The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 1145 - 1157

Performance Evaluation of Hybrid Fibre Reinforced High Volume Fly Ash based Self Compacting Concrete

Yashawant Prabhakar Pawar[1], **Dr. Chetan P. Pise**[2],
[1]Assistant Professor, [2]Professor and Dean (Industry and Institute Interaction),
[1,2]SKN Sinhgad College of Engineering, Pandharpur, MS, India.
yashawant.pawar@sknscoe.ac.in [1], chetan.pise@sknscoe.ac.in [2]

Abstract- Self-compacting concrete has become increasingly popular lately for usage in crowded concrete-reinforced buildings having challenging casting circumstances. New cement needs to have high fluidity and strong cohesion for these applications. The necessary concrete characteristics can be ensured through the use of fine elements like fly ash. The preliminary findings of a trial to produce and assess SCC created using large amounts of Fly ash is given and discussed. During this investigation, few SCC combinations and a control concrete is examined. The water/cementitious material ratio is ranges from 0.35 while cementitious material amount remained constant (300 kg/m^3). Its self-compacting mixes replaced 25%,35%,37.5%,40%, and 50%, of the cement with fly ash. All mixes were put through tests to determine their viscosity and stability as fresh concrete. Additionally, the compressive strength, Flow Ability Test, Flexural strength and Split Tensile Strength of cured concretes were measured. For the purpose of testing the flow characteristics and mechanical properties of Hybrid Propylene Steel Fibre Self-Compacting Concrete (HPSscc), Steel Fibre in combination with Poly Propylene PP Fibre (Hybrid Fibre) are used to regulate SCC at concentrations of 0.25+0.15%, 0.50+0.30%, 0.75+0.45%, 1.0% + 0.60%, and 1.25+0.75%.The ideal quantity of hybrid fibre is established. The 28-day compressive strengths of the SCCs ranged from 35 to 54 MPa. It is important to research the effects of adding steel fibres to control SCC of various types, aspect ratios, and volume fractions. Concrete can benefit from having its tensile strength increased by using synthetic fibres like polypropylene PP. It is important to achieve the ideal quantity of PP fibres to be added for a specific characteristic of the mix's constituents. Hybrid fibre is used in concrete when more than one fibre is included. The performance of concrete can be improved by using the characteristics of one type of fibre with another type of fibre. Also Flow Ability Test carried out immediately after producing concrete earlier and Split Tensile Strength tests are conducted. The outcomes demonstrate that a cost-effective SCC might be successfully constructed by adding significant amounts(35%) of fly ash.

Keywords- Fly Ash; Self Compacting Concrete(SCC), Hybrid fibre; Compressive Strength; Flow Ability Test; Split Tensile Strength;

1. Introduction-

It is a new kind of concrete which can be placed and compacted without vibration. Despite the case of crowded reinforcement, it can flow on it's own weight, fully completing form work & attaining full compaction. All toughened concrete offers the identical endurance & engineering qualities as conventional vibrated asphalt & is dense & uniform. The "Specification & Guidelines for Self-Compacting concrete" that EFNARC produced in 2002 gave producers and users up-to-date knowledge at the time. However, European design, product, and construction guidelines have yet to clearly mention SCC[1]. In sites uses, it has restricted SCC's wider acceptability, notably by designers and buyers. Since that time a great deal of technical material on SCC has been published[2]. In order to examine current best practises and generate an update covering all facets of SCC, European organizations committed to the advancement of modern materials & systems for supply &use of concrete—formed the "European Project Group" in 1994[3]. The purpose of this pamphlet, titled "The European Guidelines for Self Compacting Concrete," was to address difficulties specifically connected to the lack of European specifications, norms, and accepted test procedures[4,5].

The need for substitute construction materials has grown as a result of the world's fast urbanisation and the rising demand on naturally occurring building materials. The serious lack of materials might be alleviated by recycling materials[6]. In partially substituting recycled coarse aggregate (RCA) made from demolition and building debris for coarse aggregate (CA), significant progress has been made in the field of SCC[7]. Numerous studies in this field have demonstrated the necessity of chemical additives in producing desirable SCC fresher state features[8].

Concrete that can be laid as compacted under the weight of itself with little to no vibration effort is known as SCC, and it is also cohesive enough to allow for managed with segregation or bleeding. This is utilised to facilitate and ensure effective filling of confined regions and extensively reinforced structural components, as well as optimum structural performance[9].

SCC was created in Japan [1] around 1980s with a focus on seismic zones and heavily packed reinforced structures. It has recently become widely used in a variety of applications & structural layouts throughout several nations. SCC can also improve workplace conditions by reducing vibration noise. Utilising SCC has a lot of benefits, especially if material costs are kept to a minimum[10-12].

- Reducing labour costs and building time;
- Doing away with the requirement for vibration;
- Improving the filling capacity of extremely crowded structural members;
- Reducing noise pollution;
- Making construction easier and ensuring optimum structural performance.

