Experimental Studies On Fiber Reinforced High Stregth M80-Grade Concrete

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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. This experimental Investigation is to find the mechanical properties of fibre reinforced High strength concrete by substituting foundry sand (FS) and crushed concrete waste (CCW) 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 compressive strength, flexure, tensile, 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. 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 standard curing periods, with the results tallied and explained for each day.**

Keywords*— *HSC, PPF, IRC, Mechanical strength properties.

I. INTRODUCTION

1.1. General

HSC will become an essential concrete material than the normal 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. 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.

1.3. Classification of HSC

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	Compressive strengthin 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.

1.3.2. Classification 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

Fibers can be added to concrete to improve its properties, according to IRC: SP: 46 and IS: 456. The fibres can be carbon, steel, or polymeric synthetic fibres, and they must be uniformly distributed throughout the matrix.

1.3.2.4. Aggregates

Except for grading and any other particular requirements specified in IRC: 15, aggregates for pavement concrete should comply with IS: 383.

1.3.3. Guidelines for fine aggregates:

Fine aggregates must be free from impurities and soft particles, clay, mica, organic and other foreign matter, according to the IRC44-2017 guidelines. Table-2 of IRC44-2017, 3.4.2 clause, shall be followed for fine aggregate requirements.

1.3.4. Guidelines 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 must be free of oil, salt, acid, vegetable debris, and other contaminants that could harm the concrete.

1.3.6. Requirements 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.

II. MATERIAL SELECTION

i. Cement
- OPC of 53 Grade

ii. Fine Aggregate
- River Sand
- Foundry Sand

iii. Course Aggregate
- Crushed Stone

iv. Portable Water

v. Super plasticizer

vi. Polypropylene fibers

2.1. Physical Properties

2.1.1. Cement-For this experimental investigation, OPC-53 grade ultra-tech cement 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

2.1.2. Fine aggregate

a) River Sand and Foundry Sand

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

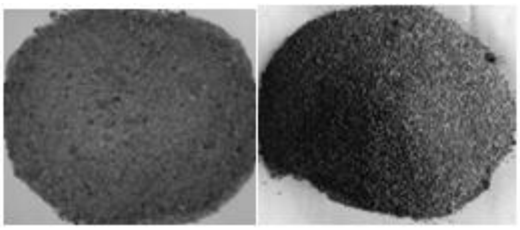

Figure 1: River Sand and Foundry Sand

Table 2.2. Properties of0Fine 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

2.1.3. Coarse aggregate

a) Natural Aggregate and CCW

All specimens are crushed granite aggregate with a specific gravity of 2.60, passing through a 20 mm screen and being maintained on a 12.5 mm sieve, as specified in IS: 383 - 1970.

The following classifications are used for the purposes of this report.

Figure2: Natural aggregate and CCW

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

2.1.4. Water

The concrete examples were cast and cured with potable water. The water used to make concrete should be free of dirt and organic matter.

2.1.5. Super Plasticizer

Super plasticizers are used to increase the workability of concrete. Poly carboxylic ether is used in this. Superplasticizers, also known as high range water reducers, are chemical additives used in applications that require well dispersed particle suspension.

2.1.5.1. Conplast Sp430 – CONPLAST SP430 shall meet BIS: 9103-1999, BS: 5075-part30, and ASTM C494 requirements.

The oppositely charged superplasticizer molecules and cement grains 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)

2.1.6. Polypropylene Fibers

Polypropylene's starting material is monomeric C3H6, a completely hydrocarbon compound. Its mode of polymerization, its high molecular weight and the way it is processed into fibres combine to give PPF very useful properties as mentioned 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^{0}C
9	Ignition Point	365^{0}C
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.

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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 - 4.75mm).
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

III. EXPERIMENTAL METHODOLOGY

3.1. Cube Casting

Cubes were constructed with a concrete mixture that did not contain discarded foundry sand as fine aggregate and CCW as coarse aggregate. With varied percentages of discarded foundry sand as fine aggregate and CCW as coarse aggregate in the HSC (Foundry sand- 10% , 20% , 30% and 40% , CCW-5 % , 10% , 15% and 20%).

3.2. Concrete Cube Curing

All test specimens were maintained at room temperature in the casting chamber after casting. After 24 hours, they were de-moulded and placed in a water-curing tank for 7, 14, and 28 days at room temperature.

