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EFFECT OF FIBRE TYPE AND VOLUME FRACTION ON THE STRENGTH OF ADVANCED HIGH-STRENGTH CONCRETE

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ABSTRACT

The demand for High-Strength Concrete (HSC) in modern infrastructure has grown due to its superior compressive strength and reduced section sizes. However, its inherent brittleness and limited tensile capacity present significant design and durability challenges. This study aims to evaluate the influence of different steel fibre types and their volume fractions on the mechanical performance of HSC across three advanced concrete grades M70, M80, and M90. The investigation employs three distinct steel fibre types: Sound Crimped Steel Fibres (SCSF), Hooked End Steel Fibres (HESF), and Flat Steel Fibres (FSF), with volume fractions varying from 0.5% to 4.0% by weight of cementitious material. Supplementary cementitious materials such as silica fume and fly ash were incorporated to further refine the mix design and enhance the composite action of fibres. A total of 243 specimens, including cubes, cylinders, and prisms, were tested to assess compressive strength, split tensile strength, and flexural strength at 28 days. Results demonstrated a marked improvement in all strength parameters with fibre addition, particularly at 3% volume fraction. Among the fibre types, FSF exhibited superior performance in flexural strength, while HESF contributed most effectively to compressive strength enhancements. The study confirms that fibre type and dosage significantly influence the mechanical behavior of high-strength concrete and that an optimal balance between workability, strength, and ductility can be achieved through careful selection of fibre characteristics. These findings offer practical implications for the design of high-performance concrete in critical structural applications.

Keywords: High-Strength Concrete (HSC), Steel Fibre Reinforcement, Compressive Strength, Flexural Performance, Volume Fraction of Fibres

1. INTRODUCTION

Concrete has remained the backbone of civil infrastructure due to its moldability, compressive strength, durability, and affordability. With rapid urbanization and the increasing demand for vertical expansion in metropolitan areas, High-Strength Concrete (HSC) has gained prominence as an essential construction material. Characterized by compressive strengths typically exceeding 60 MPa (as per IS 456:2000), HSC allows for slimmer structural elements, reduced dead loads, and improved overall structural efficiency. However, its advancement has been accompanied by critical limitations, primarily brittleness, low tensile strength, and poor post-cracking ductility. These limitations compromise its performance under dynamic loading, impact, and crack-prone environments such as seismic zones or liquid-retaining structures.

One practical and proven strategy to overcome these shortcomings is the incorporation of fibres, leading to the development of Fibre Reinforced Concrete (FRC). The inclusion of discrete fibres in the concrete matrix provides an effective mechanism to arrest crack propagation, enhance energy absorption, and improve post-cracking behavior. Among the various fibres available, steel fibres are the most widely adopted in structural-grade concretes due to their high tensile strength, good bonding characteristics, and compatibility with cementitious matrices. Common types include Hooked End Steel Fibres (HESF), Sound Crimped Steel Fibres (SCSF), and Flat Steel Fibres (FSF), each differing in geometry, aspect ratio, and mechanical behavior.

Another dimension that significantly influences the performance of fibre-reinforced HSC is the volume fraction of fibres. While increased fibre content generally improves tensile and flexural strengths, it can adversely affect workability, uniform dispersion, and compaction, particularly in high-strength mixes with low water-to-binder ratios. Hence, an optimum fibre dosage must be identified for each fibre type to maximize mechanical benefits without compromising fresh concrete properties.

The mechanical behavior of FRC is also influenced by the presence of Supplementary Cementitious Materials (SCMs) such as silica fume and fly ash. These materials enhance particle packing, reduce porosity, and contribute to strength development, particularly in high-grade concretes. Their inclusion also improves the interfacial transition zone (ITZ), promoting stronger fibre-matrix bonding and, consequently, better composite behavior.

While various studies have investigated the performance of steel fibres in normal and medium-grade concrete, limited research focuses on their comparative impact across different grades of HSC, particularly in a systematic and parametric manner involving multiple fibre types and volume fractions. Most existing literature addresses a single grade or single fibre type, leaving a gap in comprehensive data that would aid designers in selecting suitable fibre combinations for advanced structural applications.

1.1. NEED FOR THE STUDY

Given the increasing use of high-grade concrete (M70 and above) in critical infrastructure—such as high-rise buildings, bridges, and precast elements—there is a pressing need to understand the synergy between fibre geometry, dosage, and concrete grade. This study addresses this need by evaluating the effect of three steel fibre types at varying volume fractions (0.5% to 4%) on the compressive, split tensile, and flexural strengths of M70, M80, and M90 grade concrete.

