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# Experimental Study on Mechanical Properties of SCC Using Flyash, Metakaolin and Polypropylene Fibers

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**ABSTRACT:** Fibrofor fibres may indeed be added to self-compacting concrete (SCC) to obtain a much more homogenous distribution of fibres, which really is important for a wider structural usage of fiber-reinforced concrete. For the mix design of fiber-reinforced SCC, certain relevant, mostly empirical suggestions are accessible. Because fibres are incorporated, Fibrofor Fibre self-compacting concrete (FFSCC) combines the flowability of SCC with the stiffening qualities of hardened concrete. Numerous attempts have indeed been intended to improve the quality and sturdiness of Self-Compacting Concrete (SCC) since its introduction. Fibrofor fibers are utilized as the reinforcement in SCC along with usage of economical admixtures like Fly Ash and Metakaoline for the investigation. In order to reduce the carbon footprint and to achieve the increased application of flyash, the various proportions of FA ranging from 10-50% in various FFSCC mix was introduced along with two fixed proportions of 5 and 10% of Metakaoline to evaluate the efficiency of FFSCC based on the results findings. The usage of FF fiber has a greater negative impact on the workability qualities of SCC, according to the literature review. Furthermore, FF fibers are much more efficient than synthetic materials for improving SCC mechanical performance. The inclusion of FF fibers to the SCC mix was found to improve the concrete's toughened qualities. For every volume of FF fibers, 13 different types of mixes will be prepared, including normal concrete (NC), SCC, and SCC with Fibrofor Fibers (FFSCC) with a volume concentration of FF fibre of 1.5 percent respectively. To establish the efficacy of FF fibres over SC concrete qualities, different tests on fresh and hardened properties will be conducted for every mix.

**KEYWORDS:** Mechanical Properties, Flyash, Metakaolin, Polypropylene Fibers.

## I. INTRODUCTION

Since its introduction in 1988 by Okamura [1], the application of SCC in the building sector has garnered considerable attention. It's been utilised for a variety of structural components ever since, notably bridges, slabs, precast beams, and tunnel segments. SCC has massive benefits over conventional concrete, including the ability of flowing and compacting in formwork by its seldom weight without using vibrations. Even within congested reinforcing and constrained locations, appropriate compression may be obtained due to this high standard.

In general, as described in "The European Recommendations for Self-Compacting Concrete" [2], numerous testing procedures are required to evaluate SCC mixtures. The flow characteristics, passing ability, viscosity, and segregation resistance to SCC in its fresh form were determined by the test findings. As a result, the harder form of SCC is anticipated to provide some superior mechanical properties. SCC, like regular concrete, is subject to tensile crack and flexural failure. Various initiatives have already been designed to improve the quality of SCC. Because of the benefits of having more malleable and higher residue tensile strength than ordinary concrete, the examination of Self-Compacting Concrete with Fibrofor Fibers (FFSCC) for RCC structures has garnered considerable attention [3]. Furthermore, based on the properties of structure, the utilization of FF fibers can lower the quantity of traditional steel reinforcement necessary whilst retaining the building's acceptable results. SCC is a comparatively new material that can stream through its seldom weight, filling fully in the casting formwork while preserving homogenization even when the

reinforcing bars is crowded, and then consolidate without compaction. The building time is reduced, and SCC manufacturing is free from vibration and noises. SCC produces a superior finished surface and allows for more design flexibility. The major characteristics of SCC are packing ability, passage ability, and segregation resistance, that are obtained by raising the fineness (i.e. particles 0.125 mm), reducing the water-powder proportion, and using a plasticizers [1,2]. The slurry volume in SCC increases as the particles content increases, yielding in severe shrinking and creeping. To increase the segregation resistance of SCC, a stabilizer (viscosity modifying admixture) is occasionally applied to lower the paste content [3]. Fiber-reinforced SCC is an advanced building material that combine the advantages of SCC with the addition of fibre to a ductile manner (concrete). It's a ductile substance that goes into the core of moulds in its fresh state, spontaneously filling it, passing past barriers, and cementing under its own strength. Crack susceptibility in conventional concrete and weak flow ability in reinforced fibre concrete can both be improved by FRSCC. FFSCC offers a wide range of applications, including tunnel lining and railroad sleepers. The restoration of roadway and airport pavements is yet another use of FFSCC. Steel fibres in SCC, on the other hand, may alter the mobility of the components. Increasing fibre volume fraction and aspect ratio, for example, can reduce slump value and passing range whilst boosting SCCSF flow rate [5]. Steel fibres with a high percentage might be hard to uniformly disperse in a mixture. Nevertheless, appropriate diffusion is needed to reap the full benefits of the fibres. Conversely, whether aspect ratio is tiny or large, the impact is distinct. Prior studies have also shown that utilising low aspect ratio fibres can enhance SCCSF flow properties [5]. In terms of effectiveness, when a greater aspect ratio is used, the strength performance can be improved. Since a result, extreme attention should be used when choosing the aspect ratio of steel fibers, as this variable has a vast impact both on mechanical and durability aspects of cementitious materials. Since a result, the formulation of optimal mix proportions for SCCSF is critical, as both fresh and hardened qualities must be considered. As a result, the goal of this research is to see how specific steel fibres affect the flowability of SCC and how they can improve the toughened characteristics of concrete, particularly in terms of crack growth prevention.

BruggContec, a Swiss company with a superior technological history dating back 30 years, launched Fibrofor Fibre, an innovation. Fibrofor and Concrifix fibres are two of the most well-known types of fibres they've created throughout the years. The technological process of producing fibres takes place in a highly complex and modern factory that meets European Construction Material Specifications.