3.3. Mix design:

Mix Design is a method of selecting appropriate constituent materials for the creation of concrete and determining their relative proportions as efficiently as feasible in order to achieve the desired qualities of both fresh and hardened concrete. The IRC 44-2017 mix design procedure is employed in this inquiry.

Table3.1: Material requirements and mix proportion of M80grade 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 for the fresh concrete was carried for every mix to define the workability of the concrete mix. Proper workability of concrete by maintaining the w/c ratio to get the good compressive strength. Slump values were recorded for every mix.

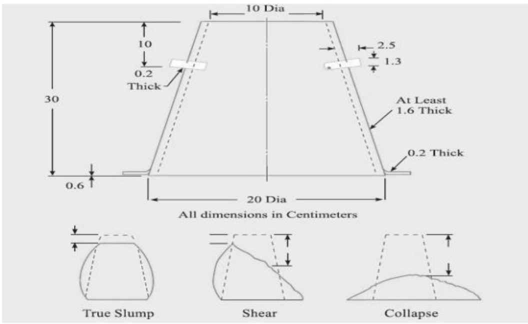

Figure 4: Slump Cone

3.4.1.2 *Compaction factor test*

Compaction factor test for fresh concrete was carried to determine the workability of concrete by determining the compaction factor of different proportion of concrete and compaction factors values are recorded for regular tests. This test is very much helpful for the concrete having very low workability.

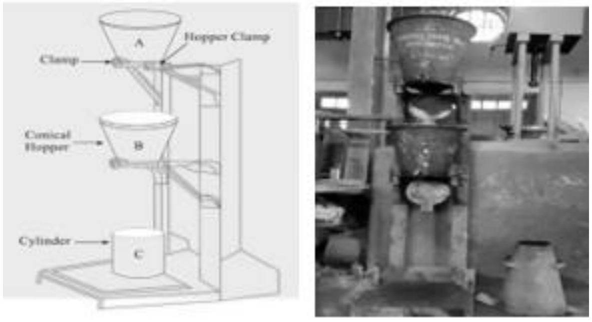

Figure5: Compaction factor testing equipment

3.4.2 Test for hardened concrete

3.4.2.1 Compressive strength

A compressive strength test determines how much compression load the specific dimension of the concrete cube can handle. A compression test setup can be used to cure and test the cube, which can be made to a standard size of 150mmx150mmx150mm. The compressive strength of the cube can be calculated using the compression load applied to the area of the specimen for various curing durations. P/A= Compressive strength, Where P be the failure loads, A is the specimen's surface area.

3.4.2.2 Split Tensile Strength

Samples of desired mix grade concrete was prepared for required mould dimension and once the concrete gets hardened for certain curing periods, the tensile taking capacity of the concrete mix can be determined by conducting split tensile strength. Cylindrical cube of 150mm diameter and 300mm length test specimen was prepared for this test.

The mould was properly positioned on the flat form, and the load after crushing was measured and used to calculate the concrete's split tensile strength. The formula was created using IS: 05816-1970 standards.

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

Where P = Crushing load on the cylinder

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

3.4.2.3 Flexural strength test

A flexural strength test can be performed using one or two point loads without supports. The 100mmx100mmx500mm mould was prepared and cured for the proper curing times. This test can be used to determine the concrete's toughness properties as well as analyse its flexural behaviour in post-cracking stages. The formula below can be used to calculate flexural strength.

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= (Wight of hammer * height * n) in N-m

Where, W= Weight of hammer

H=Height of hammer, N=Number of blows.

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

Shear strength test is carried to test the shear taking capacity of the mix by preparing the specimen in the shape of 'L' and the suitable arrangement was made in compressive strength testing machine to test the shear strength of the concrete.

Formula:

Shear Strength = (Load / Area) × 1000

Where, P = Failure load in kN, A = Area of shear surface.

IV. EXPERIMENTAL RESULTS

4.1. Tests on Super Plasticizer

4.1.1 Marsh Cone test results

Time taken in seconds are recorded for each dosage andrespective 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:

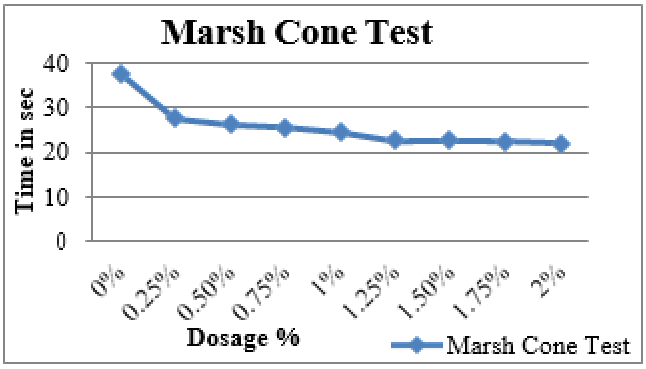

Figure 7: Marsh Cone Test graph

4.1.2 Workability test results

4.1.2.1. Slump 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
	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