This concrete needs high slump, which is easily attained by adding superplasticizer to the concrete mix. Nevertheless, extra consideration must be given to mix proportioning if such concrete is to remain cohesive during handling activities. A straightforward solution is to increase quantity of sand by 4% to 5% at the expense of the coarse aggregate content in order to prevent segregation upon superplasticizer addition [2], [3]. However, the decrease in aggregate composition necessitates the use of a large amount of cement, which raises temperatures and increases costs. Incorporating a viscosity-modifying admixture to improve stability is an alternative strategy[13]. However, using chemical admixtures might raise the price of the raw materials because they are expensive. The inclusion of mineral additives like fly ash, blast furnace slag, or limestone filler could raise the settling rate of concrete mix without raising its cost. However, labour savings may be sufficient to balance the extra expense[14].

2. Literature Survey-

SCC, according to Abbas, is high-performance concrete which can flow on itself, fill the mould entirely with segregation and bleeding, and consolidate naturally despite any needs for vibration. Several mixes were created with water-powder proportion of 0.35 to this purpose: control mix, SCC with VMA only, and SCC with VMA plus glass fibres. According to studies, the new characteristics of SCC were lowered following the inclusion of fibres yet these characteristics were still within the permitted range. After the fibres were added, the harder attributes improved.

According to Khaled, experimental research was done to choose the best fibre contents. In this investigation, three different types of volume fraction from hooked form steel fibres were used. The portions of volume for the hooked steel fibres ranged from 0.0% to 1.5%. The geometry for the beam is selected to apply the necessary forces in test zone, such as concurrent torsion & bending moments. 7 beams all total, divided into three distinct categories were tested.

According to Saint Petersburg, self-compacting concrete is a cutting-edge technology that is actively used in the building industry around the globe. In this study, we investigate the impact of polypropylene and glass fibre individually and in combination on mechanical and rheological characteristics of SCC. To be able to do this, 10 instances have been created, including those that comprise (A) combined polypropylene and glass fibre & (B) polypropylene fibre with volume fractions of 0.1, 0.2, and 0.3. These studies' findings indicate that adding glass fibre to polypropylene can improve tensile and bending strengths. Additionally, the resilience of concrete is greatly increased by these additions.

SCC, as suggested by AL Madhoun, compacts itself entirely on account of its own weight and fills the formwork almost entirely. In steel fibre SCC, the steel fibres had an impact on the material's compressive as well as tensile strength. It was an ideal steel fibre content, that ranged between 0.75 and 1 percent, where the material performed best in terms of both of the aforementioned characteristics. At both curing ages, all fibre mixtures showed higher splitting tensile strength & flexural strength over plain mix. Equally the fibre content rose, the strengths rose as well. The fibres marginally decreased the U.P.V and behaved similarly to how SCC's compressive strength did.

As Satheskumar K noted, reducing expenses for construction is one of the primary goals of every building project. Many nations are attempting to cut costs overall, which is prompting the construction industry to come up with innovative strategies to do so. The current work examines the workability and strength of grade M30 GGBS plus superplasticizer SCC reinforced in steel & basalt fibre. By conducting the mix layout and subsequently fine-tuning with the help of EFNARC recommendations, the mix proportions for SCC were established. The powder component should be combined with 30% of GGBS & 70% of cement. It was maintained across all of the mixes. Additionally, data on hardened concrete's compressive strength, split tensile strength, & flexural strength should be collected.

As Abbas AL-Ameeri[15], said its own weight, self-compacting concrete (SCC) compacts itself by itself and fills the formwork almost entirely. In steel fibre self-compacting concrete, the steel fibres had an impact on the material's compressive and tensile strength, elastic modulus, and ultrasonic pulse velocity. There was an ideal steel fibre content, which was between 0.75 and 1 percent, at which the material performed best in terms of both of the aforementioned characteristics. At all curing ages, all fibre mixtures showed higher splitting tensile strength and flexural strength than plain mix. As the fibre content rose, the strengths rose as well. The U.P.V followed the same behaviour as the compressive strength of SCC as the fibres somewhat decreased it[15].

3. Experimental Investigation

To characterise the behaviours of FRSCC, it is crucial to consider a number of fresh and hardened state properties. It is well-known that fibres typically have a negative effect on the workability of SCC. The kind, geometry, volumetric ratio, and dispersion of the fibres in the concrete all affect how much of an impact they have. The impact that fibres' existence has on a material's mechanical characteristics is also significant. The results of several experiments also indicate that fibres can increase the SCC's endurance. The effects of various fibres on the microstructure of SCC are detailed in Table 1.

Table 1: compares the performance of SCC with and without the addition of fibres.

Property	**FRSSC Mix**		
	SFRSCC	**SyFRSCC**	**HyFRSCC**
Compressive Strength	By delaying the spread of macro fractures, steel fibres enable concrete to reach higher peak stresses.	Synthetic fibres aid in preventing the development of microcracks, minimising stiffness loss, and facilitating greater load transmission.	Combining the two fibres results in concrete that is resistant to both macro and micro fractures.
Flexural Strength	Steel fibres are manufactured in a variety of forms and have varying capacities for adhering to concrete. The increased tensile strength of fibres helps them resist heavier loads from adjacent concrete under higher tensile stress.	Because synthetic fibres have a low unit weight and are flexible, they can be distributed uniformly to create a variety of flexural stress-resisting planes.	Both fibres being present in the matrix will enable proper fibre orientation and strong bonding. HyFRSCC therefore provides the greatest boost to flexural strength.
Modulus of Elasticity	Steel fibres' arrangement allows for larger strain to be achieved because of their large elasticity modulus. Steel fibres can assist the element in withstanding more deformation at maximum stresses when used at the recommended dosage.	For cement beams, synthetic fibres can increase deflection resistant by upto 90%; evidence also points to a favourable relationship between the proportion of fibres & deflection resistance in both shorter and longer beams.	Due to the better cracking process and load distribution provided by HyFRSCC mixes, which disperse the stress over the component to achieve larger stresses, its modulus of elasticity has increased.
Crack Control	Because of their high dispersion, synthetic fibres aid in preventing the development of microcracks inside a crosssection.	Steel fibres greatly improve their tensile resistance, which results in improved crack dispersion. They slow the spread of macrocracks if they are distributed and positioned properly in matrix.	Micro и macro cracks can be restrained when both fibres are present in a hybrid composite system, which can improve cracking control. There is an observed rise in post-cracking load resistance.

