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PERFORMANCE OF STEEL FIBER EXTRACTED FROM OLD WASTE TYRES ON MECHANICAL PROPERTIES OF CONCRETE FOR RIGID PAVEMENT CONSTRUCTION

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Abstract — The application of Waste Recycled Steel Fibers (WRSF) extracted from waste tyres in fiber-reinforced concrete production has great benefits in civil engineering. Thus, this creates a need to study the appropriate length and dosages of recycled steel fiber in fiber-reinforced concrete. In this experimental research, the effects of varying lengths (5cm and 10 cm) and dosages (1, 1.5, 2, 2.5, and 3%) of WRSF on various mechanical properties of fiber-reinforced concrete for rigid pavement construction were studied. The aggregates were taken from a stockpile, commercially available cement Dangote Ordinary Portland Cement (OPC), and potable water. Non-probable sampling techniques were adopted to collect extracted waste steel tyres. The quality test for sand (fine) and coarse aggregate satisfies the requirements specified in the ASTM. The concrete mix design was done in two categories; the first was a control mix concrete and the second was the experimental mix concrete with the addition of steel fibers with varying lengths (5cm and 10 cm) and dosages (1, 1.5, 2, 2.5, and 3%) of WRSF in concrete (percentages were determined by density for each fiber). The mix ratio of cement: sand: aggregate (1:2:3) with a constant water-to-cement ratio of 0.53 was used throughout this investigation. The outcome showed that the fiber fraction with 1.5% and 10cm of fiber had the maximum compressive strength which was 45.59 MPa, while for the fraction with 1% and 5cm of fiber, the maximum compressive strength was 43.85 MPa. The flexural strength had a maximum value of 5.88 MPa at 3% fiber content for 5cm fiber and 5.09 MPa at 3% for 10cm of fiber. The maximum tensile strength attained was 4.74 MPa and 3.50 MPa at 3% WRSF for 5cm and 10cm of fiber, respectively. The strain value had a maximum value at 3% for both 10cm and 5cm of fiber which were 0.53 and 0.6 respectively. The concrete strength which was obtained with the addition of steel fiber showed reasonable improvement in compressive, indirect tensile, and flexural strength. However, as the percentage of WRSF increased, the workability of concrete reduced.

***Keywords*:** Steel fiber, waste tire, compressive strength, tensile strength, flexural strength

1.0 INTRODUCTION

Recently, the global rapid growth of the vehicle industry and the usage of automobiles in urban and rural areas as the primary mode of transportation have significantly boosted tyre production. This has resulted in a massive stockpile of illegally dumped used tires. This collection of waste tires is hazardous due to the potential negative environmental impact, the breeding of mosquitoes, and the risk of uncontrolled combustion [1][2] There is a growing interest in Waste Recycled Steel Fibers (WRSF) due to significant health and environmental problem. Researchers have proposed many ways to solve the problem of the accumulation of waste tyres in different countries and to promote new techniques adopted for the recycling of waste products [3][4][5][6]. A number of scholars have investigated the effective utilization of waste tyres as sustainable construction materials to minimize their environmental impact [6][7][8][9][10].

Currently, rubberized concrete is one of the materials that has been gaining interest due to its mechanical performance and sustainability. Furthermore, rubber aerogel has remarkable sound and thermal insulation qualities, resulting in practical and efficient waste tyre recycling. Old waste tyres are mostly made up of steel fibers, which can be used in a variety of profitable technical applications, particularly in the construction industry. Currently, both researchers and practitioners are interested in the use of recycled steel fibers derived from waste scrap tyres in the manufacture of sustainable green concrete structures [10][11][12].

There are prior studies that have been conducted to evaluate the mechanical qualities of concrete made with recycled steel fibers that are extracted from old waste tyres, with promising findings and suggestions in the future. The results [12][13][14] show that the use of recycled steel fibers (RSF) improves the overall mechanical properties of concrete and has negligible effects on its durability. Moreover, an investigation conducted by [10] demonstrates that the addition of waste steel fiber in the production of steel fiber reinforced concrete (SFRC) reduces the overall width and depths of propagated cracks in concrete which ultimately reduces the effect of various harmful chemical agents in concrete.

The use of steel fibers extracted from waste tyres in the concrete mix increases the performance of concrete in terms of its flexural and compression strength. However, the use of high-volume fractions of steel fiber has negatively affected the fresh state properties of the concrete matrix which creates difficulty in compaction and consequently leads to high porosity in concrete, high susceptibility to crack opening, and durability issues during the design period [11]. Thus, there is a need to study the suitable length and dosages of RSF in fiber-reinforced concrete [15][16].

The overall enhancement in the mechanical performance of steel fiber reinforced concrete in terms of various parameters such as post-cracking strength, shear strength, fatigue resistance, and dynamic resistance is mainly related to a uniform dispersion of steel fibers in a concrete matrix, which mainly depends on the fiber length and dosage of steel fiber during matrix formation. Steel fibers improve concrete's ductile behavior, reduce crack formation, and improve mechanical properties. These are primarily related to the cracking bridging effect of steel fiber that controls the early-crack origination and propagation which contributes to enhanced post-cracking resistance of fiber-reinforced concrete structure [17][18][19]. A study by [15] compared industrial steel fiber and tire-recycled steel fiber in concrete applications. The industrial steel fiber content used in the investigation ranged from 0.5% to 2.5% with an increment of 0.5 % based on the volume ratio; whereas the tyre recycled steel fiber content ranged from 1.2% to 3.6% with an increment of 0.6% based on the volume mix ratio. Yancong Zhang and Lingling Gao found that tyre recycled steel fibers have a significant enhancement effect on the overall mechanical properties and flexural toughness of the cement concrete and it can be used as a green concrete material. This shows that using steel fibers extracted from waste tyres in concrete production is an economical way to manage an environmental challenge while enhancing the overall mechanical property of concrete in engineering applications [5][10][13][16].