Fibrofor fibre is a coiled, nanofibrous structure with 3D fibernet that ensures quick and continuous dispersion and connecting of concrete and fibre throughout the concrete mass. Macro Polypropylene Fiber makes up the majority of it.

#### TYPES OF FIBROFOR FIBRE.

- High grade Fibrofor.
- Diamond Fibrofor.
- Multi Fibrofor.

#### DESCRIPTION OF PRODUCT:

As a structural concrete reinforcing, High Grade is an improved, coiled, fibrillated high - performing fibre. During the mixing process, the especially rough surface promotes effective anchorage within the concrete and quick three-dimensional dispersion throughout the matrices. The concrete's improved technical aspects are utilized to help with building designers. Higher Grade is a structural reinforcing that improves the concrete's impact resistance and can also be utilised in structural applications.

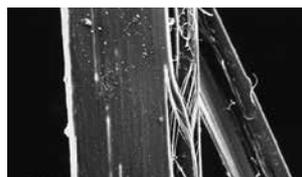


Fig.1 Microstructure of Fibrofor

#### SPECIFICATIONS:

- Bajaj Reinforcements produces Fibre Tuff, which has a higher modulus of 6 to 10 Gpa.
- Surface anchoring mechanism that is continuously engraved to improve binding.



- Fiber Tuff Macro Structured Synthetic Fabrics meet the BS EN 14889 - 2 standard for category II. Macro Fibres: > 0.30 mm in diameter
- The values varies between 550 Mpa and 640 Mpa for Tensile strength and length of 36 mm, 47 mm,/ 54 mm, and 60 mm.

PHYSICAL PROPERTIES OF FIBROFOR FIBER:

Table 2. Fibro-for fibre physical characteristics.

<b>Form</b>	Fibrillated
<b>Bulk density</b>	0,91
<b>Lengths</b>	19mm, tolerance+/- 1.5mm 38mm, tolerance +/- 5%
<b>Colour</b>	Beige
<b>Resistance to acids/alkalis</b>	Inert
<b>Tensile strength</b>	400 N/mm <sup>2</sup>
<b>Modulus of Elasticity</b>	4900 N/mm <sup>2</sup>
<b>Softening point</b>	150°C
<b>Foil thickness</b>	80 micro meter

II. RELATED WORK

Reinforced Fibrofor-fiber SCC (FFSCC) is a modern construction product which integrates the flowability of SCC with the hardening properties of set concrete due to the inclusion of fibers. FF fibers are employed as SCC fabrications in the literature. It can be deduced from the research studies that the fresh and hardened aspects of SC concrete can be greatly enhanced. Following are the major research carried out FFSCC.

S. Nandhini<sup>1</sup>, Mrs. R. Manju<sup>2</sup> (2017).

This Research is based on the study of Hybrid fibre reinforced SCC. This research evaluates the effectiveness of M30 Grade SCC utilizing hybridization fibres and additives such as flyash (FS), silicon fume (SF), limestone powder (LP), and marble powder (MP).

Controlled Mix comprising of 40 percent flyash and Blend Incorporating hybrid fibre along with an equal percent of 4 Mineral admixtures are the four mixes casted with varied mix proportions. Steel and Polypropylene are used in 0.75 percent and 0.25 percent of the total, correspondingly. They Conducted various tests on fresh properties respectively. Workability is affected by incorporating fibres to the blend. The Nix has 28.37 percent more compressive strength, 56.61 percent higher tensile strength, and 67.59 % greater flexural strength than the Control mix. The Rheological Properties of SCC Mix both with and without inclusion of Hybrid Fibres are found to be satisfied, and the presence of fibers impacts the workability of fresh Concrete. Even fresh concrete characteristics such like Flow Slump, T500, V-Funnel, J-Ring, and U-box test measured values meet EFNARC norms, and a 1% hybridization Volume concentration inclusion with Steel-Polypropylene Integrate and Boost the Compressive stregh, Split Tensile strength, and Flexural Strength of the Sample. The absorbed energy of the Mix is 37.50 percent more than Control Mix, according to the results of an impacting tests performed. The absorbed energy of the blend is 37.50 percent more than the Control Sample, and it was eventually discovered that 1 percent Blended Fibre (0.75 percent -0.25 percent) Steel Polypropylene fibre Composite outperforms Normal SCC in an impact test.

SubhanAhmad<sup>a</sup>, Arshad Umar<sup>b</sup> (2016).

They Conducted research on Rheological Properties of SCC mainly depends on Plasticity and fraction of paste of SCC which mainly depends on fines Content of the mix which in turn affects the Shrinkage and Creep. By use of a viscous customised agent reduces paste volume that also increases segregation tolerance. Moisture content of fine and coarse particles varies by 1.5 percent, resulting in a variability of 10 to 15 litres/m<sup>3</sup> of free water in SCC, which ultimately resulted in differences in characteristics in concrete. As a result, the resilience to Concrete is increased. They investigated the relationship among split tensile strength and compressive strength, as well as the relationship between Modulus of Elasticity and compressive strength. In order to truly comprehend the rheological properties of concrete, they used SCC to evaluate the fluctuations of compressive strength, split tensile strength, modulus of elasticity, and ultra pulse velocity. In case of Compressive Strength, They found that there is an increase in Compressive Strength of SCC When Stabilizer or Viscosity Modified Agent was increased to 0-0.4% respectively i.e After 7 days, the raise in



the compressive was determined to be 2% and 5.7 percent for 0.2 percent and 0.4 percent, significantly and 28 days Compressive Strength was to be increased by 3.35% and 8.68% 0.2% and 0.4% of VMA Dosage respectively and results conducted shown that there is an decline in Compressive strength for VMA Dosage Content of 0.6.