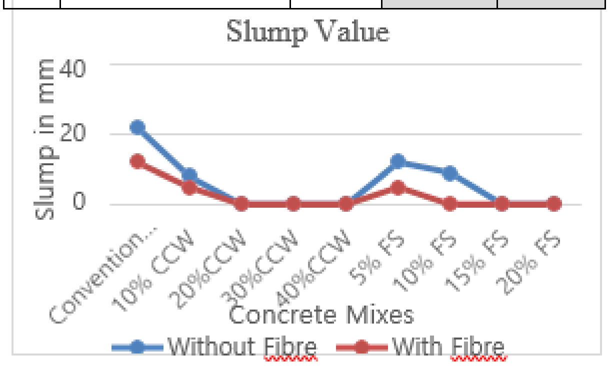

Figure 8: Graphical representation of slump test results

4.1.2.2. Compaction 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

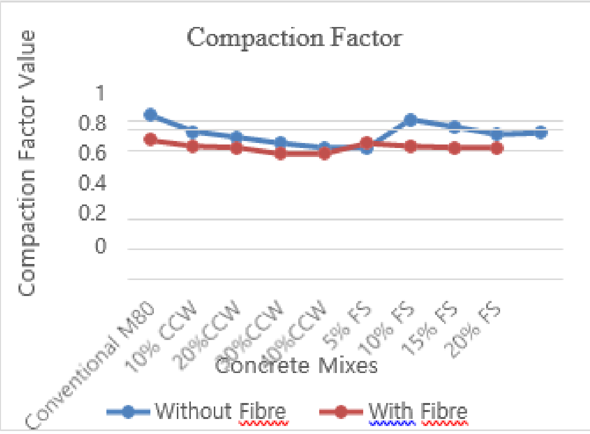

Figure 9: Compaction Factor Test results

4.1.3 Trength Test Results

4.1.3.1. Compressive strength test results

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

SL	Replacement Material	Arg. Compressive 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

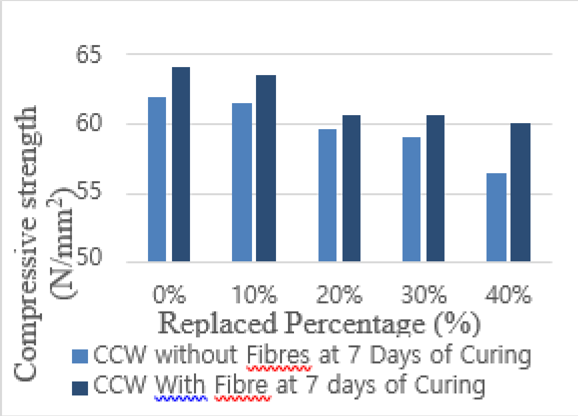

Figure 10: Graph showing compressive strength results for7 days curing

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

SL	Replacement Material	Arg. Compressive 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

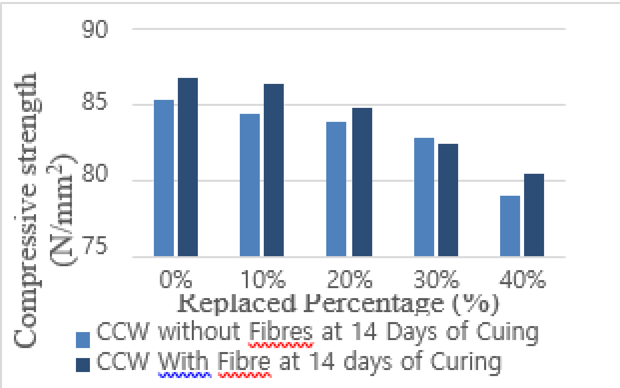

Figure 11: Graphical representation of compressive strengthof CCW for 14 days curing

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

SL	Replacement Material	Arg. Compressive strength 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

