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Experimental Studies on Fiber Reinforced High Strength Concrete on Rigid Pavement

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EXPERIMENTAL STUDIES ON FIBER REINFORCED HIGH STREGTH CONCRETE ON RIGID PAVEMENT

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ABSTRACT

High strength concrete is one that aids in all aspects of overcoming practical obstacles as well as other functionality of any structure. Concrete pavements, high-rise buildings, long-span bridges, hydraulic systems, and other applications all benefit from the use of High strength concrete. With the addition of fibres to the concrete mix, the qualities of the concrete improve dramatically. Many research projects are currently underway to make High strength concrete more cost-effective and durable by including supplemental cementation ingredients and alternative replacement aggregates. The purpose of this study is to investigate the mechanical properties of fibre reinforced High strength concrete by substituting foundry sand and crushed concrete waste for fine and coarse aggregate, respectively. Every 5% interval, the percentage replacement of foundry sand ranges from 0% to 40%, and every 10% interval, the percentage replacement of crushed concrete waste varies from 0% to 40%. Mechanical parameters of High strength concrete were tested, including crushing strength, flexural strength, split tensile strength, shear strength, and impact strength. For the preparation of High strength concrete, M80 Mpa concrete is used. The IRC44:2017 rules and recommendations were followed during the mix design process. To improve the performance of the concrete, the proper dosage of super plasticizer was maintained. Polypropylene fibres weighing 0.3 percent of the cement weight were employed in this study. Mechanical qualities were determined by producing certain mould sizes for specific tests, which were cured for 7, 14, and 28 days, with the results tallied and explained for each day.

Keywords: High strength concrete, Poly-Propylene fibres, IRC Guidelines, Mechanical properties.

1. INTRODUCTION

1.1 General

HSC will become an essential concrete material for conventional concrete in the coming years. HSCs with a strength equal to or more than M-80 MPa are used in a wide range of construction applications, taking into account their performance and role in each application. HSC's high strength and performance are frequently achieved by lowering the W/C ratio and adding a specific admixture that also increases workability (Admixtures such as water reducing agents, plasticizers, super plasticizers, hyper plasticizers and hyper- hyper plasticizers). Different types of steel or polymer based fibres are employed in HSC to increase tensile strength, ductility, and toughness, resulting in fibre reinforced concrete. The Permeability criteria are also reduced by the HSC. Proper concrete mix design is critical in achieving the desired concrete in the construction business. Concrete becomes more workable and durable when the W/C ratio is maintained properly. By limiting the W/C ratio to an exceptionally low percentage, additional strength can be achieved in terms of plasticizers and superplasticizers.

1.2 Scope of HSC

HSC is required in all concrete fields and construction projects that have concrete components that must resistance against high crushing loads. HSC is applicable in tall structures where the grade of concrete is higher there by reducing the total density of the member. It has been used in components of the framed structures such as vertical members especially on bottom stories loads is greater, retaining walls and footing sections. HSC with fibres are also largely used in construction of heavy bridges having long spans as well. HSC is also used in the construction of culverts and highway pavements. HSC also largely used in pre-stressed concrete girders.

1.3Classification of HSC

Classification of HSC by considering the strength aspect in to consideration are as follows-

1.3.1 Based on Characteristic Strength

Based on28-days of curing, the been suggested by below table.

Table1.1: Classification of concrete based on Characteristic Strength

Sl	Classification of Concrete	Crushing strength in Mpa for 28 days
1	Ordinary Concrete	10 to 20 MPa.
2	Standard/Normal Concrete	25 to 55 MPa.
3	High-Strength Concrete	60 to 100 MPa.
4	Exceptional Concrete	> 150 MPa.

1.3.2Classification of materials as per IRC 44-2017:

1.3.2.1 Cement:

i. OPC, 43 Grade & 53 Grade, IS: 269.
ii. PPC, IS: 1489, Part-1.
iii. Portland Slag cement, IS: 456.
iv. Composite Cement, IS: 16415.

1.3.2.2 Admixtures

Mineral Admixtures and Chemical admixtures:

Guidelines: Retarders, plasticizers and super plasticizers conforming to IS: 9103 can be used as 0.5, 1 and 2 percent by mass of cementitious materials respectively.

1.3.2.3 Fibers

As per IRC: SP: 46 and IS: 456, fibers may be added to concrete for to enhance the properties. The fibers may be carbon, steel fibers or polymeric synthetic fibers and which shall be uniformly dispersed in the concrete mass at the time of concrete production.

1.3.2.4 Aggregates

Aggregates for the pavement concrete should satisfy with IS: 383 except for grading and any other specific requirement given in IRC: 15.

1.3.3Guidelines for fine aggregates:

As per the IRC44-2017 guidelines, fine aggregates shall be free from soft particles, clay, shale, loam, cemented particles, mica and organic and other foreign matter. Requirements of the fine aggregates should follow as per table-2 of IRC44-2017, 3.4.2 clause.