Ahmad et al. (2017)

The research focused on the strength and physical properties of traditional concrete, SCC, and SCC fiber reinforced fibres (GFSCC). SCC was found significantly higher compression and tensile strengths than ordinary concrete. SCC's modulus of rupture and elasticity, on the other hand, were found to be lower than those of conventional concrete. They also found that the addition glass fibres improved compressive strength and modulus of elasticity while significantly increasing splitting tensile strength and modulus of rupture.

R L Lija and S Minu (2017)

SCC has highly efficient characteristics in terms of mechanical and reliability. When Compared with Conventional Vibrated Concrete. Use of Industrial waste and by product as raw Material is of very good Practical Significance in Promoting building material Component as substitution for material and providing an Supplementary to the Construction Industry Economically. Concrete Technology advancements can help to minimize the use of natural material and the debris generated in natural processing plants, which has a negative effects on the environment and people's health. The viability of supplementary cementations material is described in this paper. The current project or research is to use marble sawing as filler materials for cement, which will help to accomplish the goal of lowering construction costs while also addressing the problems connected with its dispersal, such as environmental concerns. Various experiments on SCC are carried out in this work, replacing Silica Fume with 0%, 15%, 20%, 25%, 30%, and marble Powder 15% in SCC. In comparison to conventional concrete, SCC has little variance in flow properties. The outcomes of the Compressive Strength Test revealed a 6.04 percent higher strength. If 10% Silica Fume is used to partially cement replacement, the strength was decreased. The Flexural parameters of the 20% substitute mix is almost identical to that of the Control mix.

Pratik Deshmukh(2015).

In Present development of India there is a greater need for SCC. Durability of SCC is also a one of the greater factors that has to be considered, every day, a considerable amount of red mud is produced, which is hazardous to the environment. This red mud from the aluminium industry is used to fill low-lying areas, causing long-term environmental degradation. If this red mud is used in the construction industry, it will reduce environmental pollution while also lowering construction costs and making concrete more durable. Various SCC experiments are carried out with varying percentages of red mud and admixtures such as (SP+VMA). It has been discovered that adding red mud increases compressive strength by up to 2%. If more amount of red mud i.e greater than 2% is added the Compressive strength is going to decrease. The compressive strength of the mixture rises by 9.11 % when 2% red mud is incorporated.

Umar et al. (2016)

blended equal parts crystal and polyvinyl alcohol (PVA) fibres in SCC and evaluated the blends for fresh and hardened concrete. They revealed that incorporating PVA fibres into SCC diminishes its workability characteristics more than incorporating glass fibres. The compression strength and modulus of elasticity of SCC are unaffected by the introduction of glass and PVA fibers. Glass fibres significantly improved splitting tensile strength and modulus of fracture, with PVA fibres showing the biggest boost.

Prasad et al. (2009)

Glass fibers were shown to boost the compressive strength of SCC by a small amount. After the inclusion of fiber glass, the split tensile strength was observed to be dramatically increased. The ultimate compressive strength and maximum strain of GFRSCC were observed to vary exponentially with Fibre index (Fi). Peak strain  $u = (1 + 0.107 Fi)$ , where f is the ultimate compressive strength and maximal strain of SCC in the absence of fibres, respectively. The amount of glass fibres used in the experiment improved the suppleness.

Sahmaran and Yaman (2007)

FRSCC integrating elevated fly ash (HVFA) that did not fulfil the refinement standards of ASTM C 618 was examined for fresh and hardened characteristics. The overall fibre content (60 kg/m<sup>3</sup>) was maintained by using a combination of



linear steel fibres and hooked-end. The volume of water necessary for the SCC mixture was found to be lowered when HVFA was used. The usage of least-diameter linear steel fibres mitigated the drop in compressive strength of SCC caused by the HVFA's low pozzolanic activity. The tensile modulus of SCC with HVFA was found to be increased more effectively with longer fibres with hooked ends.

V. Cervanter, J. Roesler (2007)

Upon 28 days, study has found that GGBS has a positive effect both on flexural and compressive concrete strength. The Compressive Strength is lower than 100 percent OPC combination in the 1st 7 days. The Compressive Strength of Slag-Free Concrete is approximately Equal to the Strength of Slag-Free Concrete in the first 7 to 14 days. Following 28 days, you'll notice a significant increase in strength. The Flexural Strength of Slag Cement is dependent on numerous elements such as the amount of slag, OPC, and W/C ratio, according to a 1992 study. The use of slag as a cement substitute in an SCC mixture has proven to be effective. SCC combinations with various Slag Cement Contents were tested. Slump flow and flow periods were similar in the SCC combinations with Cement Concrete and the Controlling Mix. The Mechanical Properties of the Slag Cement Mixture surpassed its goal strength in 28 days, attaining 31.46Mpa.

Cunha et al. (2006)

SCC compressive behaviour was investigated in terms of fibre content and concrete maturity level. Whenever the mass of steel fibres was risen from 30 to 45 kg/m<sup>3</sup>, the compressive and modulus of elasticity improved with aging, while the elastic modulus declined. Both the fibre content and the strain at maximal stress declines with age. Whenever the density of the fibres was risen from 30 kg/m<sup>3</sup> to 45 kg/m<sup>3</sup>, the strength discarded during compression rises with increasing but stayed unchanged.