Following are the parameters of selection in SCC -

a. ***Target Strength For Mix Proportioning –***

$$fck = f\,ck + 1.65\,S$$

$$fck = f\,ck + X \qquad \text{whichever is higher}$$

Where, Fck- target average compressive strength at 28 days, S = standard deviation, and X = factor based on grade of concrete

b. ***Approximate Air Content-***

For aggregates with a maximum allowable size of 20mm, quantity of trapped air in typical (non-air-entrained) concrete is around 1%.

c. ***Selection of Water-Cement Ratio***

For the OPC 53 grade curve, the free water-cement ratio needed to achieve the target strength of 58.25N/mm^2 is 0.35. This is less than the maximum value of 0.60 that IS 456, specifies for "Mild" exposure for plain cement concrete.   0.35 to 0.60, so OK

d. ***Based on the normal ranges for the mix's elements, initial mix must first be estimated.***

According to the information for the mix determining in Table 2, the properties exhibited by fresh concrete, include flowability, passing ability, segregation resistance, and viscosity.The original mixture needs to pass tests for a number of features (materials smaller than 0.125 mm make up 8%, according to sieve analysis). According to IS 1199 (Part 6), changes to the original mix must be performed until desired characteristics are obtained. When using the concrete mix at the project site, it might be essential to make changes to the various mix design parameters that are provided in this example. For this study, cement paste with a water-to-cement ratio of (w/c = 0.35) is used. The ideal time is found by adding HWRA to cement paste to a proportion of cement weight. The following results is tabulated:

Table 2: Time vs. % HWRA weight

5208NS PCE based	**%**	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6
	Time (Sec)	23	20.5	18.5	17	16.5	16	16	16

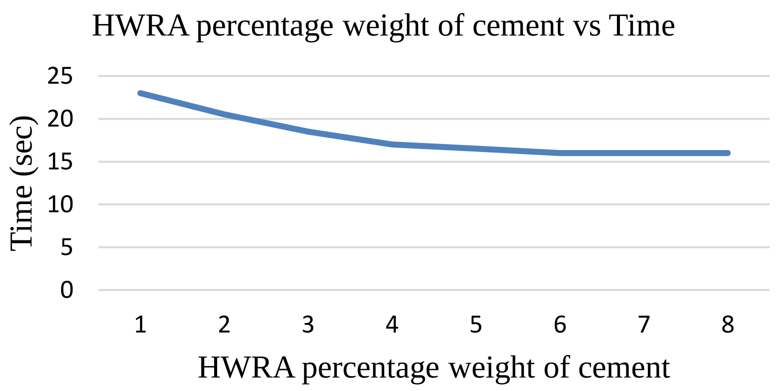


Figure 1: HWRA percentage weight of cement vs Time

The ideal HWRA dosage for experimental work is 1.2% of the cement's overall weight. The ideal amount of time is 16 seconds, and adding more HWRA doesn't reduce that amount of time until March. Cone Using a cementitious material with an admixture dose of 1.2%, the mass of the admixture is equal to (1.2/100)X542, or 5.97kg/m3, and the viscosity modifying agent is equal to (0.1/100)X542, or 54 kg/m3.

The steps that must be taken in order to proportion SCC using the suggested method are listed below.

1. Water requirement for concrete(Maximum size of aggregate 12.5mm)
2. Take Weight of water and W/C ratio
3. Weight of cement $= \frac{\mathrm{Ww}}{\mathrm{W/C}}$
4. Weight of Fly ash
5. The dry volume o gravel (VG) is select
6. Calculate the dry volume of gravel (WGD) by multiplying (VG) by the dry–rodded unit weight of gravel.
7. Calculate the saturated surface dry (SSD) weight of the gravel:
8. Determine V_W/Wc+V_L
9. Calculate fine aggregate content by absolute volume method.
10. Mix proportions for ACI method

In this present work, we had used Composite design methods of –

a. Method of Gazi et al. which is combination of EFNARC guide lines for producing SCC and modified ACI method of mix design for normal concrete.

