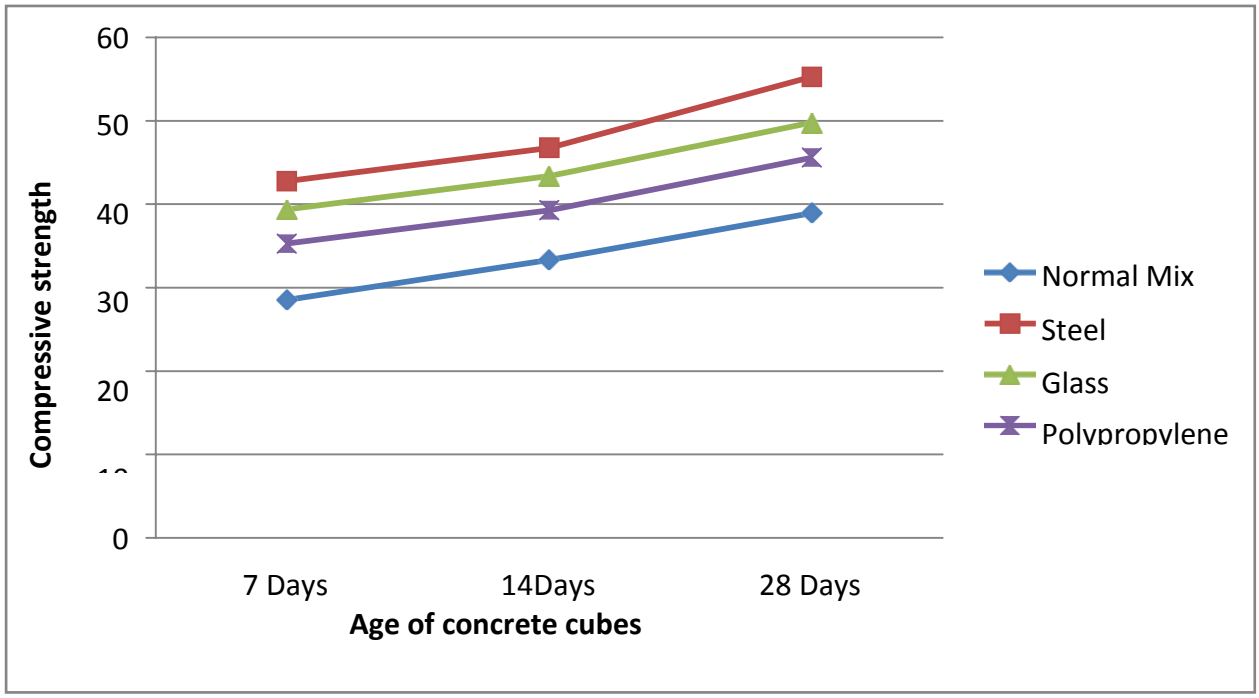


Compressive strength -Age of concrete cubes for 0.25% of fiber content Observations

It was observed that when compared to normal mix, the compressive strength of concrete of steel fiber, glass fiber, polypropylene fiber was increased for 0.25% of fiber content.

Compressive strength increases for 14, 28 days compared to 7 days strength.
It was observed that steel fibers attain more strength compared to glass and polypropylene fiber.

Compressive strength Vs age of concrete (0.5%)