1.3.4Guidelines for Coarse aggregates:

Coarse aggregates must be made up of clean, firm, sturdy, compact, non-porous, and long-lasting crushed stone or crushed gravel with no flaky or elongated particles. The total flakiness and elongation index must not exceed 35 percent, and the overall impact value must not exceed 30%. Table-1 of IRC44-2017, 3.4.1.1 clause, specifies the size and grading of coarse aggregates.

1.3.5 Water: water used for concrete shall be free from injurious amounts of oil, salt, acid, vegetable matter or other substances to the concrete.

1.3.6Requirements for the mix proportion of concrete as per IRC44-2017.

Following are the requirements for the preparation of mix design

- Type of binding agent
- Max nominal size of the aggregate
- Min cement/ cementitious materials content.
- Workability required at the time of placement.
- Time duration from mixing to placement.
- Method of transporting and placing.
- Degree of supervision (good)

- Type of fine aggregate and coarse aggregate.
- Whether a mineral admixture shall or shall not be used and the type of chemical admixture and extent of use.

2. MATERIAL SELECTION:

From the above listed materials, priority of the materials are selected based on the many factors and the role in to consideration. The following materials are selected for the preparation of HSC, they are-

i. **Cement**
   - OPC of 53 Grade.

ii. **Fine Aggregate**
   - River Sand
   - Foundry Sand

iii. **Course Aggregate**
   - Crushed Stone
   - Recycled Concrete Waste

iv. **Portable Water.**

v. **Super plasticizer.**

vi. **Polypropylene fibers.**

2.1Physical Properties

2.1.1Cement-In this experimental work, OPC-53 grade was used.

Table2.1: Properties of Cement

Sl	Test Carried Out	Results	Requirement
1	Fineness (m^2/Kg)	300	Min 225
2	Consistency (%)	30.0	Should Not Less Than 2 7%
3	Setting Time (Min) A) Initial Setting B) Final Setting	 35 370	Min.30 Max.600
4	Soundness Test	1.0	Max.10
5	Crushing Strength At 3 Days A) At 7 Days	 35.32 32.43	Min. 27 Min. 37
6	Specific Gravity	3.1	3.1

2.1.2Fine aggregate

***a) River Sand and Foundry* Sand**

Clean and Dry river sand is used an available locally available material.

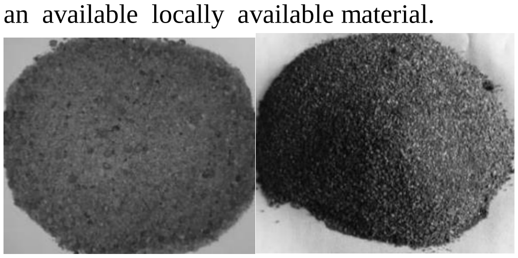

Figure 1: River Sand and Foundry Sand

Table 2.2. Properties of Fine Aggregate

Sl	Test Carried Out	Results	Requirement
1	Specific Gravity	2.46	2.2-2.7
2	Bulking of Sand	4%	-----------
3	Silt Content	Nil	Less than 8%
5	Abrasion Test In Wt. Loss(G)	0.235	-----------
6	Particle Size Distribution	2.7 (Medium)	Fine:FM:2.2-2.6 Medium:F.M:2.6-2.9 Coarse:F.M:2.9-3.2
1	Specific Gravity	2.45	2.2-2.7
2	Bulking of Sand	6%	-----------
3	Silt Content (%)	4	Less than 8%
4	Particle Size Distribution	3.2 (Coarse)	Fine:FM:2.2-2.6 Medium:F.M:2.6-2.9 Coarse:F.M:2.9-3.2

Environmental Condition during Test, Temperature= 27+/- 2 Degree Centigrade

2.1.3Coarse aggregate

a) Natural Aggregate and Crushed concrete waste

Crushed granite aggregate with specific gravity of 2.60 and passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383 - 1970 is used for all the specimens.

For the purpose of this report, the following classifications are adopted.

Figure2: Natural aggregate and Crushed Concrete Waste

Table 2.3. Properties of Coarse Aggregate

Sl	Test Carried Out	Results	Requirement
1	Specific Gravity	2.46	2.2-2.7
2	Crushing Strength (%)	26.60	Should Not Less Than 30%
3	Flakiness (%)	5.36	Less Than 15%
4	Elongation (%)	14.76	Less Than 15%
5	Impact Value	18.82	10-20%- Strong
6	Water Absorption	2.37	-------------
1	Specific Gravity	2.45	2.2-2.7

2	Crushing Strength (%)	25.39	Less Than 30%
3	Flakiness (%)	14.6	Less Than 15%
4	Elongation (%)	17.5	Less Than 15%
5	Impact Value	14.79	10-20% Strong
6	Water Absorption	4.75%	-------------

2.1.4 Water

Casting and curing of concrete specimens were done with the potable water.Water used in the preparation of concrete should be free from dirt and organic matters.

2.1.5 Super Plasticizer

To achieve the workability for concrete, super plasticizers are used. In this, poly carboxylic ether is used. Super plasticizers, also known as high range water reducers, are chemical admixtures used where well dispersed particle suspension is required.

2.1.5.1 Conplast Sp430 –

CONPLAST SP430 should complies with BIS: 9103-1999 and BS: 5075-part3 and ASTM C494.Super plasticizer molecules and cement grains are oppositely charged and hence repel each other.