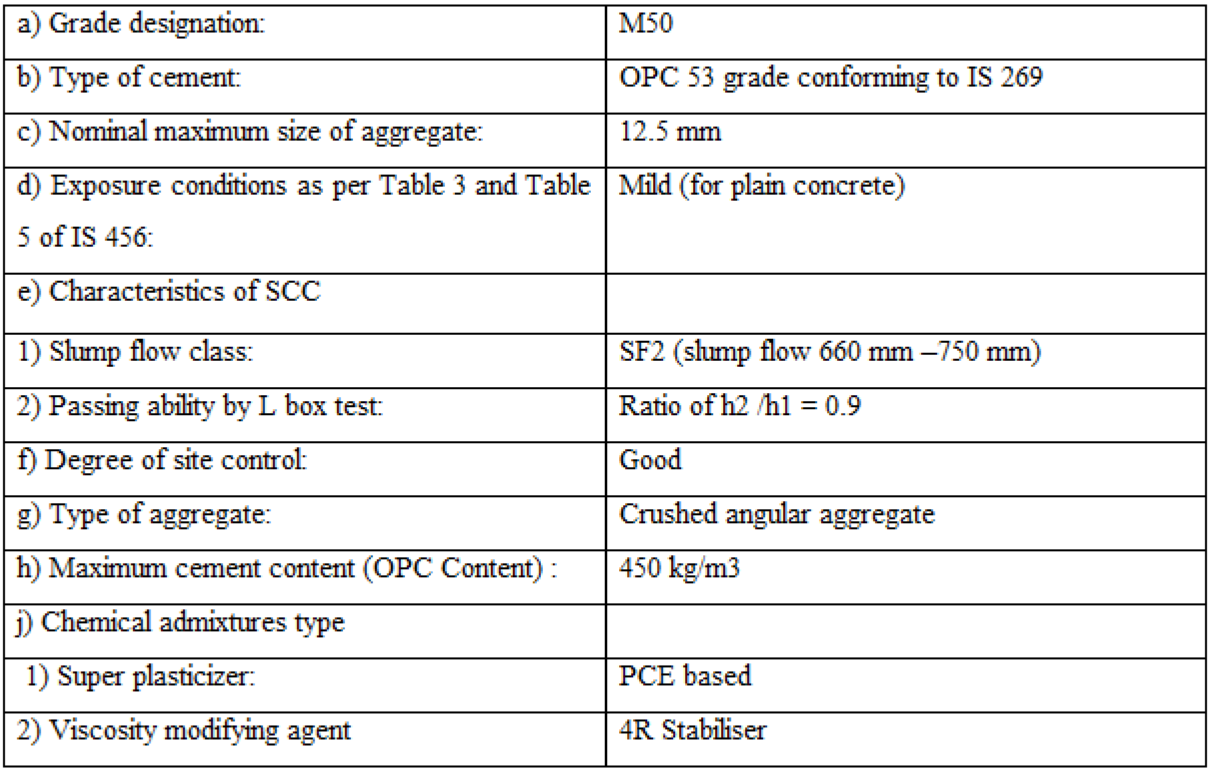
b. ISO10262:2019- Mix design method for producing SCC. This method is based on Target Compressive Strength which reduces number of trial mixes.

For the purpose of testing the flow characteristics and mechanical properties of Hybrid Propylene Steel Fibre Self-Compacting Concrete (HPSscc), Steel Fibre in combination with Poly Propylene PP Fibre (Hybrid Fibre) are used to regulate SCC at concentrations of 0.25+0.15%, 0.50+0.30%, 0.75+0.45%, 1.0% + 0.60%, and 1.25+0.75%.The ideal quantity of hybrid fibre is established.

We had done experimentation for M50, W/C ratio selected =0.35. Also OPC 53 grade cement is replaced by fly Ash by percentage weight. Cement is replaced by Class F fly ash with the percentage as represented in table 5 below. IS 10262:2019 mix design method used to evaluate properties of SCC. Experimental set up is done for the purpose of obtaining flow characteristics of SCC in fresh state. Ingredients of mix are calculated. Mechanical properties of SCC are determined in fresh state & in hardened state. Filling ability, passing ability of SCC is determined.

In the step for preparing concrete mix we use the following material specification as shown in table 3.