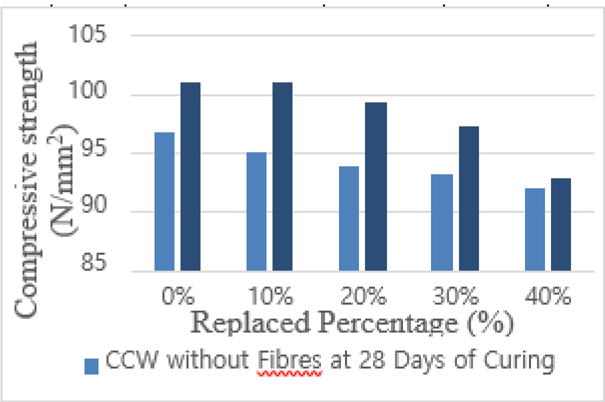

Figure 12: Graph showing compressive strength of CCW for 28 days curing

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

SL	Replacement Material	Arg. Compressive strength 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

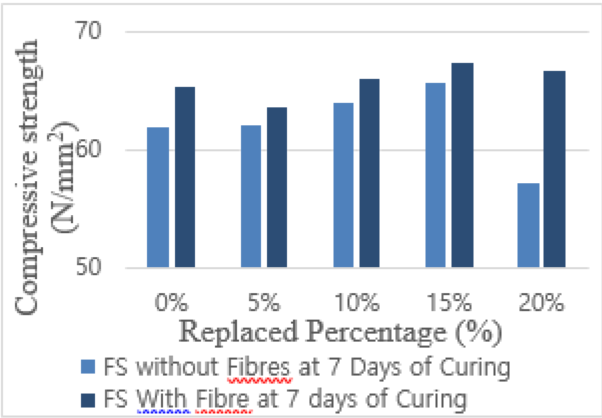

Figure 13: Graph showing Compressive strength results of FS for 7 days curing

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

SL	Replacement Material	Arg. Compressive strength 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: Compressive strength result of Foundry Sand for 28 Days of curing

SL	Replacement Material	Arg. Compressive strength 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

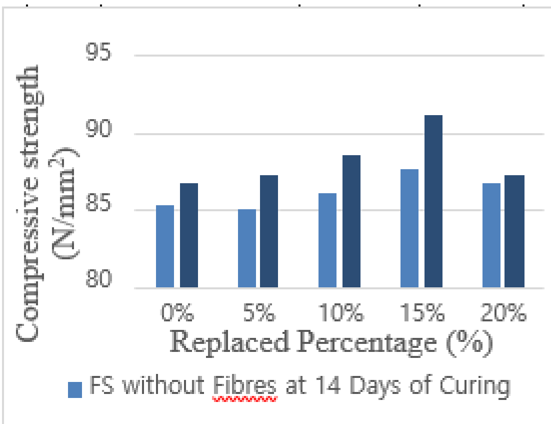

Figure 14: Graph of Compressive strength results of FS for 14 days curing

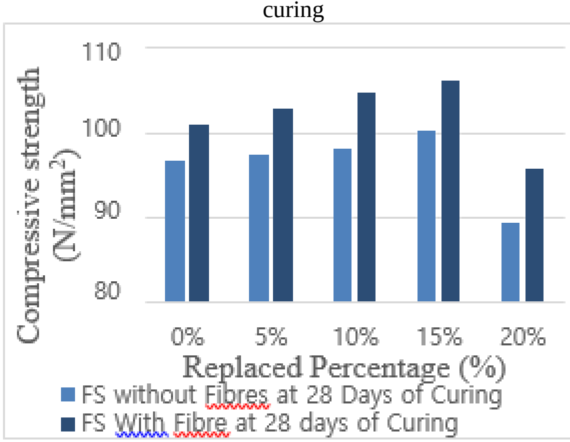

Figure15: Graph showing Compressive strength results of FS for 28 days curing

4.1.3.2. Percentage contribution of replaced aggregate in HSC

Table4.10:Percentage contribution in the compressivestrength 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 Compressive strength

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

SL	Percentage of replacement	Compressive 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 daysof 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