Sahmaran et al. (2005)

Stainless steels with frequent and hooked ends had been used, and testing was performed in both fresh and hardened conditions. Research showed that a fibre composition of 60 kg/m<sup>3</sup> allows for self-compaction. To ensure satisfactory flow properties in SCC embedded steel fibres, the amount of slurry in the mix must be required to enhance fibre dispersion. The ultimate compressive strength values were found in SCC supplemented with linear steel fibres, while the maximum splitting tensile strength value was found in SCC reinforced with equal proportions of pinned and linear reinforcing steel.

Sippel, C and Cramer S (2005)

Studied the impact of Cement replacements with Grade 100 GGBS on Portland Cement Concrete Performance GGBS was used to substitute 0%, 30% and 50% of cement with constant W/C=0.45. When Coarse Aggregate type, Cement manufacture and curing regain. The Compressive Strength were measured from Compressive strength Development and Deices freeze thaw Sealing resistance. The results shown that the amount of needed to reach 3000 psi traffic Opening Strength more than twice from 3 days to 7 days with 3000 GGBS Concrete Strength can be Comparable to OPC after 56 days. Deicer freeze thaw sealing tended to increase as the GGBS level increases and appeared to be tied to the level of Carbonation at the Surface. Traditional Curing Method were less Effective with GGBS in case of Durability. The possibility of Minor variation may result from different mix Constituents in OPC that appear to be accentuated in GGBS Concrete and 30% GGBS level is optimum.

Cristian Drutta (2003)

He examined the adhesion among both coarser aggregate and cement pan using confocal microscopy, as well as the compression strength and splitting tensile strength of SCC and NCC. Steel slag, fly ash, and slag cement, as well as additives and viscosity modifiers, are used as preservatives. SCC was revealed to achieve uniformity and self-compatibility through its own volume without using external excitation. Because the use of Special Preservatives, SCC has densities ranging from 2400 to 2500 kg/m<sup>3</sup>, which is significantly higher than NCC's concentration of 2370-2321 kg/m<sup>3</sup>.

Mr Dhruvkumar H Patel<sup>1</sup>, Mr Dixitkumar D. Patel<sup>2</sup>, Mr Dhaval. Patel<sup>3</sup> et al.



### III. METHODOLOGY

The Concrete Mix comprising to M40 grade was selected for the study. The design was made as per the Indian Standards IS-10262:2019 and IS-456:2000. The SC concrete mix will be prepared with varying volumetric fraction of Fibrofor fibres 0.5%, 1.0% and 1.5% respectively. The 13 different mixes for each volumetric fraction of FF along with economical admixtures is represented in the table below. The sequence of the study conducted is as follows:

1. A mix design for M40 concrete will be created in accordance with IS 10262-2009.
2. The SC concrete will be prepared by addition of FF with various volumetric fraction of 1.0% along with FA and Metakaoline respectively.
3. For each FFSCC mix 13 different proportion would be tested along with usage of FA and Metakaoline and the optimum mix results will be determined by testing each mix of fresh and hardened state for its properties.
4. The test specimens for control concrete would be featured with pulverised granite as coarse aggregate and river sand as fine aggregate.
5. The blends will be labelled FFSCC, and the water/cement ration will be kept constant at 0.40. In the laboratory, the concrete will be mixed in a concrete pan mixer.
6. The major test to determine the workability and flow parameters of FFSCC will be conducted in the fresh state of FFSCC concrete.
7. Upon 24 hours, the specimens will be reframed in the laboratory facilities and demoulded. The specimens will be instantaneously cured. Regulation specimens will be assessed at 7, 28, 56, and 96 days of age to ascertain mechanical properties such as compressive, split tensile, and flexural strengths, as well as concrete durability of concrete including such acid and alkalinity reaction.
8. In conformance with IS 516: 1959 [11], the compressive strength test will be carried out on a 200 tones Compression Machine.
9. A 200-tonne Compression Strength Testing Machine would be used to undertake the split strength test in conformance with IS 5816-1999 [12].
10. A 1200 tones UTM was used to undertake the flexural strength test in conformance with IS 516-1959 [11]

### IV. EXPERIMENTAL RESULTS

TABLE 3. FFSCC-1 MIX DESCRIPTION

FFSCC-1 MIX DESCRIPTION				
MIX-1	-	-	-	100% C
MIX-2	-	-	-	100% C
MIX-3	1.0% FF	-	-	100% C
MIX-4	1.0% FF	10% FA	5% MK	85% C
MIX-5	1.0% FF	20% FA	5% MK	75%
MIX-6	1.0% FF	30% FA	5% MK	65%
MIX-7	1.0% FF	40% FA	5% MK	55%
MIX-8	1.0% FF	50% FA	5% MK	45%
MIX-9	1.0% FF	10% FA	10% MK	80%
MIX-10	1.0% FF	20% FA	10% MK	70%
MIX-11	1.0% FF	30% FA	10% MK	60%
MIX-12	1.0% FF	40% FA	10% MK	50%
MIX-13	1.0% FF	50% FA	10% MK	40%



Table 4. Total Quantity of materials for mix.