1.2. OBJECTIVES OF THE STUDY

- The key objectives of this research are:
- To investigate the influence of fibre type (SCSF, HESF, FSF) on the mechanical performance of HSC.
- To study the variation in strength parameters (compressive, tensile, flexural) across different fibre volume fractions.
- To identify the optimum fibre type and content for each grade of concrete based on mechanical efficiency.
- To compare the performance trends across three advanced concrete grades and establish fiber–matrix interaction patterns.

This study provides valuable insights for structural engineers, researchers, and concrete technologists aiming to design more ductile, crack-resistant, and durable high-performance concrete for modern construction applications.

2. LITERATURE REVIEW

2.1. OVERVIEW OF STEEL-FIBRE-REINFORCED HIGH-STRENGTH CONCRETE (SFRC)

He et al. (2023) studied the impact of fibre cross-sectional shape and dosage on SFRC's mechanical characteristics, reporting that hooked-end fibres outperform others in strength enhancement. Parallelly, Song & Hwang demonstrated that compressive strength peaks at ~1.5% fibre volume in HSC.

2.2. FIBRE VOLUME FRACTION & MECHANICAL STRENGTH

Ye et al. (2023) observed up to 11.5% increase in compressive and nearly 49% gain in flexural strength at 2% steel fibre content in plain concrete. Wang et al. (2023) showed mechanical properties rise until ~2% dosage, then degrade beyond. Zhao et al. (2023) investigated self-compacting mixes, highlighting dosage-distribution trade-offs .

2.3. FIBRE MORPHOLOGY (TYPE & SHAPE)

The comparative study by Wang et al. (2023) revealed milled fibres performed slightly better in flexure and splitting tests than hooked-end at equivalent volume. You et al. (2023) explored recycled aggregates and fibre morphology, presenting reinforcing benefits albeit with reduced workability. Wu and Shi's F–CTOD investigations confirm that fibre geometry significantly affects post-cracking behavior.

2.4. FIBRE–MATRIX BOND & FRACTURE BEHAVIOR

MDPI's overview emphasised stronger fibre–matrix bonding with higher aspect ratio or deformed fibres . The fracture energy work by He et al. confirmed that hooked-end and corrugated fibres better resist crack propagation

2.5. ULTRA-HIGH PERFORMANCE CONCRETE (UHPC) & INNOVATIVE FIBRES

Kim et al. (2023) reviewed innovative steel fibres for UHPC, from twisted to nanocoated, demonstrating improved interfacial bonds and tensile strength. Dong et al. compiled trends in steel-fibre-reinforced UHPC, noting that deformed fibres provide significantly better flexural behaviour than straight ones

2.6. HYBRID MIXES & SUPPLEMENTARY CEMENTITIOUS MATERIALS

Silica fume and fly ash inclusion alongside steel fibres significantly improved strength as per Köksal & Şahin highlighting dosage-dependency. Nili & Afroughsabet confirmed that silica fume–hooked fibre synergy boosts long-term strength

2.7. WORKABILITY, DURABILITY & FIELD APPLICATIONS

MDPI noted dosage beyond 2% diminishes workability, reducing compressive strength. Recycled steel fibres show promise, but workability issues persist.

2.8. RESEARCH GAPS & STUDY CONTRIBUTION

Despite extensive studies on single-grade or single-fibre cases:

- No systematic comparison across M70, M80, M90 grades using multiple fibre types.
- Limited fracture-energy data in high-grade mixes.
- Lack of unified guidance on optimum fibre dosage per grade.
- Sparse data on fresh-state properties (workability vs dosage) in HSC.

To bridge these gaps, our study conducts a parametric investigation using three fibre types (SCSF, HESF, FSF) over 0.5%–4% volume, assessing compressive, split tensile, and flexural strengths along with workability metrics.