Table2.4: Properties of Super Plasticiser

SL	Properties	Value
1	Specific Gravity	1.08
2	Colour	Dark Brown

2.1.5.2 Setting out the dosage of superplasticizer using MarshCone Test (Flowability Test).

Marsh cone is a conical brass vessel, which has a smooth aperture at the bottom of diameter 5mm. to conduct this experiment by taking 2 Kg of cement sample and by maintaining the W/C ratio of 0.50.

Figure 3: Marsh Cone apparatus for Cement & mortar (5mm and 12mm diameter mouth)

Observation was made by taking the plasticizer dosage of 0%, 0.25%, 0.5%, 0.75%, 1.0%, 1.25%, 1.5%, 1.75% and 2.0% to the weight of cement into Consideration.Active performance of the cement with Super plasticisers are discussed in Chapter-6.

2.1.6 Polypropylene Fibers

The raw material of polypropylene is derived from monomeric C_3H_6 which is purely hydrocarbon. Its mode of polymerization, its high molecular weight and the way it is processed into fibres combine to give polypropylene fibres very useful properties as explained in below table:

Table2.5: Properties of Poly-Propylene Fibers

Sl	Property	Description
1	Colour	Natural White
3	Length	40mm
4	Cross Section	Rectangular (1x0.5 m m)
5	Density	0.91 kg/m^3 nominal
6	Specific Surface Area	250 sq. meters per kg
7	Absorption	Nil
8	Melt Point	160^0C
9	Ignition Point	365^0C
10	Thermal & Electrical Conductivity	Low
12	Acid Resistance	High
13	Alkali Resistance	100%

2.2 Methodology

1) A collection of high-quality materials that are locally available.
2) Physical and chemical properties of materials are tested at a basic level.
3) Aggregate proportioning using the maximum density technique and its gradations
4) Calculations for mix design for a specific cementitious concentration to achieve excellent performance.
5) Using different experiments to determine the water content of a specific combination.
6) Fine aggregate percentage calculation
7) Using the maximum density approach, fix the percent of various coarse aggregate sizes (i.e. 20-10, 10 - 4.75 mm).
8) Perform trial mixes to obtain the desired slump and homogeneous concrete mix free of honeycombing and segregation.
9) Samples are cast.

10) Samples were tested at 7 and 28 days old.

11) Discussions and conclusions

3. EXPERIMENTAL METHODOLOGY

3.1 Casting of Cubes

Cubes were made using concrete mixture without waste foundry sand as fine aggregate and crushed concrete waste as coarse aggregate and concrete mixture Containing waste foundry sand as fine aggregate and crushed concrete waste as coarse aggregate as partial replacements in the HSC with various varying percentages (Foundry sand-10%, 20%, 30% and 40%, crushed concrete waste-5%, 10%, 15% and 20%).

3.2 Curing of Concrete Cubes

After casting, all the test specimens were stored at room temperature in the casting room. They were de-moulded after 24 hours, and were put into a water-curing tank for 7, 14 and 28 days at room temperature.

3.3 Mix design:

Mix Design is a process of selecting suitable ingredient materials for the preparation concrete and determining their relative proportions as economically as possible that would satisfy the desired properties of fresh and hardened concrete as well. In this investigation, IRC 44-2017 mix design procedure is used for M-80 grade concrete (HSC).Mix proportion of HSC are as follows:

Table3.1: Material requirements and mix proportion of M80 grade concrete

Requirement	Cement	Fine aggregate	Coarse aggregate	Water	Super plasticizer
Weight of materials in Kg/m^3	450 kg/m^3	564 kg/m^3	1329 kg/m^3	123 Lt	6.0
Mix proportion	1	1.25	2.95	W/C= 0.27	0.0052

3.4 Experimental Observations:

3.4.1 Tests for fresh concrete:

3.4.1.1 Slump test

Slump test is the one of the easy test to carry out the workability of the concrete both in field and laboratory. This type of test is done when the concrete is more workable and the slump value of concrete depends on the W/C ratio.

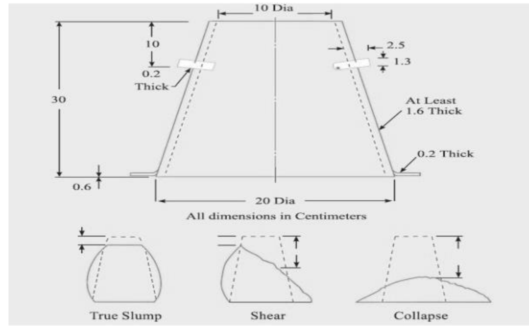

Figure 4: Slump Cone

3.4.1.2 Compaction factor test

Compaction factor test is carried in the laboratory only to determine the compaction factor of the concrete. The concrete of very hard concrete can also determine using this test. Very low workable concrete can also be determined through this test.