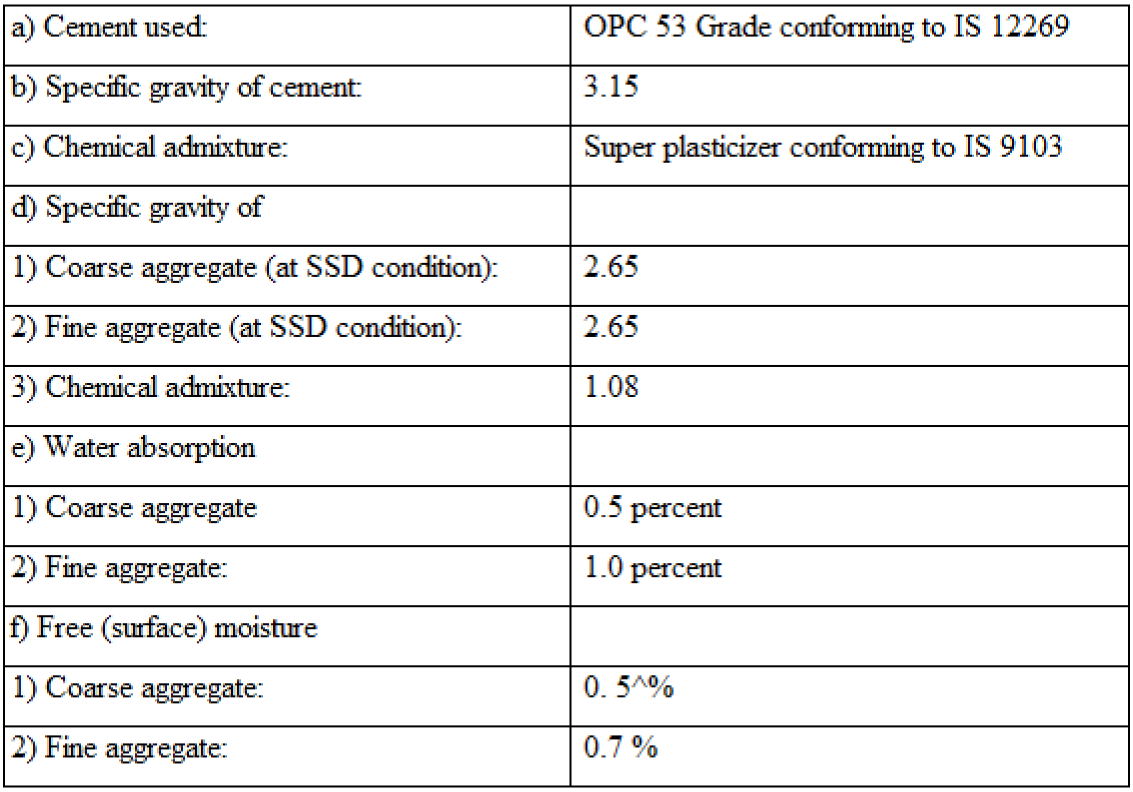
Table 3- Material specification for Mix



a) Grade designation:	M50
b) Type of cement:	OPC 53 grade conforming to IS 269
c) Nominal maximum size of aggregate:	12.5 mm
d) Exposure conditions as per Table 3 and Table 5 of IS 456:	Mild (for plain concrete)
e) Characteristics of SCC	
1) Slump flow class:	SF2 (slump flow 660 mm –750 mm)
2) Passing ability by L box test:	Ratio of h2 /h1 = 0.9
f) Degree of site control:	Good
g) Type of aggregate:	Crushed angular aggregate
h) Maximum cement content (OPC Content) :	450 kg/m3
j) Chemical admixtures type	
1) Super plasticizer:	PCE based
2) Viscosity modifying agent	4R Stabiliser

Test data for materials used is represented in table 4 below.

Table 4- Test data for materials



a) Cement used:	OPC 53 Grade conforming to IS 12269
b) Specific gravity of cement:	3.15
c) Chemical admixture:	Super plasticizer conforming to IS 9103
d) Specific gravity of	
1) Coarse aggregate (at SSD condition):	2.65
2) Fine aggregate (at SSD condition):	2.65
3) Chemical admixture:	1.08
e) Water absorption	
1) Coarse aggregate	0.5 percent
2) Fine aggregate:	1.0 percent
f) Free (surface) moisture	
1) Coarse aggregate:	0. 5^%
2) Fine aggregate:	0.7 %

4. Results And Discussion-

Fly ash (%) is used in place of cement, and the *Compressive* strengths of the concrete are calculated. Table 5 shows the effect of Fly Ash addition instead of cement on compressive strength. Here we add fly as 25, 35, 37.5, 40 and 50%.

Table5: Effect of addition of Fly Ash in Compressive Strength

Mixing Properties	**Fly Ash (%) Mixing**				
	25%	**35%**	**37.5%**	**40%**	**50%**
Cement in kg/m^3	407.14	352.85	339.281	325.71	271.425
Fly Ash in kg/m^3	135.71	190	203.568	217.146	271.425
Water(Net Mixing) in kg/m^3	190	190	190	190	190
Fine aggregate(SSD) in kg/m^3	801.25	801.25	801.25	801.25	801.25
Coarse aggregate(SSD) in kg/m^3	780	828.712	755	752.5	732.5
Chemical admixture in kg/m^3	3.794	3.794	3.794	3.794	3.794
Free water-cement ratio	0.35	0.35	0.35	0.35	0.35
Powder content in kg/m^3	568	568	568	568	568
Compressive strength in N/mm^2	**53.66**	**52.25**	**50.08**	**46.91**	**36.66**

The slump flow test is carried out for the control's SCC with the intention of determining filling capacity. Hooked end steel fibre with an aspect ratio of l/d = 60 is introduced to control SCC to study its mechanical properties. These fibres are added to SCC in percentage volume fractions of 0.25%, 0.50%, 0.75%, 1.0%, and 1.25%. As steel fibre is added, the slump flow increases, and the time T500 increases, according to the slump flow test. Table 6 and figure 2 below shows Flow ability test and compressive strength for steel Fiber reinforced SCC. Steel fibre insertion increases compressive strength over control SCC by a marginal 0.5%. With the addition of 0.75% of steel fibre, it increased by around 20.11% greater than the control SCC. When 1.0% and 1.25% of steel fibre were added, the rate of growth fell by 11.92% and 8.58%, respectively, compared to the control SCC. 28 Days Compressive Strength of SFscc for Determination of Mechanical Properties of Steel Fibre Reinforced SCC in Hardened State. Table 6 and figure 2 shows the Compressive strength for steel fibre