3. MATERIALS USED

The materials used in the preparation of High-Strength Fibre Reinforced Concrete (HSFRC) were carefully selected to ensure high performance, consistency, and compliance with relevant Indian Standards. Ordinary Portland Cement (OPC) of 53 Grade, conforming to IS: 12269–1987, was employed as the primary binder in all concrete mixes. This type of cement is known for its superior early strength development, making it suitable for high-strength concrete applications. The cement used was tested in the Concrete Technology Laboratory for various physical properties including fineness, specific gravity, setting times, and compressive strength. The measured fineness was 6% (retained on IS sieve No. 9), which ensures good workability and bonding with other materials. The specific gravity was found to be 3.15, and the setting time was recorded as 118 minutes for initial setting and 322 minutes for final setting, indicating adequate workability time for placing and compacting the concrete. The soundness of cement was tested using Le-Chatelier's apparatus and was found to be within permissible limits at 1 mm. The compressive strength results were also satisfactory, with strengths of 41.03 MPa at 3 days, 55.44 MPa at 7 days, and 77.82 MPa at 28 days, confirming its high strength characteristics.

In addition to cement, Supplementary Cementitious Materials (SCMs) such as silica fume and fly ash were incorporated to enhance the durability and long-term performance of the concrete. These materials improve the particle packing density, reduce permeability, and contribute to pozzolanic reactions, thereby increasing the strength and reducing the brittleness of high-strength concrete. Detailed descriptions of other materials including fine and coarse aggregates, fibres, water, and chemical admixtures are provided in subsequent sections.

Table 1 Physical Properties of Ordinary Portland Cement (OPC)

Sr. No.	Description of Test	Results
01	Fineness of cement (residue on IS sieve No. 9)	6%
02	Specific gravity	3.15
03	Setting time of cement a) Initial setting time b) Final setting time	 118 minute 322 minute
04	Soundness test of cement (with Le-Chatelier's mould)	1mm
06	Compressive strength of cement (a) 3 days (b) 7 days (c) 28 days	 41.03 N/mm^2 55.44 N/mm^2 77.82 N/mm^2

4. EXPERIMENTAL PROGRAM

To evaluate the influence of fibre type and volume fraction on the mechanical behavior of High-Strength Fibre Reinforced Concrete (HSFRC), a comprehensive experimental program was meticulously designed. The study involved the preparation and testing of concrete mixes corresponding to three advanced strength grades—M70, M80, and M90. For each concrete grade, eight different fibre volume fractions were used, ranging from 0% (control mix) to 4.0%, in increments of 0.5%. Each fibre volume level was incorporated with a single type of steel fibre: Sound Crimped Steel Fibre (SCSF), Hooked End Steel Fibre (HESF), or Flat Steel Fibre (FSF).

For every fibre type, eight unique mixes were created per concrete grade, resulting in 24 mixes (3 grades × 8 fibre contents). Additionally, one control mix (0% fibre) was cast for each grade to serve as a baseline, bringing the total number of unique mixes to 27. This strategic design enabled a thorough investigation of the effect of fibre type and content on compressive strength, split tensile strength, and flexural strength across multiple high-strength concrete grades.

Each of the 27 mixes was used to prepare three types of specimens—cubes (100 mm × 100 mm × 100 mm), cylinders (100 mm diameter × 200 mm height), and prisms (100 mm × 100 mm × 500 mm). For statistical reliability and consistency, three specimens per type were tested, leading to a total of 243 test specimens (3 specimens × 3 shapes × 27 mixes). The specimens were cured and tested at 28 days to analyze their mechanical performance under standardized laboratory conditions. This experimental program provided a robust dataset to assess the interaction between fibre morphology, dosage, and concrete grade, enabling informed conclusions on fibre optimization in high-strength applications.

Table 2 Schedule of Experimental Program

Sr. No.	Mix designation of M70 grade HSFRC	Mix designation of M80 grade HSFRC	Mix designation of M90 grade HSFRC	Fibre content (%)	No. of specimen (cubes, cylinders and prisms each) using types of Fibres		
					SCSF	HESF	FSF
1	M0	N0	O0	0.0	3X3 = 9		

2	M1	N1	O1	0.5	3 X 3 =9	3 X 3 =9	3 X 3 =9
3	M2	N2	O2	1.0	3 X 3 =9	3 X 3 =9	3 X 3 =9
4	M3	N3	O3	1.5	3 X 3 =9	3 X 3 =9	3 X 3 =9
5	M4	N4	O4	2.0	3 X 3 =9	3 X 3 =9	3 X 3 =9
6	M5	N5	O5	2.5	3 X 3 =9	3 X 3 =9	3 X 3 =9
7	M6	N6	O6	3.0	3 X 3 =9	3 X 3 =9	3 X 3 =9
8	M7	N7	O7	3.5	3 X 3 =9	3 X 3 =9	3 X 3 =9
9	M8	N8	O8	4.0	3 X 3 =9	3 X 3 =9	3 X 3 =9