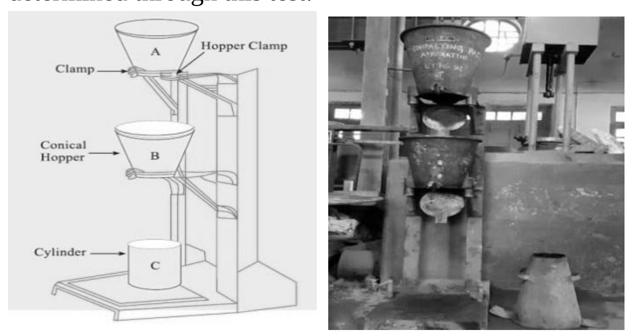

Figure5: Compaction factor testing equipment

3.4.2 Test for hardened concrete

3.4.2.1 Crushing strength

The amount of compression load handled by the specific dimension of the concrete cube is determined by a crushing strength test. The cube can be made to a standard size of 150mmx150mmx150mm and cured and tested using a compression test setup. The compression load applied on the cube to the area of the specimen can be used to compute the crushing strength of the cube for different curing durations. Crushing strength = $P/A \times 1000$

Where , P = Failure load.

A = Area of specimen.

3.4.2.2 Split Tensile Strength

The split tensile strength test is used to assess the tensile capacity of a hardened concrete sample. The cube is cylindrical in shape, with dimensions of 150mm in diameter and 300mm in length, and is used to test the split tensile strength of concrete.

The mould was placed on the flat form in a suitable manner, and the load after crushing was measured and utilised to calculate the split tensile strength of the concrete. IS: 05816-1970 standards were utilised to create the formula.

$$Ft = 2P/\pi DL$$

Where P = Crushing load on the cylinder

L = Length of the cylinder D = Diameter of the cylinder

3.4.2.3 Flexural strength test

One or two point loading without supports can be used to perform a flexural strength test. The 100mmx100mmx500mm mould was prepared and cured for the appropriate curing durations. This test can be used to measure the toughness properties of the concrete and to analyses the flexural behavior of the concrete in post-cracking phases. Flexural strength can be calculated by bellow formula

Flexural strength= (PL/bd^2) x100

Where, P=critical load in KN, L= Effective length of beam=400mm

b= Beam width-100mm

d=Beam depth=100mm

3.4.2.4 Impact test (Dropping Weight test)

Figure 6: Impact strength testing machine

Computation of the impact strength was as follows-

Impact strength of sample= (W * h * n) N-m

Where, W= Weight of hammer=4.5 Kg=45N

H=Height of hammer-0.457m

N=Number of blows.

3.4.2.5 Shear Strength Test of Concrete (As Per IS: 516-1959)

Shear strength is the most extreme load required to remove an example such that the subsequent pieces or totally certain of each other. This is experienced lust before a material cracks.

Formula:

Shear Strength = (P / A) × 1000

Where, P = Failure load in kN

A = Area of shear surface.

1. EXPERIMENTAL RESULTS

4.1Tests on Super Plasticizer

4.1.1 Marsh Cone test results

Time taken in seconds are recorded for each dosage and respective W/C ratio are tabulated bellow-

Table4.1: Recorded time corresponding to the Dosage

Sl.	Dosage in %	W/C ratio	Time in sec
1	0	0.50 (By maintaining Constant W/C ratio)	37.70
2	0.25		27.50
3	0.5		25.65
4	0.75		25.50
5	1.0		24.50
6	1.25		22.56
7	1.50		22.90
8	1.75		22.90
9	2.0		22.10

Chart was made on super plasticizer Dosage in percentage in X-direction V/S Marsh Cone time in seconds in Y-direction:

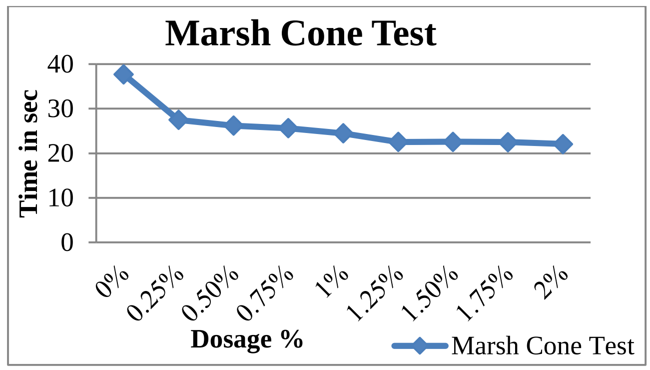

Figure 7: Marsh Cone Test graph

4.1.2 Workability test results

4.1.2.1Slump test results as per IS 1199:1959

Table4.2: Slump values of the concrete

SL	Concrete Type	W/C Ratio	Slump In mm	
			Without Fibre	With Fibre
1	Conventional M80 Grade	0.27	22	12
2	M80 concrete with 10% CCW		8	5
3	M80 concrete with 20% CCW		0	0
4	M80 concrete with 30% CCW		0	0
5	M80 concrete with 40% CCW		0	0
6	M80 concrete with 5% FS		12	5
7	M80 concrete with 10% FS		9	0
8	M80 concrete with 15% FS		0	0
9	M80 concrete with 20% FS		0	0