Table 6 Flow Ability Test and compressive strength Results for Steel Fibre Reinforced SCC

Steel fiber	T_{500} Sec	%	28 days compressive strength
CScc	3	Control	53.1
SFscc1	4.6	0.25	54.77
SFscc2	4.97	0.5	55.91
SFscc3	5.66	0.75	63.78
SFscc4	7.5	1	59.43
SFscc5	7.8	1.25	57.66

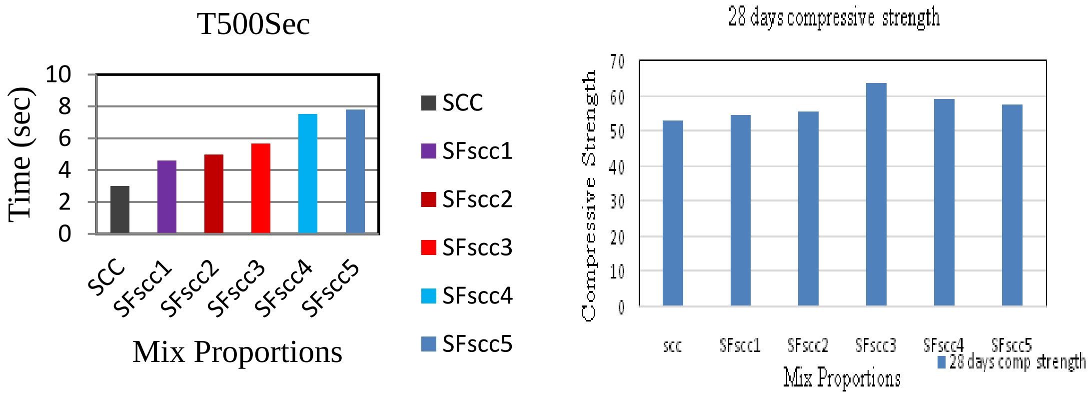


Figure 2- Flow Ability Test and compressive strength Results for Steel Fibre Reinforced SCC

.

The inclusion of steel fibre increases compressive strength over control SCC by a marginal amount of up to 0.5%. For a 0.75 percent addition of steel fibre, it climbed by roughly 20.11% more than the control SCC. According to table 7and Figure 3, the rate of growth decreased by 11.92% & 8.58% compared to the control SCC with the addition of 1.0% & 1.25% steel fibre, respectively.

To control SCC, virgin polypropylene mesh fibre that has been fibrillated and is graded in length is added. These fibres are added as a percentage of volume. These fibres are added to Control SCC at a rate of 0.15%, 0.30%, 0.45%, 0.60%, and 0.75%.The ideal number of PP fibres is established. Investigated are the mechanical characteristics of polypropylene fibre reinforced self-compacting concrete (PFscc). an ability of freshly prepared SCC to flow under its own weight and completely fill the form work. In the absence of impediments, the flowability and flow rate of SCC are measured using the T500 time. Table 5 and figure 3 below shows Flow ability and compressive strength test for poly propylene fiber reinforced SCC.

Table 7: Flow Ability Test and compressive strength Results for polypropylene fiber Reinforced SCC

Mix Polypropylene fiber	T_{500} Sec	%	28 days comp strength
Scc	3	Control	53.1
PFscc1	3.1	0.15	53.79
PFscc2	3.7	0.3	54.87
Pfscc3	3.9	0.45	53.2

PFscc4	4.2	0.6	52.18
PFscc5	7.5	0.75	51.4

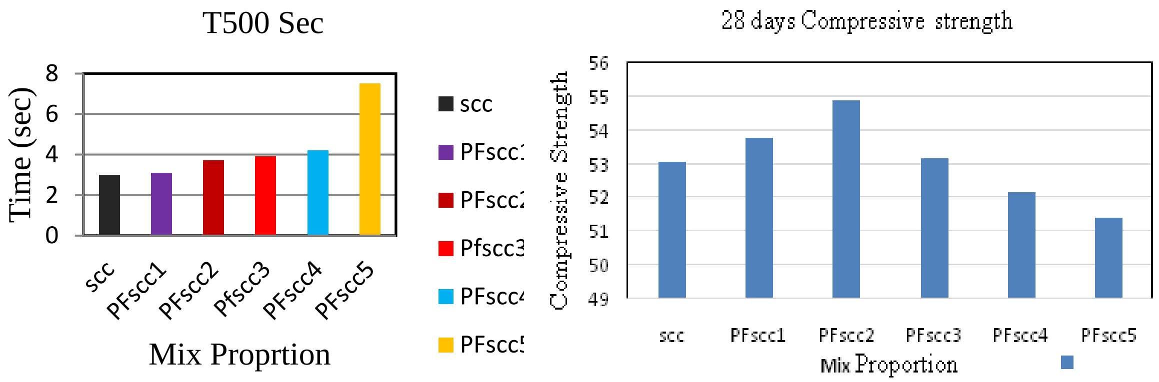


Figure 3: Flow Ability/Filling Ability and compressive strength of different mix proportions

The Compressive strength of PFscc for 28 days to is utilized to determine of the mechanical characteristics of PFscc (Polypropylene Fibre Reinforced SCC). It has been noted that adding PP to control SCC does not significantly alter compressive strength. Table 7 and figure 3 shows the Compressive strength for PP fibre.