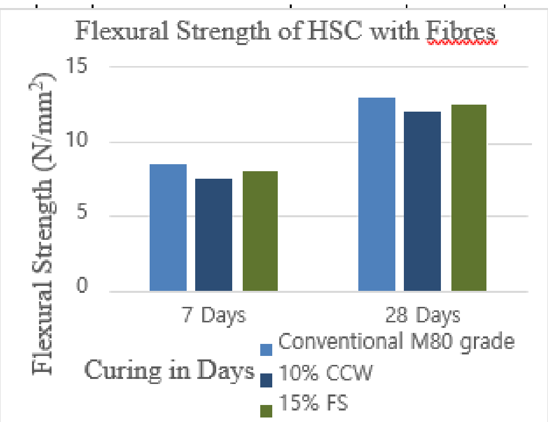

Figure 16: Graph showing of Flexural strength results

4.1.5 Split tensile strength test results

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

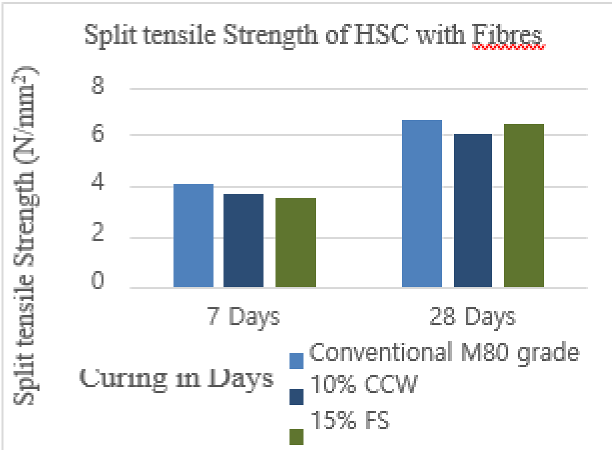

Figure 17: Graph showing Split tensile strength results

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 Fi bre)	356	946	7.12	19.45
2	Normal M80 C oncrete (With fi bre)	1623	3107	32.46	63.89
3	15%Foundry sa nd	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 impactstrength 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 fib re	60.93	213.3

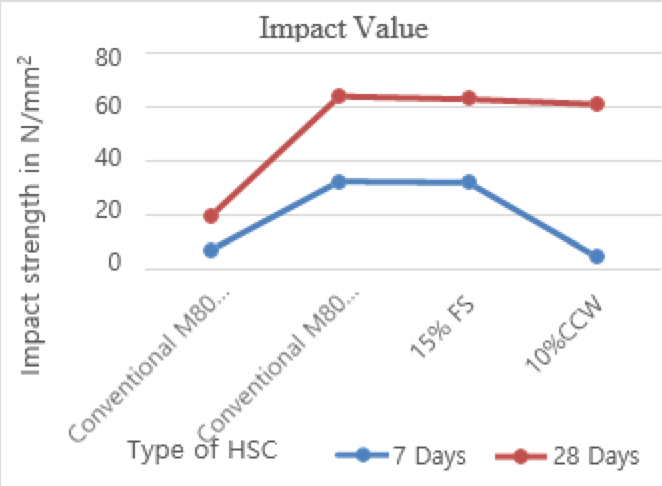

Figure 18: Graphshowing impact test values

4.1.7 Shear 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

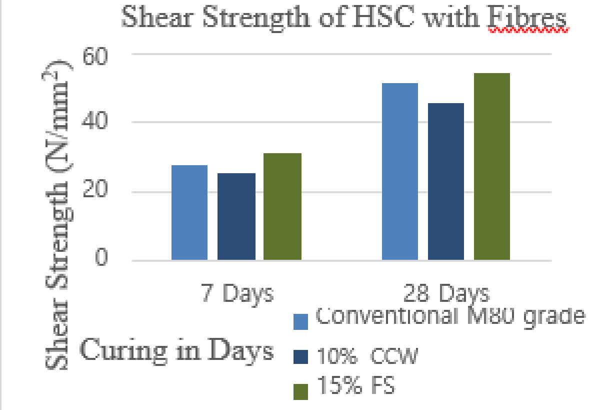

Figure 19: Graph showing Shear strength results

V. 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 compressive strength of HSC compared to replaced concrete is given as follows: Compressive strength of Conventional HSC without fibre=96.74 Mpa Compressive strength of Conventional HSC with fibre=101.03 Mpa Optimum value of compressive strength of foundry sand without fibre=100.14 Mpa
- Optimum value of foundry sand compressive strength with fibre=106.22 Mpa
- Compressive strength of crushed concrete waste without fibre at optimum=95.11 Mpa
- Compressive strength of crushed concrete waste with fibre=101.03 Mpa optimum value
- The maximum replacement of foundry sand in compressive strength with and without adding fibre is 15%, and crushed concrete waste is 10%.
- The best replacements were chosen based on compressive 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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