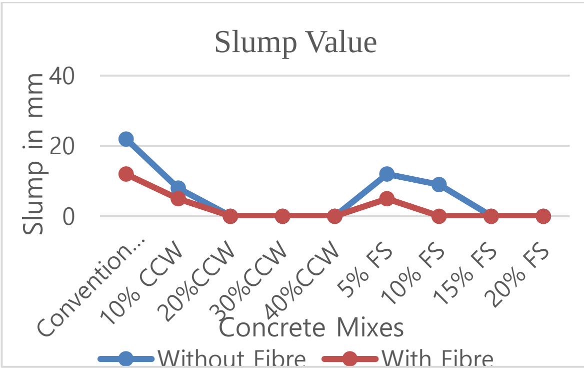

Figure 8: Graphical representation of slump test results

4.1.2.2Compaction factor test as per 1199:1959

Table4.3: Compaction factor values of the concrete

SL	Concrete Type	Compaction Factor	
		Without Fibre	With Fibre
1	Conventional M80 Grade	0.84	0.67
2	M80 concrete with 10% CCW	0.73	0.63
3	M80 concrete with 20% CCW	0.69	0.62
4	M80 concrete with 30% CCW	0.65	0.58
5	M80 concrete with 40% CCW	0.62	0.58
6	M80 concrete with 5% FS	0.81	0.65
7	M80 concrete with 10% FS	0.76	0.63
8	M80 concrete with 15% FS	0.71	0.62
9	M80 concrete with 20% FS	0.72	0.62

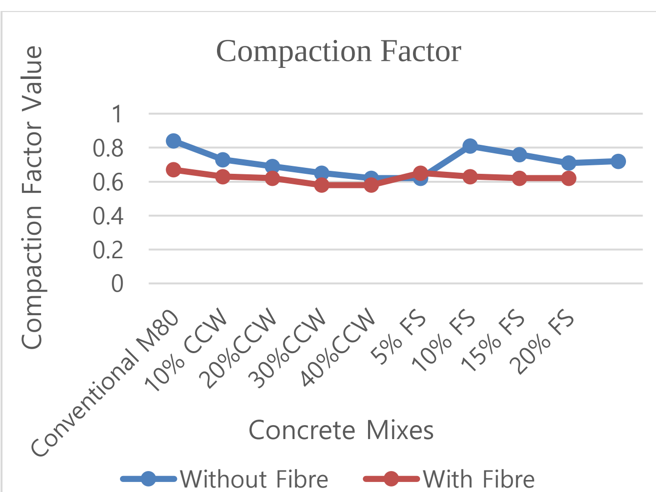

Figure 9: Compaction Factor Test results

4.1.3 Strength test results

4.1.3.1 Crushing strength test results

Table4.4: Crushed Concrete Waste for 7 Days of curing

SL	Replacement Material	Arg. Crushing Strength Mpa	
		without	**with**
1	Normal M80	61.92	64.14
2	CCW 10%	61.48	63.55
3	CCW 20%	59.70	60.59
4	CCW 30%	59.11	60.59
5	CCW 40%	56.44	60.00

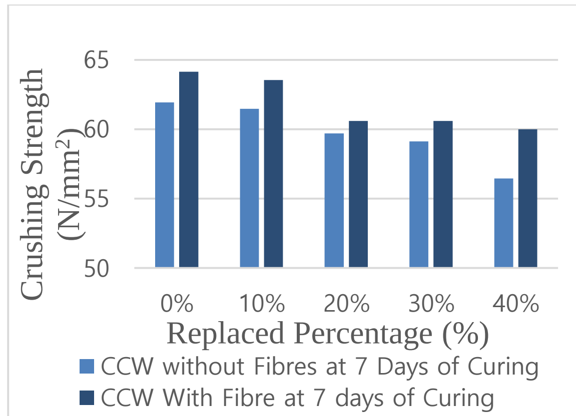

Figure 10: Graph showing crushing strength results for 7 days curing

Table4.5: Crushing strength result of Crushed Concrete Waste for 14 Days of curing

SL	Replacement Material	Arg. Crushing Strength Mpa	
		without	**with**
1	Normal M80	85.33	86.81
2	CCW 10%	84.44	86.37
3	CCW 20%	83.85	84.88
4	CCW 30%	82.81	82.37
5	CCW 40%	78.96	80.44

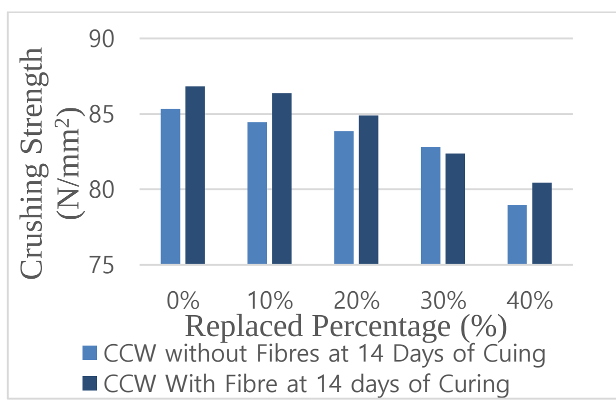

Figure 11: Graphical representation of crushing strength of CCW for 14 days curing