For the purpose of testing the flow characteristics and mechanical properties of Hybrid Propylene Steel Fibre Self-Compacting Concrete (HPSscc), Steel Fibre in combination with Poly Propylene PP Fibre (Hybrid Fibre) are used to regulate SCC at concentrations of 0.25+0.15%, 0.50+0.30%, 0.75+0.45%, 1.0% + 0.60%, and 1.25+0.75%.The ideal quantity of hybrid fibre is established. Table 8 and figure 4 below shows Flow ability and compressive strength *test* for Hybrid Propylene Steel Fibre SCC.

Table 8 Flow Ability and compressive strength Test Results

Mix (HPSfscc)	**T_{500} Sec**	**%**	**28 days comp strength**
SCC	3	Control	53.1
HPSscc1	5	0.15+0.25	54.19
HPSscc2	5.2	0.30+0.5	56.94
HPSscc3	6	0.45+0.75	53.22
HPSscc4	8.3	0.6+1	52.9
HPSscc5	10	0.75 + 1.25	52.30

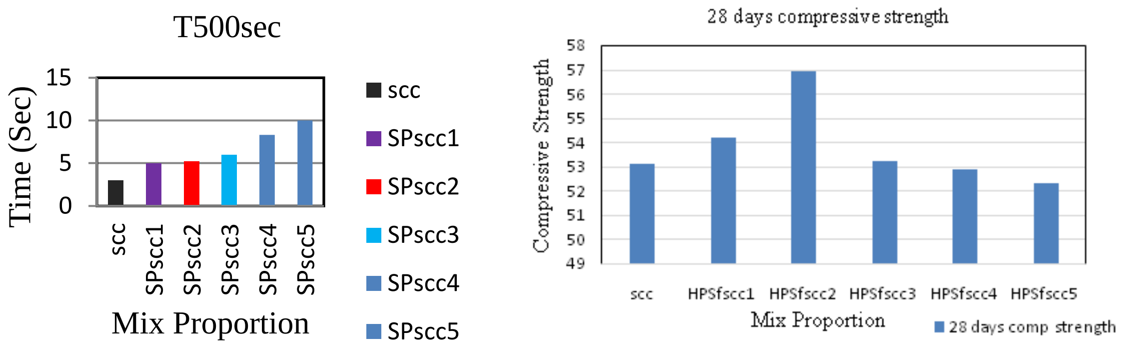


Figure 4: Flow Ability/Filling Ability and compressive strength of different mix proportions

For a 28 days Compressive strength of self-compacting hybrid (polypropylene + steel) fibre reinforced concrete (HPSscc), and determination of mechanical parameters of HPSscc is shown in table6 and figure 4. It is observed that there is slight increase in compressive strength as compared to control SCC. For 0.15% +0.25% hybrid fiber addition flexural strength is increased by 31.85 % as that of control SCC.

The Flexural Strength test for the Steel and polypropylene fibre and Hybrid (Polypropylene + Steel) Fiber reinforced concrete is shown in table 9 and figure 5 below.

Table 9 - 28 days Flexural Strength

Test	Steel fiber	28 days flexural strength (N/mm^2)	Polypropylene fiber	28 days flexural strength	HPSfscc	28 days flexural strength
Scc	Scc	8.1	Scc	7.88	scc	7.88
Scc1	SFscc1	10.21	PFscc1	9.01	HPSfscc1	10.68
Scc2	SFscc2	11.66	PFscc2	9.38	HPSfscc2	11.99
Scc3	SFscc3	13.06	PFscc3	10.44	HPSfscc3	13.51
Fscc4	SFscc4	14.52	PFscc4	9.57	HPSfscc4	14.78
Fscc5	SFscc5	13.50	PFscc5	9.11	HPSfscc5	12.31

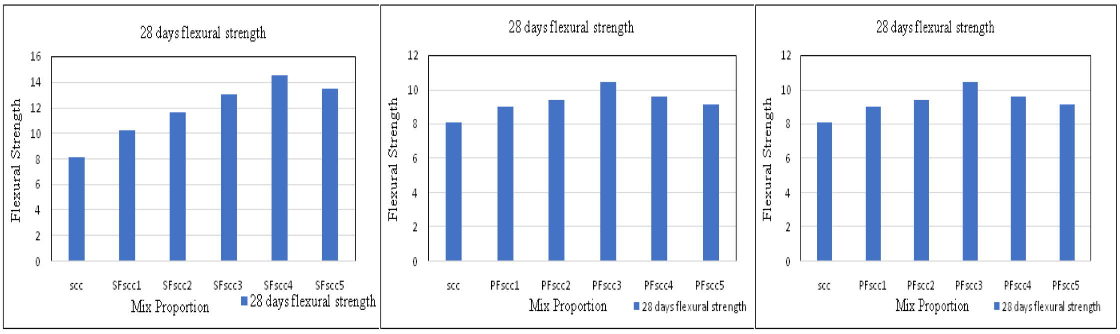


Figure 4 28 days Flexural Strength

Flexural strength is increased by 26.04 % , 43.95 %, 61.23 % & 75.25 % more than control SCC for addition of steel fiber 0.25 %, 0.50 % 0.75 % & 1.0%respectively. Flexural strength is increased by 11.23 % ,15.80 % & 28.88% more than control SCC for addition of PP fiber 0.15 %, 0.30 % & 0.45 % respectively. flexural strength obtained for hybrid fiber addition by percentage volume fraction 0.30% + 0.50%, 0.45%+ 0.75% & 0.60% + 1.0 % is increased 48.02 %, 66.79 % & 84.31% percent respectively as that of control concrete.