MIX ID	Type of Mix	Fiber content (1kg/m3)	Water (Lit/m3)	Metakaoline (Kg)	Fly Ash (Kg)	Cement( kg)	Superplasticizers
MIX-1	Control Mix	1.0%	186	-	-	11.72	
MIX-2	SCC	1.0%	186	-	-	11.72	88
MIX-3	FSCC	1.0%	186	-	-	11.72	90
MIX-4	10FA5MK	1.0%	186	0.47	0.85	9.96	93
MIX-5	20FA5MK	1.0%	186	0.47	1.7	8.8	95
MIX-6	30FA5MK	1.0%	186	0.47	2.56	7.26	96
MIX-7	40FA5MK	1.0%	186	0.47	3.4	6.45	97
MIX-8	50FA5MK	1.0%	186	0.47	4.26	5.3	99
MIX-9	10FA10MK	1.0%	186	0.93	0.85	9.4	94
MIX-10	20FA10MK	1.0%	186	0.93	1.7	8.2	97
MIX-11	30FA10MK	1.0%	186	0.93	2.56	7.03	99
MIX-12	40FA10MK	1.0%	186	0.93	3.4	5.86	100
MIX-13	50FA10MK	1.0%	186	0.93	4.26	4.69	101

**TEST ON FRESH CONCRETE**

Table 5. Slump flow values in mm and T50 H ratio in seconds for various mix of CC concrete ad Fibrofor fiber concrete mix.

FFSCC MIX DESCRIPTION					Slump Flow (mm)	T <sub>50</sub> H Ratio(sec)
MIX-1	-	-	-	100% C	-	-
MIX-2	-	-	-	100% C	720	2.5
MIX-3	1.0% FF	-	-	100% C	700	4.8
MIX-4	1.0% FF	10% FA	5% MK	85% C	720	4.8
MIX-5	1.0% FF	20% FA	5% MK	75%	720	4.7
MIX-6	1.0% FF	30% FA	5% MK	65%	730	4.7
MIX-7	1.0% FF	40% FA	5% MK	55%	740	4.7
MIX-8	1.0% FF	50% FA	5% MK	45%	740	4.6
MIX-9	1.0% FF	10% FA	10% MK	80%	760	4.7
MIX-10	1.0% FF	20% FA	10% MK	70%	770	4.7
MIX-11	1.0% FF	30% FA	10% MK	60%	770	4.6
MIX-12	1.0% FF	40% FA	10% MK	50%	780	4.6



MIX-13	1.0% FF	50% FA	10% MK	40%	790	4.5
EFNARC Min					650	2
EFNARC Max					800	5

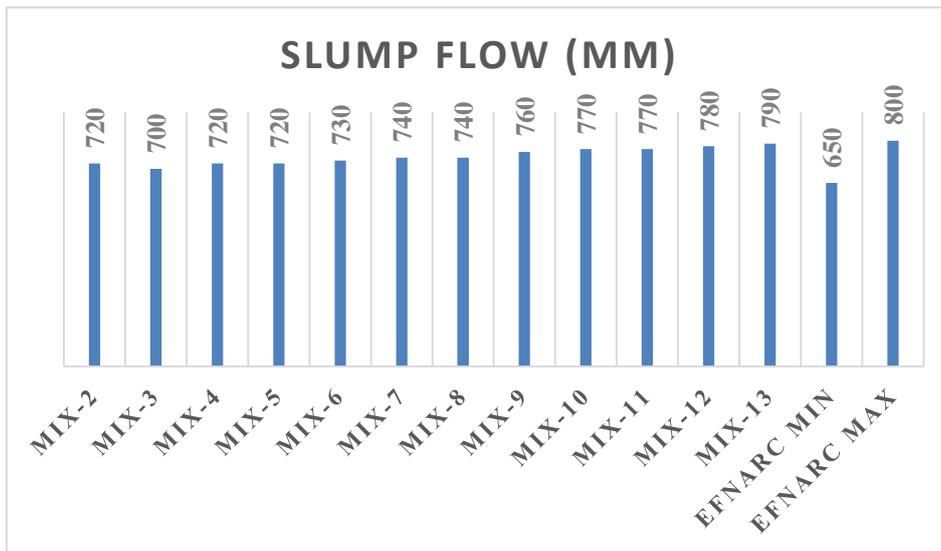


FIG 2. Graphical representation of Slump flow in mm of various mix of CC concrete and Fibrofor concrete.

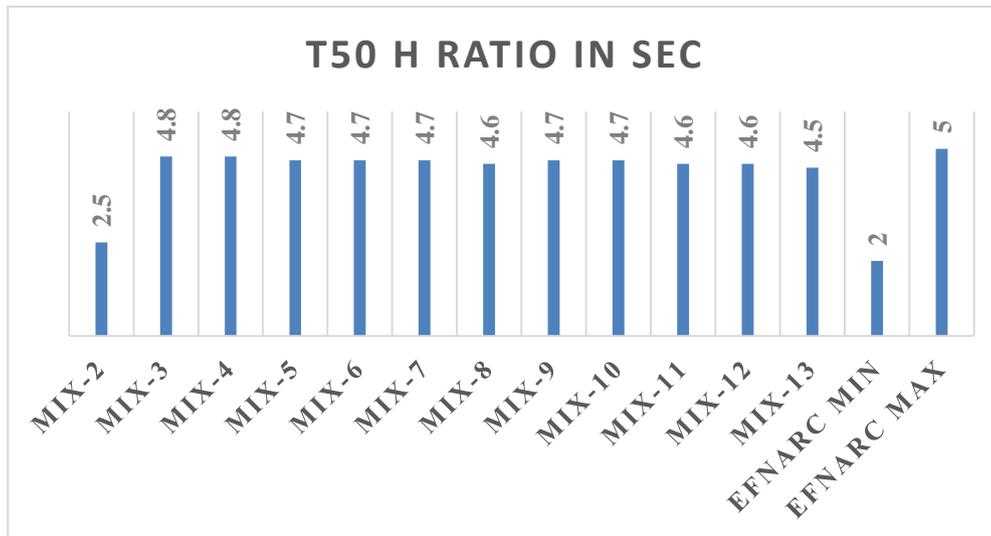


FIG 3. Graphical representation of T<sub>50</sub> H ratio in sec of various mix of CC concrete and Fibrofor concrete.