Table4.6: Crushing strength result of Crushed Concrete Waste for 28 Days of curing

SL	Replacement Material	Arg. Crushing S trength Mpa	
		without	**with**
1	Normal M80	96.74	101.03
2	CCW 10%	95.11	101.03
3	CCW 20%	93.92	99.40
4	CCW 30%	93.18	97.33
5	CCW 40%	92.00	92.88

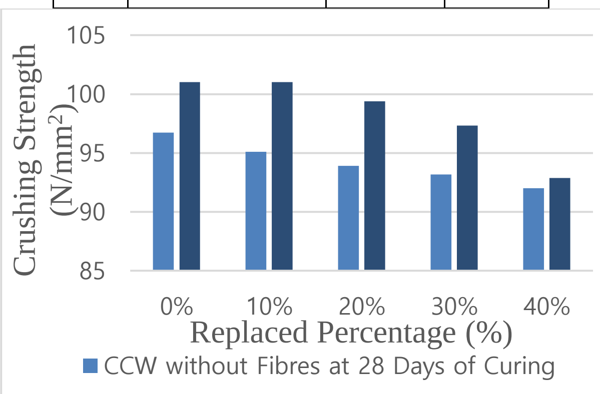

Figure 12: Graph showing crushing strength of CCW for 28 days curing

Table4.7: Crushing strength result of Foundry Sand for 7 Days of curing

SL	Replacement Material	Arg. Crushing S trength Mpa	
		without	**with**
1	Normal M80	61.92	65.33
2	FS5%	62.07	63.55
3	FS10%	64.00	65.92
4	FS15%	65.62	67.25
5	FS20%	57.18	66.66

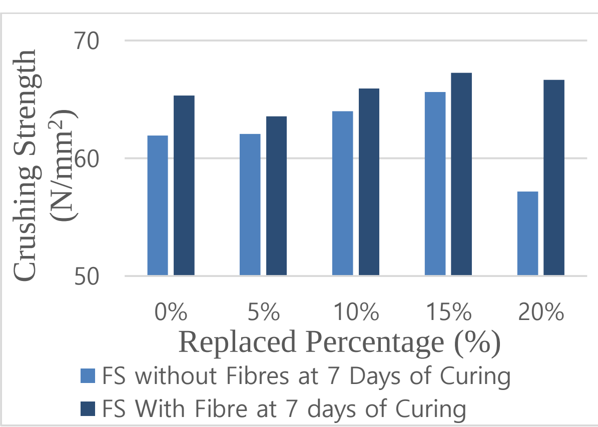

Figure 13: Graph showing Crushing strength results of FS for 7 days curing

Table4.8: Crushing strength result of Foundry Sand for 14 Days of curing

SL	Replacement Material	Arg. Crushing S trength Mpa	
		without	**with**
1	Normal M80	85.33	86.81
2	FS5%	85.03	87.25
3	FS10%	86.07	88.59
4	FS15%	87.70	91.20
5	FS20%	86.61	87.25

Table4.9: Crushing strength result of Foundry Sand for 28 Days of curing

SL	Replacement Material	Arg. Crushing S trength Mpa	
		without	**with**
1	Normal M80	96.74	101.03
2	FS5%	97.48	102.81
3	FS10%	98.07	104.59
4	FS15%	101.14	106.22
5	FS20%	89.33	95.84

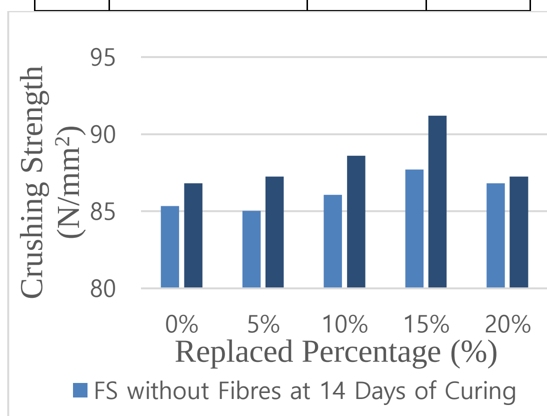

Figure 14: Graph of Crushing strength results of FS for 14 days curing

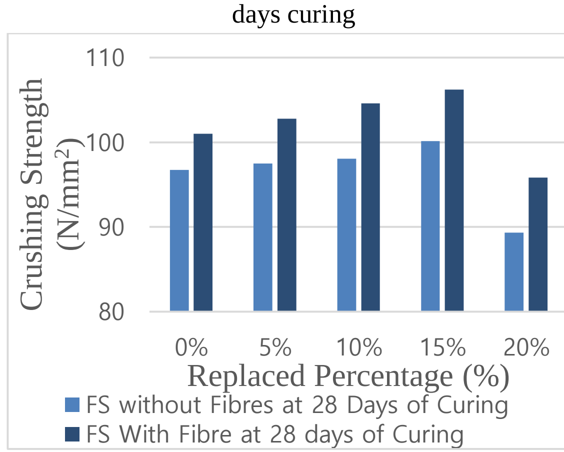

Figure15: Graph showing Crushing strength results of FS for 28 days curing

4.1.3.2 Percentage contribution of replaced aggregate in HSC

Table4.10:Percentage contribution in the crushing strength with respect to normal concrete