Crushed stone metal with a maximum size of 12.5 mm from a local (Aurangabad, Maharashtra, India), conforming to the requirements of IS: 383-1970 was used. Locally available river (Godavari River) sand passing through 4.75 mm IS sieve conforming to grading zone-II of IS: 383-1970 was used. The properties of aggregates are presented in Table 3

Table 3 Physical Properties of Fine and Course Aggregate

Sr. No	Property	Results	
		Fine Aggregate	**Course aggregate**
1.	Particle Shape, Size	Rounded, 4.75 mm down	Angular, 10mm down
2.	Fineness Modulus	2.38	6.87
3.	Silt content	2%	
4.	Specific Gravity	2.624	2.684
5.	Bulking of sand	4.16%	0.4%
6.	Bulk density	1586.26 kg/m^3	1565 kg/m^3
7.	Surface moisture	Nil	Nil

Sulphonated melamine based super plasticizer supplied by Roff. Chemicals India Pvt. Ltd. Mumbai is used as water reducing and self retarding admixture in the experimental work. The properties comply with the requirements of IS 9103-1999 (Amended 2003) as well as ASTM C 494-type F.The fly ash are used which available from Nashik. The specific gravity of fly ash was 2.3. The properties of fly ash are presented in Table 4

Table 2.4 Physical Properties of Fly Ash

Sr. No.	Description of Test	Results
01	Specific Gravity	2.3
02	Colour	Grayish white
03	Bulk Weight	Approx. 0.9 metric ton per cubic meter
04	Specific density	Approx. 2.3 metric ton per cubic meter
05	Average Particle size	0.14mm
06	Particle shape	Spherical

The properties of various types of fibres considered for the study are presented in Table 5

Table 5 Properties of Fibres used

Sr. No.	Property	Properties of various types of fibres		
		SCSF	**HESF**	**FSF**
2.	Length (mm)	30	25	60
3.	Width (mm)	-	-	2
4.	Diameter (mm)	0.45	0.45	-
6.	Aspect Ratio	66.66	55.55	30
7.	Colour	White	White	White
8.	Specific Gravity	7.85	7.85	7.85
9.	Density kg/m^3	1.36	1.36	1.36
10.	Tensile strength MPa	400-1000	400	400
11.	Melting point	253^{0}C	253 $^\circ C$	253 $^\circ C$
10	Young's modulus kN/mm^2	25.19	25.19	25.19
13.	Water absorption	0.04%	0.04%	0.04%
14.	Minimum elongation	8%	8%	8%
15.	Resistance to alkali in high strength concrete	Excellent	Excellent	Excellent

Production of HSFRC Concrete

The high strength concrete of M70, M80 and M90 grade was designed as per DOE method. Table 6 shows the weights of various constituents of HSFRC

Table 6 Mix Proportion

Sr. No	Material	Weight of material in Mass kg/m³ for M70 Grade	Weight of material in Mass kg/m³ m³ for M80 Grade	Weight of material in Mass kg/m³ m³ for M90 Grade
1	Ordinary Portland Cement (85 % of CM)	471	472.6	500
2	Silica fume (5 % of CM)	57	27.8	119
3	Fly Ash (10 % of CM)	28	55.6	32
4	Fine Aggregate	963	702	919
5	Coarse Aggregate	1131	1042	1096
6	Water	150	150	150
7	Superplasticizer	18 ml per kg of Cement	18 ml per kg of Cement	18 ml per kg of Cement
8	Water Binder Ratio	0.27	0.25	0.23

5. RESULT AND DISCUSSION

5.1. COMPRESSIVE STRENGTH

For compression test, cube specimens of dimensions (100×100×100mm) were cast. and tested at the age of 28 days. The compressive strength results for each type of fibre and its volume fraction are shown in Table 7.