Table 6. V-funnel time in seconds for various mix of CC concrete ad Fibrofor fiber concrete mixes.

FFSCC MIX DESCRIPTION					V Funnel time (sec)
MIX-1	-	-	-	100% C	-
MIX-2	-	-	-	100% C	9
MIX-3	1.0% FF	-	-	100% C	10
MIX-4	1.0% FF	10% FA	5% MK	85% C	9.9
MIX-5	1.0% FF	20% FA	5% MK	75%	9.7
MIX-6	1.0% FF	30% FA	5% MK	65%	9.5
MIX-7	1.0% FF	40% FA	5% MK	55%	9.2
MIX-8	1.0% FF	50% FA	5% MK	45%	8.9
MIX-9	1.0% FF	10% FA	10% MK	80%	9.7
MIX-10	1.0% FF	20% FA	10% MK	70%	9.5
MIX-11	1.0% FF	30% FA	10% MK	60%	9.2
MIX-12	1.0% FF	40% FA	10% MK	50%	9.2
MIX-13	1.0% FF	50% FA	10% MK	40%	8.5
EFNARC Min					8
EFNARC Max					12

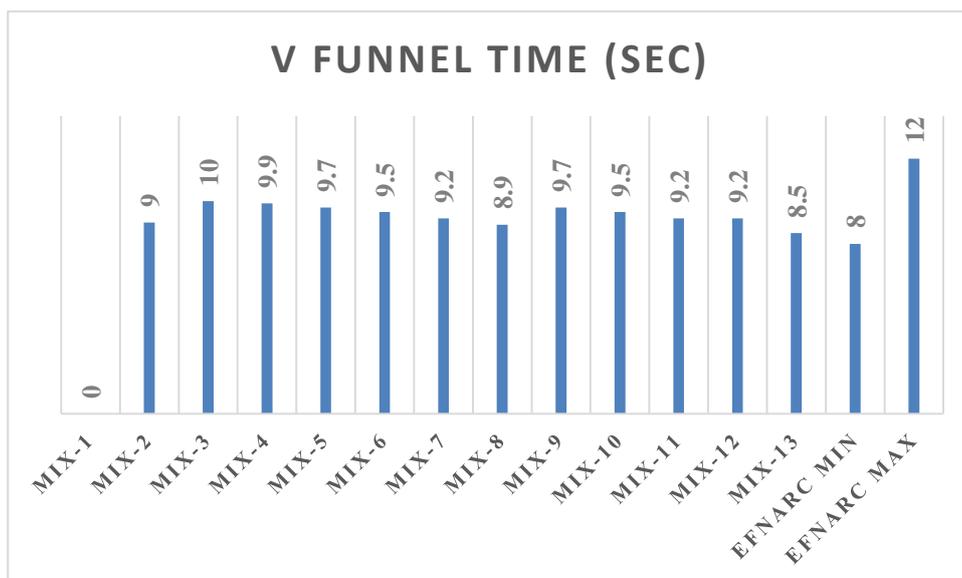


FIG 4. Graphical representation of V-Funnel time in seconds of various mix of CC concrete and Fibrofor concrete.



Table 7. J-Ring slump in mm for various mix of CC concrete ad Fibroforfiber concrete mixes.

FFSCC MIX DESCRIPTION					J-Ring slump mm
MIX-1	-	-	-	100% C	-
MIX-2	-	-	-	100% C	640
MIX-3	1.0% FF	-	-	100% C	600
MIX-4	1.0% FF	10% FA	5% MK	85% C	610
MIX-5	1.0% FF	20% FA	5% MK	75%	615
MIX-6	1.0% FF	30% FA	5% MK	65%	630
MIX-7	1.0% FF	40% FA	5% MK	55%	640
MIX-8	1.0% FF	50% FA	5% MK	45%	650
MIX-9	1.0% FF	10% FA	10% MK	80%	615
MIX-10	1.0% FF	20% FA	10% MK	70%	620
MIX-11	1.0% FF	30% FA	10% MK	60%	640
MIX-12	1.0% FF	40% FA	10% MK	50%	660
MIX-13	1.0% FF	50% FA	10% MK	40%	670
EFNARC Min	-	-	-	-	-
EFNARC Max	-	-	-	-	-