SL	Percentage of replacement	Total Percentage	
		Without	With
1	Normal	0	0
2	10% CCW	-1.69	0
3	20% CCW	-1.25	-1.62
4	30% CCW	-0.79	-2.08
5	40% CCW	-1.27	-4.57
6	5% FS	5.95	10.69
7	10% FS	0.60	1.73
8	15% FS	2.11	1.56
9	20% FS	-10.8	-9.78

4.1.3.3 Fibre contribution in achieving Crushing strength

Table4.11:Percentage increase or decrease in the crushing strength with fibres

SL	Percentage of replacement	Crushing strength In Mpa for 28days		Total %
		Without fibres	With fibres	
1	Normal	96.74	101.03	4.43
2	10% CCW	95.11	101.03	6.22
3	20% CCW	93.92	99.40	5.83
4	30% CCW	93.18	97.33	4.45
5	40% CCW	92.00	92.88	0.96
6	5% FS	97.48	102.81	5.47
7	10% FS	98.07	104.59	6.65
8	15% FS	100.14	106.22	6.07
9	20% FS	89.33	95.84	7.29

4.1.4 Flexural strength test results

Table4.12: Flexural Strength test results for 7 and 28 days of curing

SAMPLE	7 days in Mpa	28 days in Mpa
Conventional M80 With fibre	8.5	13.0
10% CCW With fibre	7.5	12.0
15% FS With fibre	8.0	12.5

Table4.13: Percentage increase or decrease in the Flexural strength with adding the fibres

SL	SAMPLE	28 days in Mpa	Total %
1	Conventional M80 With fibre	13.00	0
2	10% CCW With fibre	12.00	-7.70
3	15% FS With fibre	12.50	-3.85

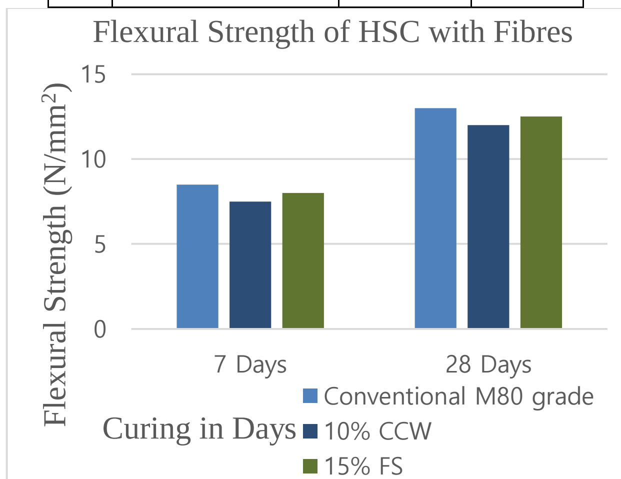

Figure 16: Graph showing of Flexural strength results

4.1.5 Split tensile strength test results

Table4.14: Split tensile Strength test results for 7 and 28 days of curing

SAMPLE	7 days in Mpa	28 days in Mpa
Conventional M80 With fibre	4.10	6.65
10% CCW With fibre	3.68	6.08
15% FS With fibre	3.54	6.50

Table4.15: Percentage increase or decrease in the split tensile strength with addition of fibres

SL	Percentage of replacement	Split tensil strength in Mpa	Total %
1	Conventional M80 With fibre	6.65	0
2	10% CCW	6.08	-8.50
3	15% FS With fibre	6.50	-2.13