Table 7 Compressive Strength at 28 Days

Sr. No	Fibre Volume Fraction *Vf* (%)	Compressive Strength of HSFRC at 28 Days in N/mm² for various types of fibres								
		SCSF			HESF			FSF		
		M70 Grades	M80 Grades	M90 Grades	M70 Grades	M80 Grades	M90 Grades	M70 Grades	M80 Grades	M90 Grades
1	0	76.30	82.50	92.25	76.30	82.50	92.25	76.30	82.50	92.25
2	0.5	79.00	83.67	93.83	76.90	82.67	82.50	76.80	82.67	92.86
3	1.0	80.86	84.83	94.5	77.50	86.16	85.86	77.50	86.16	94.25
4	1.5	81.26	85.83	95.25	78.50	92.50	91.5	79.50	87.00	95.85
5	2.0	82.00	86.16	96.26	79.00	93.50	92.25	81.00	90.00	96.86
6	2.5	82.93	86.50	96.5	81.80	95.50	94.50	84.50	94.67	95.25
7	3.0	**87.40**	**87.50**	**97.25**	**86.00**	**99.67**	**95.60**	**88.30**	**97.67**	**97.86**
8	3.5	86.63	83.60	94.30	84.50	81.67	90.25	87.20	96.50	92.25
9	4.0	85.5	79.67	92.25	83.6	75.83	88.25	86.2	82.83	89.86

5.2. SPLIT TENSILE STRENGTH

For split tensile strength test, cylinder specimens of dimensions (100×200mm) were cast in concrete laboratory. Split tensile strength was calculated as,

Split Tensile strength (N/mm2) = 2P/π DL,

Where P= failure load, D= diameter of cylinder, L=Length of cylinder. The average results of split tensile strength are shown in Table 8

Table 8 Split Tensile Strength at 28 Days

Sr. No	Fibres Volume Fraction *Vf* (%)	Split Tensile Strength at 28 Days (N/mm²)								
		SCSF			HESF			FSF		
		M70 Grades	M80 Grades	M90 Grades	M70 Grades	M80 Grades	M90 Grades	M70 Grades	M80 Grades	M90 Grades
1	0	6.10	4.66	3.46	6.10	4.66	3.86	6.10	4.66	3.50
2	0.5	6.94	4.81	3.82	6.29	5.51	4.02	6.23	4.81	3.88
3	1.0	7.58	4.95	3.86	7.29	6.36	4.72	7.59	4.95	4.29
4	1.5	7.96	5.23	4.27	7.46	6.64	4.97	7.50	5.65	4.78
5	2.0	8.46	6.36	4.96	8.20	6.79	5.24	8.15	5.8	5.20
6	2.5	9.72	6.5	5.66	9.12	6.93	5.46	9.23	6.22	5.46
7	3.0	9.88	6.94	5.80	9.60	6.79	5.78	10.05	6.36	**5.82**

8	3.5	**9.75**	**4.81**	**5.50**	**9.96**	**6.36**	**5.20**	**9.95**	**5.09**	4.90
9	4.0	9.60	4.66	4.92	6.29	5.23	4.82	9.78	4.95	4.15

5.3. FLEXURAL STRENGTH

For flexural strength test, prisms of dimensions (100×100×500 mm) were cast in concrete laboratory. Flexural strength was calculated as,

Flexural strength (N/mm2) ft = , where P= failure load, D= depth of prism, L=Length of prism. The average results of flexural strength are shown in Table 9

Table 9 Flexural Strength at 28 Days

Sr. No	Fibres Volume Fraction *Vf* (%)	Flexural Strength At 28 Days (N/mm²)								
		SCSF			**HESF**			**FSF**		
		M70 Grades	**M80 Grades**	**M90 Grades**	**M70 Grades**	**M80 Grades**	**M90 Grades**	**M70 Grades**	**M80 Grades**	**M90 Grades**
1	0	12.86	16.30	17.8	12.86	16.30	17.80	12.86	16.30	17.80
2	0.5	12.98	16.80	18.20	13.03	16.53	18.12	12.92	16.68	18.31
3	1.0	13.14	16.96	18.42	13.29	17.16	18.41	13.19	16.93	18.65
4	1.5	13.36	17.10	18.45	13.49	17.53	18.78	13.55	16.90	18.98
5	2.0	13.54	17.40	19.13	13.65	18.06	19.02	13.69	17.00	19.22
6	2.5	13.92	17.56	19.36	13.88	18.36	19.43	13.86	17.23	19.56
7	3.0	14.15	16.53	19.66	14.21	17.43	18.40	14.82	17.4	19.86
8	3.5	**14.50**	**15.05**	**18.88**	**14.56**	**15.76**	**16.66**	**14.42**	**19.16**	**20.22**
9	4.0	14.48	14.65	17.82	14.45	15.00	15.80	14.30	16.00	19.10