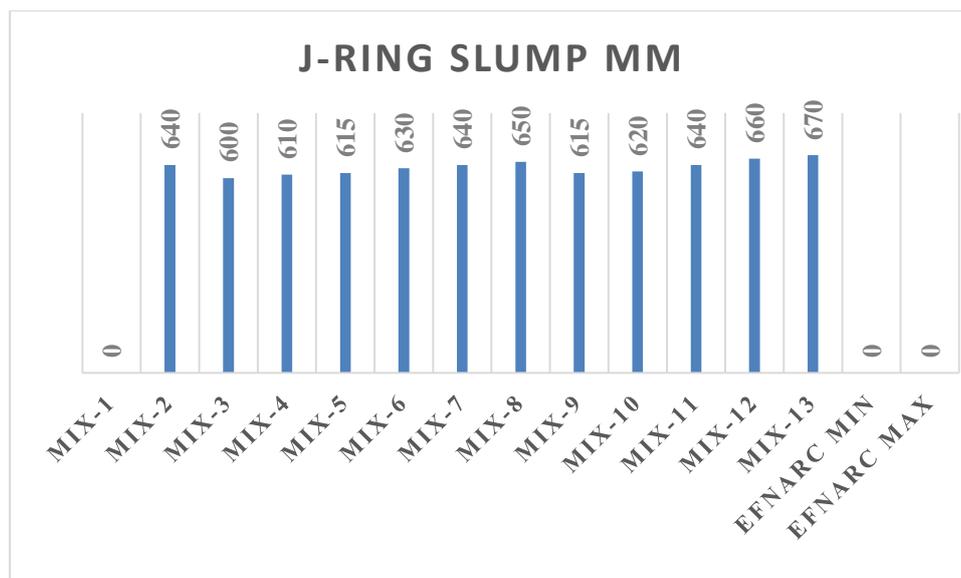


FIG 5. Graphical representation of J Ring slump in mm of various mix of CC concrete and Fibrofor concrete.



Table 8. L Box H Ratio for various mix of CC concrete ad Fibrofor fiber concrete mixes.

FFSCC MIX DESCRIPTION					L Box H Ratio
MIX-1	-	-	-	100% C	-
MIX-2	-	-	-	100% C	0.85
MIX-3	1.0% FF	-	-	100% C	0.9
MIX-4	1.0% FF	10% FA	5% MK	85% C	0.9
MIX-5	1.0% FF	20% FA	5% MK	75%	0.88
MIX-6	1.0% FF	30% FA	5% MK	65%	0.88
MIX-7	1.0% FF	40% FA	5% MK	55%	0.86
MIX-8	1.0% FF	50% FA	5% MK	45%	0.86
MIX-9	1.0% FF	10% FA	10% MK	80%	0.9
MIX-10	1.0% FF	20% FA	10% MK	70%	0.88
MIX-11	1.0% FF	30% FA	10% MK	60%	0.88
MIX-12	1.0% FF	40% FA	10% MK	50%	0.86
MIX-13	1.0% FF	50% FA	10% MK	40%	0.86
EFNARC Min					0.8
EFNARC Max					1.0

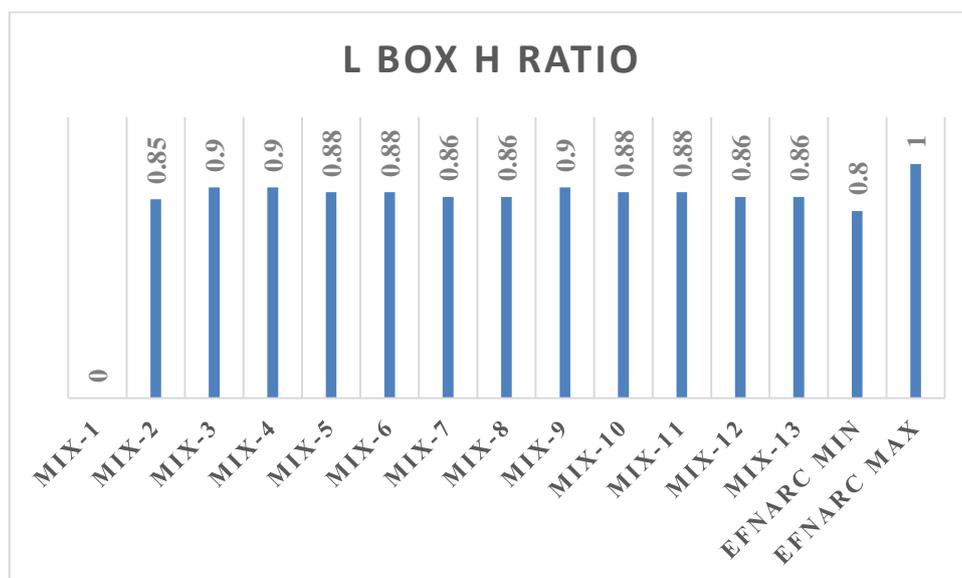


FIG 6. Graphical representation of L Box H Ratio of various mix of CC concrete and Fibrofor concrete.



**TEST ON HARDENED CONCRETE**

Table 9. Compressive strength values various mix of CC and Fibrofor concrete.

FFSCC MIX DESCRIPTION					Compressive strength MPa
MIX-1	-	-	-	100% C	38.53
MIX-2	-	-	-	100% C	40.26
MIX-3	1.0% FF	-	-	100% C	43.48
MIX-4	1.0% FF	10% FA	5% MK	85% C	44.53
MIX-5	1.0% FF	20% FA	5% MK	75%	45.82
MIX-6	1.0% FF	30% FA	5% MK	65%	43.02
MIX-7	1.0% FF	40% FA	5% MK	55%	40.60
MIX-8	1.0% FF	50% FA	5% MK	45%	37.23
MIX-9	1.0% FF	10% FA	10% MK	80%	45.0
MIX-10	1.0% FF	20% FA	10% MK	70%	46.22
MIX-11	1.0% FF	30% FA	10% MK	60%	43.62
MIX-12	1.0% FF	40% FA	10% MK	50%	39.02
MIX-13	1.0% FF	50% FA	10% MK	40%	37.0