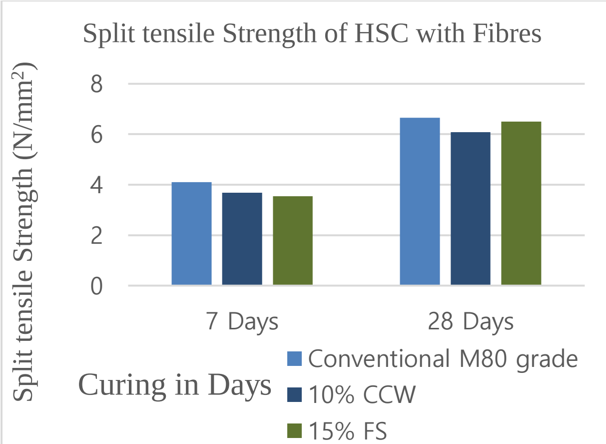

Figure 17: Graph showing Split tensile strength results

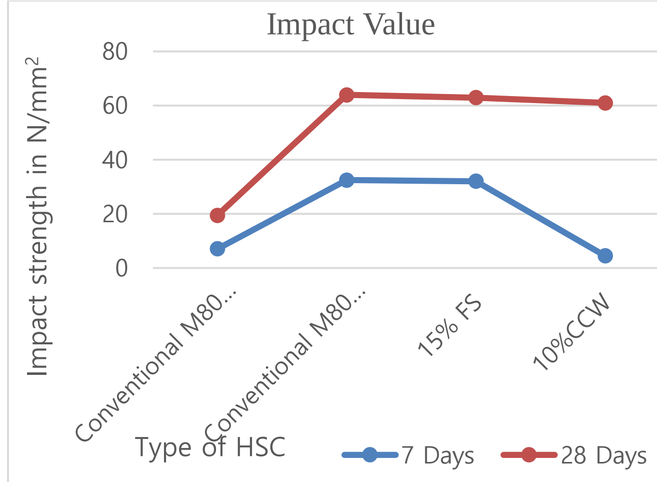

Figure 18: Graphshowing impact test values

4.1.6 Impact strength test results

Table4.16: Impact strength test results for 7 and 28 Days of Curing

Sl	Sample	Number of blows for final Crack		Impact value in kN/m²	
		7 Days	28 Days	7 Days	28 Days
1	Conventional M 80 Grade concrete (Without Fibre)	356	946	7.12	19.45
2	Normal M80 Concrete (With fibre)	1623	3107	32.46	63.89
3	15%Foundry sand	1603	3058	32.06	62.88
4	10% Crushed concrete waste	1526	2963	30.52	60.93

Table4.17: Percentage increase or decrease in the impact strength with addition of fibres

Sl	Percentage of replacement	Impact strength in Mpa 28 days	Total%
1	Conventional M80 With fibre	19.45	0
2	Conventional M80 Without fibre	63.89	229
3	15% FS With fibre	62.88	224
4	10% CCW with fibre	60.93	213.3

4.1.7Shear strength test results

Table4.18: Shear Strength test results for 7 and 28 days of curing

SAMPLE	7 days in Mpa	28 days in Mpa
Conventional M80 With fibre	27.78	51.12
10% CCW With fibre	25.56	45.56
15% FS With fibre	31.12	54.45

Table4.19: Percentage increase or decrease in the Shear strength with adding the fibres

Sl	Percentage of replacement	Shear strength Mpa for 28d	Total Percentage
1	Conventional M80 With fibre	460	0
2	10% CCW	410	-10.87
3	15% FS With fibre	490	6.52

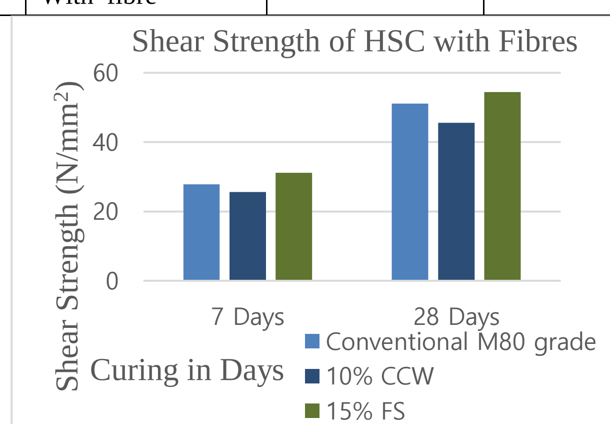

Figure 19: Graph showing Shear strength results

2. CONCLUSIONS

- • The FRHSC's workability quality reduces the slump value when replaced, and the similar effect is seen in fibered concrete. However, in this scenario, the compaction factor remained below 1 (Compaction factor 1). In this study, shear slump was found for all types of HSC.
- • For 28 days of curing, the optimal value of crushing strength of HSC compared to replaced concrete is given as follows: Crushing strength of Conventional HSC without fibre=96.74 Mpa Crushing strength of Conventional HSC with fibre=101.03 Mpa Optimum value of crushing strength of foundry sand without fibre=100.14 Mpa
- Optimum value of foundry sand crushing strength with fibre=106.22 Mpa
-
- Crushing strength of crushed concrete waste without fibre at optimum=95.11 Mpa
- Crushing strength of crushed concrete waste with fibre=101.03 Mpa optimum value
-
- The maximum replacement of foundry sand in crushing strength with and without adding fibre is 15%, and crushed concrete waste is 10%.
-
- The best replacements were chosen based on crushing strength after 280 days of curing, and the Flexural strength of the concrete was tested on those concrete mixtures.
- The flexural strength of typical concrete after 280 days of curing is 13 Mpa.
- Flexural0strength of 10% CCW achieved after 280 days of curing=12.0 Mpa
- Flexural strength of 15% foundry sand obtained after 280 days of curing= 12.5 MpaThere is a substantial increase in the Flexural strength of the HSC by providing the poly-propylene fibres of dosage about 0.3% by volume of cementitious material for both conventional and replaced concrete.

• The impact strength of HSC will be doubled when polypropylene fibre is added, as shown in the test results. The impact value of the FRHSC was found to be 229 percent higher than that of standard concrete in this study.

• The split tensile strength of the fibre reinforced HSC for 10 percent CCW and 15 percent FS was notable at 6.08 Mpa and 6.50 Mpa, respectively.

• In comparison to typical M80 grade concrete, shear strength of fibre reinforced HSC increases with 15% replacement of foundry sand and decreases with 10% replacement of CCW. Strength values for 15 percent FS and 10% CCW are 54.45 Mpa and 45.56 Mpa, respectively.

Flexural strength of 15% foundry sand obtained after 280 days of curing= 12.5 Mpa

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