The Split Tensile Strength test for the Steel and polypropylene fibre and Hybrid (Polypropylene + Steel) Fiber reinforced concrete is shown in table 10 and figure 6 below.

Table 10. Split Tensile Strength

Test	Steel fiber	28 days split tensile strength	Polypropylene fiber	28 days split tensile strength	HPSfscc	28 days flexural strength
Scc	scc	5.01	Scc	5.01	scc	7.88
Scc1	SFscc1	5.85	PFscc1	5.61	HPSfscc1	10.68
Scc2	SFscc2	6.81	PFscc2	6.23	HPSfscc2	11.99
Scc3	SFscc3	6.97	PFscc3	6.51	HPSfscc3	13.51
Fscc4	SFscc4	7.16	PFscc4	6.7	HPSfscc4	14.78
Fscc5	SFscc5	6.40	PFscc5	6.10	HPSfscc5	12.31

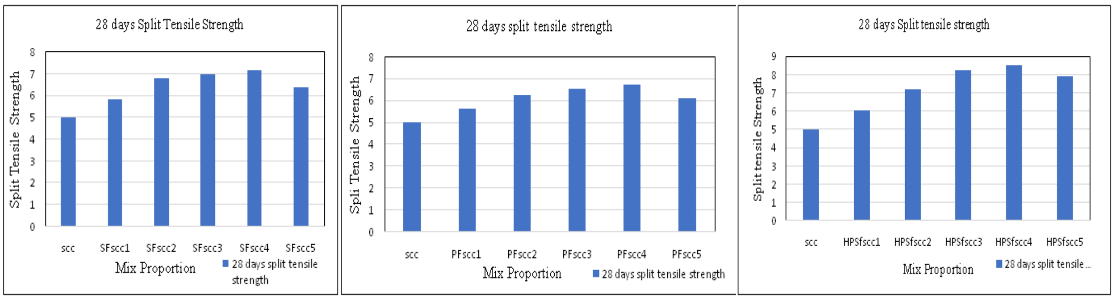


Figure 5- Split Tensile Strength

Split tensile strength is increased by 16.76 % ,35.92 %, 39.12 % & 42.91 % more than control SCC for addition of steel fiber 0.25 %, 0.50 % 0.75 % & 1.0 % respectively. Split tensile strength is increased by 11.97 % , 24.35 %, & 29.94 % & 33.93 % more than control SCC for addition of PP fiber 0.15 %, 0.30 % 0.45 % & 0.60 % respectively to control SCC. Split tensile strength is 19.96 % more than control SCC when 0.15% +0.25% hybrid fiber is added. Further it is increased 39.92 % ,64.27%, 69.92% respectively as that of control SCC.

5. Conclusion-

The following lists the main outcomes of the argument we make work: When fibre is added to concrete, the mixture stiffens because recycled aggregate had a lower specific gravity & greater water absorption than standard regular aggregates. As a result, the workability is reduced when fibre is added. The inclusion of steel fibre increases compressive strength over control SCC by a marginal amount of up to 0.5%. For a 0.75 percent addition of steel fibre, it climbed by roughly 20.11% more than the control SCC. For the addition of 1.0% and 1.25% steel fibre, the rate of growth decreased by 11.92% and 8.58%, respectively, compared to the control SCC. It has been noted that adding PP to control SCC does not significantly alter compressive strength. The Flexural strength is increased in all cases also Split tensile strength is increased.

References-

[1] Abbas shukala , 2017. A Comparative Study of the Performance Of Self-compacting Concrete Using Glass Fibres. International journal of mechanical and production engineering ,ISSN:2320-2092,Volume -5, Issue -10

[2] Khaled Ahmed, et al. experiment on natural fibre reinforced self compacting concrete. Research article 2017 IJESC, Volume 7 issue No.4

[3] Saint Petersburg, A Study on behaviour of chopped fiber reinforced self-compacting concrete. Volume 1 issue 1 2016.

[4] Abdulla Taisir AL madhoun. Mechanical properties of ultra high performance fibre reinforced self compacting concrete. The Islamic university of gaza higher education deanship faculty of engineering civil engineering department, 2019

[5] Sathish kumar. Comparative study on self compacting concrete using steel fibre and basalt fiber. Research article. ISSN: 2395-5775, 2018

[6] Rajalekshmi J. R., Mrs. Raji R, 2015, Study on Flexural and Shear Behaviour of Hybrid Fibre Reinforced Self-Compacting Concrete using Recycled Aggregates as Replacement Material, International Journal Of Engineering Research & Technology (IJERT) Ncrace – 2015 ,Volume 3, Issue 29.

[7] Abbas AL-Ameeri. The effect of steel fiber on some mechanical properties of self compacting concrete. American journal of civil engineering 2013; 1(3): 102-110. Doi:10.111648/j.ajce.20130103.14.