The discussion on each result is presented in the following sections

5.4. EFFECT OF FIBRES CONTENT (%) ON COMPRESSIVE STRENGTH OF HIGH STRENGTH CONCRETE

The effect of Silica fume, fly ash and the three types fibres on compressive strength of M70, M80 and M90 grades of concrete as shown in figure 3.1. The fibre volume fraction is indicated on X-axis and compressive strength is on Y-axis. The compressive strength increases significantly due to the addition of fibres compared with normal high strength concrete. In general, the compressive strength of the concrete having Hooked End Steel Fibres (HESF) was higher than that of concrete with other fibres at the same volume fractions of fibres up to the limit. The compressive strength of concrete with all fibres is increased up to the 3 % of fibres volume fraction and then decreases. The maximum values of compressive strength at 3 % fibres volume fraction are 87.40 N/mm2, 87.50 N/mm2 and 97.25 N/mm2 for SCEF (M70, M80 and M90 grade Concrete), 86.00 N/mm2 99.67 N/mm2 and 95.60 N/mm2 for HESF (M70, M80 and M90 grade Concrete), 88.30 N/mm2, 97.67 N/mm2 and 97.86 N/mm2 for FSF SCEF (M70, M80 and M90 grade Concrete) respectively.

5.5. EFFECT OF FIBRES CONTENT (%) ON SPLIT TENSILE STRENGTH OF HIGH STRENGTH CONCRETE

The effect of Silica fume, fly ash and three types of fibres on split tensile strength of a high strength fibres reinforced concrete has been shown in figure 3.2. The fibre volume fraction is indicated on X-axis and split tensile strength is on Y-axis. he result from Table 2.4 shows that the cylinder split tensile strength of concrete increases considerably with an increase in fibres content. A continuous increase in strength is observed up to a limit. The 3.5 % of fibres content has given maximum increase in split tensile strength as compared to that of normal concrete i.e. 9.75 N/mm2, 4.81 N/mm2 and 5.50N/mm2 for SCEF (M70, M80 and M90 grade Concrete), 9.96N/mm2, 6.36N/mm2 and 5.20 N/mm2 for HESF (M70, M80 and M90 grade Concrete), 9.95 N/mm2, 5.09 N/mm2 and 4.90 N/mm2 for FSF (M70, M80 and M90 grade Concrete).

As per above results M70 grades fibre reinforced concrete gives maximum split tensile strength as per other grades of high strength Fibres reinforced concrete.

5.6. EFFECT OF FIBRES CONTENT (%) ON FLEXURAL STRENGTH OF HIGH STRENGTH CONCRETE

The effect of Silica fume, fly ash and six types of fibres on flexural strength of a high strength fibres reinforced concrete has been shown in figure 3.3. The fibre volume fraction is indicated on X-axis and flexural strength is on Y-axis. The result from Table 2.4 shows that the prism flexural strength of concrete increases considerably with an increase in fibres content. A continuous increase in strength is observed up to a limit. The 3.5 % of fibres content has given maximum increase in flexural strength as compared to that of normal concrete i.e. 14.50 N/mm2, 15.05 N/mm2 and 18.88 N/mm2 for SCEF (M70, M80 and M90 grade Concrete), 14.56 N/mm2, 15.76 N/mm2 and 16.66 N/mm2 for HESF (M70, M80 and M90 grade Concrete), 14.42 N/mm2, 19.16 N/mm2 and 20.22 N/mm2 for FSF (M70, M80 and M90 grade Concrete).

6. CONCLUSION

From the results discussed in the previous section, following conclusions are drawn.

1) HSC without fibres is relatively brittle and fails suddenly when compared with HSFRC with different types of fibres.
2) The compressive strength of HSC improves with addition of fibres. The maximum strength was occurred at 3% of volume fraction of each fibres. The obtained strength for three types of fibres.
3) The split tensile strength of HSC improves with addition of fibres. The maximum strength was occurred at 3% and 3.5of volume fraction of each fibres.
4) The flexural strength of HSC improves with addition of fibres. The maximum flexural strength was occurred at 2.5% of volume fraction steel fibre.

From this study it is concluded that the use of fibres in HSC can increase the mechanical properties of HSFRC for split tensile strength as compare to compressive and flexural strength.

CONFLICT OF INTERESTS

None.

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None.

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