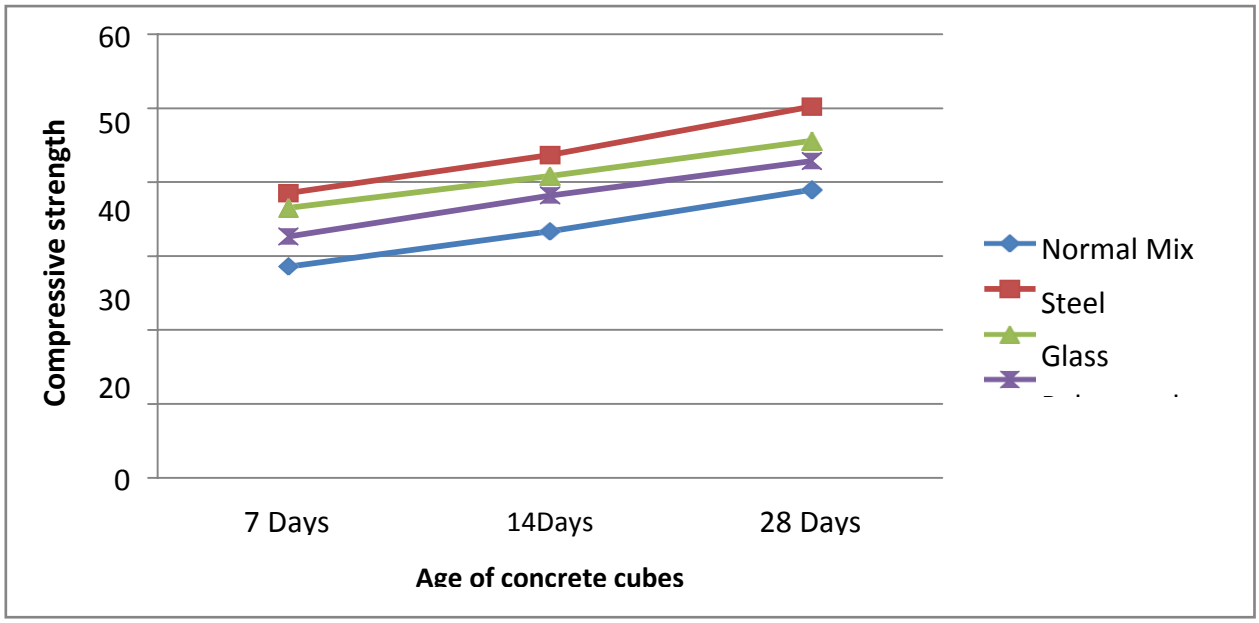
Compressive strength -Age of concrete for cubes of 0.5% of fiber content Observations:

It was observed that when compared to conventional mix, the compressive strength of concrete of steel fiber, glass fiber, polypropylene fiber was increased for 0.5% of fiber content.

Compressive strength increases for 14, 28 days compared to 7 days strength.

It was observed that steel fibers attain more strength compared to glass and polypropylene fiber.

Compressive strength vs. age of concrete (1%)



Compressive strength -Age of concrete for cubes of 1% of fiber content Observations:

It was observed that when compared to conventional mix, the compressive strength of concrete of steel fiber, glass fiber, polypropylene fiber was increased for 1% of fiber content.

Compressive strength increases for 14, 28 days compared to 7 days strength

It was observed that steel fibers attain more strength compared to glass and polypropylene fiber.

CONCLUSIONS

1. With the increase of fibre content material the compressive strength increases.
2. The remaining load behaviour is likewise progressed because of the addition of fibres.

Three. Steel fibres supply greater strength while as compared to glass and polypropylene fibres.

The steel fiber reinforced concrete offers 29.Sixty one% with addition of one% metal fiber volume of concrete with as compared with normal mix.

Four.The glass fiber reinforced concrete offers 21.Eight% with addition of 1% glass fiber quantity of concrete with in comparison with regular blend.

Five.The polypropylene fiber strengthened concrete offers 14.Sixty five% with addition of one% polypropylene fiber quantity of concrete with as compared with everyday mix.

6. The metal fiber bolstered concrete gives 22.48% with addition of zero.Five% steel fiber quantity of concrete with in comparison with ordinary mix.
7. The glass fiber bolstered concrete gives 14.Sixty five% with addition of zero.5% glass fiber volume of concrete with as compared with everyday mix.

Eight.The polypropylene fiber reinforced concrete offers nine.05% with addition of zero.5% polypropylene fiber volume of concrete with compared with regular blend.

9. The metallic fiber bolstered concrete offers 15.Seventy eight% with addition of zero.25% steel fiber volume of concrete with compared with everyday mix.
10. The glass fiber bolstered concrete offers eight.97% with addition of 0.25% glass fiber extent of concrete with compared with everyday mix.

    Eleven.The polypropylene fiber strengthened concrete offers 3.15% with addition of zero.25% polypropylene fiber volume of concrete with in comparison with regular blend

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