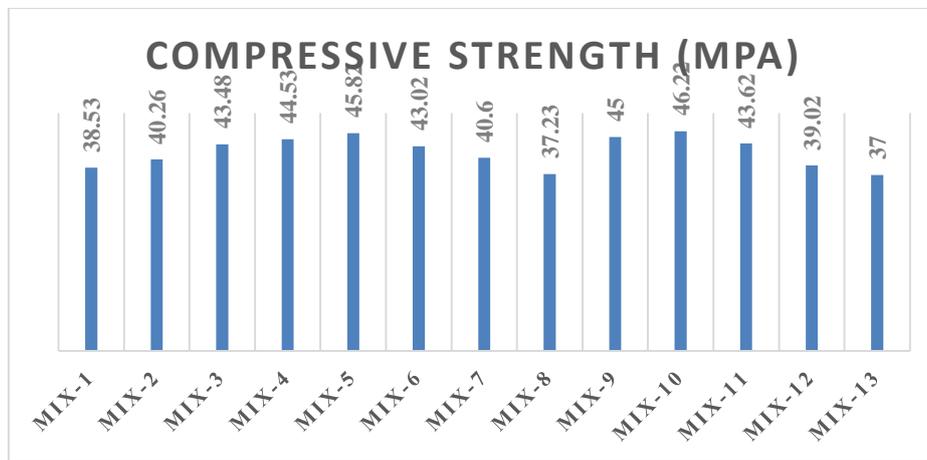


FIG 7. Graphical representation of Compressive strength of various mix of CC concrete and Fibrofor fiber concrete.

Table 10. Split Tensile strength values various mix of CC and Fibrofor concrete

FFSCC MIX DESCRIPTION					Split Tensile strength Kg/m3
MIX-1	-	-	-	100% C	3.95
MIX-2	-	-	-	100% C	4.04
MIX-3	1.0% FF	-	-	100% C	4.35
MIX-4	1.0% FF	10% FA	5% MK	85% C	4.6
MIX-5	1.0% FF	20% FA	5% MK	75%	4.72



MIX-6	1.0% FF	30% FA	5% MK	65%	4.4
MIX-7	1.0% FF	40% FA	5% MK	55%	4.12
MIX-8	1.0% FF	50% FA	5% MK	45%	3.82
MIX-9	1.0% FF	10% FA	10% MK	80%	4.62
MIX-10	1.0% FF	20% FA	10% MK	70%	4.7
MIX-11	1.0% FF	30% FA	10% MK	60%	4.40
MIX-12	1.0% FF	40% FA	10% MK	50%	3.95
MIX-13	1.0% FF	50% FA	10% MK	40%	3.8

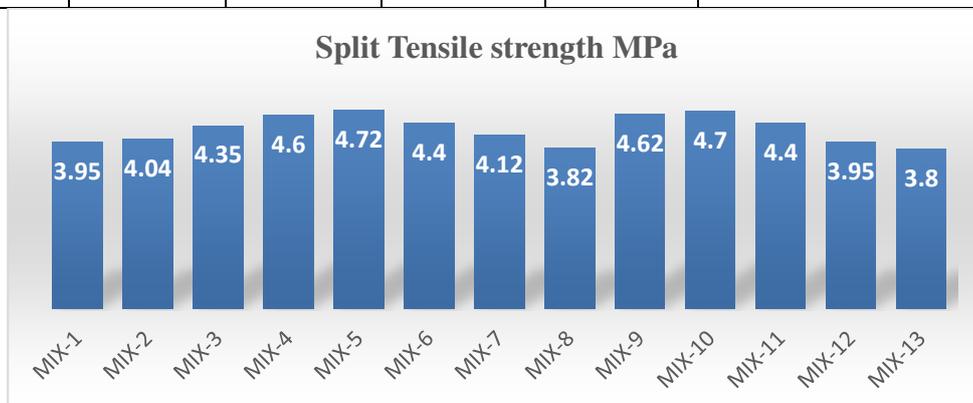


FIG 8. Graphical representation of Split Tensile strength of various mix of CC concrete and Fibrofor fiber concrete.

### V. CONCLUSION

In this section, the results obtained by conducting various engineering and mechanical properties of CC and Fibrofor concrete are discussed as follows.

1. The slump value for various mix of CC concrete and Fibrofor concrete was found to be varying from 720-790mm from Mix-1 to Mix-13 respectively.
2. The T<sub>50</sub> H Ratio value in seconds for various mix of CC concrete and Fibrofor concrete was found to be increase from 2.5 seconds to 4.5 seconds from Mix-1 to Mix-13 respectively.
3. The V-Funnel time value in seconds for various mix of CC concrete and Fibrofor concrete was found to be varying from 9 seconds to 9.2 seconds from Mix-1 to Mix-13 respectively.
4. The J-Ring slump value in mm for various mix of CC concrete and Fibrofor concrete was found to be varying from 640 seconds to 670 seconds from Mix-1 to Mix-13 respectively.
5. The L Box H Ratio values for various mix of CC concrete and Fibrofor concrete was found to be varying from 0.85 to 0.88 from Mix-1 to Mix-13 respectively.
6. The Compressive strength values for various mix of CC concrete and Fibrofor concrete was found to be varying from 38.53 Mpa to 43 Mpa from Mix-1 to Mix-13. In Mix-10, the maximum compressive strength value was 46.22 Mpa.
7. The Split Tensile strength values for various mix of SC concrete and Fibrofor concrete was found to be varying from 3.95 Mpa to 4.40 Kg/m<sup>3</sup> from Mix-1 to Mix-13. The maximum Split Tensile strength value of 4.7 Kg/m<sup>3</sup> was observed in Mix-10 respectively.



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