The main objective of this study is to evaluate the performance of steel fiber extracted fom the old waste tyre on the mechanical properties of concrete for rigid pavement construction. The concrete mix design prepared for C-30 was done in two categories; the first is a control mix concrete and the second one is with the addition of WRSF of varying lengths (5cm and 10 cm) and dosages (1, 1.5, 2, 2.5, and 3%).

2.0 MATERIALS AND METHODS

2.1 Raw Materials Used

2.1.1 Recycled steel fibers (RSF)

To investigate the overall performance of SFR from old waste tyres on the mechanical properties of concrete for rigid pavement, steel fibers were extracted from burned waste tires. The waste tyre steel fibers are of two different lengths; 5cm and 10cm. Samples of waste tyre steel fibers were extracted randomly and analyzed depending on the content of the fiber. The detailed length measurement of extracted waste tyre steel fiber used in this study is shown in Figure 1.

Figure 1 Determining the length of fibers

2.1.2 Cement

The cement utilized in this study was Ordinary Portland cement (Type I) with 42.5 rapid type class, conforming to the requirements of ASTM C 150 standard specifications. The performance parameters of the cement are indicated in Table 1, which fulfills the specification standards.

Table 1 Performance indicators of cement used

Setting time, (minutes)		**Compressive strength, (MPa)**			**Fineness, (m^2/kg)**	**Normal consistency, (%)**
Initial set	Final set	1 day	3 days	28 days	355	28.7
175	265	10.62	18.04	40.98		
Chemical oxide contents of cement, (%)						
SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	LOI
20.90	4.85	3.29	62.65	1.45	2.25	0.83

2.1.3 Crushed stone aggregate (CSA)

The crushed coarse aggregate used throughout the experiment was crushed stone with a particle size between 4.75mm and 20mm as displayed in Figure 2. The detailed experimental parameters of coarse aggregate used in this study are shown in Table 2.

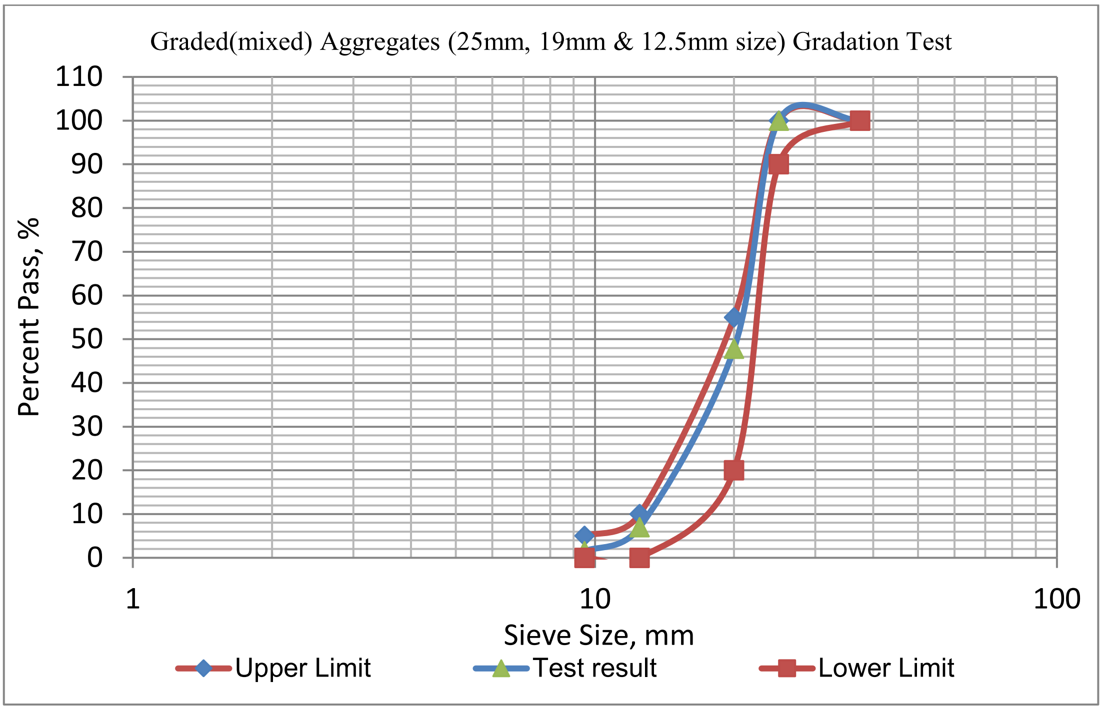

Figure 2 Gradation of coarse aggregate

2.1.4 Fine aggregate

Fine aggregate that was used in this study was natural river sand which was mainly composed of clean, strong, durable, and uncoated grains that were free from lumps or flaky particles, organic matter, loam, and other deleterious substances. The gradation of fine aggregate is shown in Figure 3 and the detailed summarized physical properties of fine aggregate used in this investigation are given in Table 2. For the determination of the distribution of fine aggregate particles in size, AASHTO standard sieve sizes of square openings 9.5, 4.75, 2.36, 1.18, 0.6, 0.3, 0.15, and 0.075 mm were utilized.

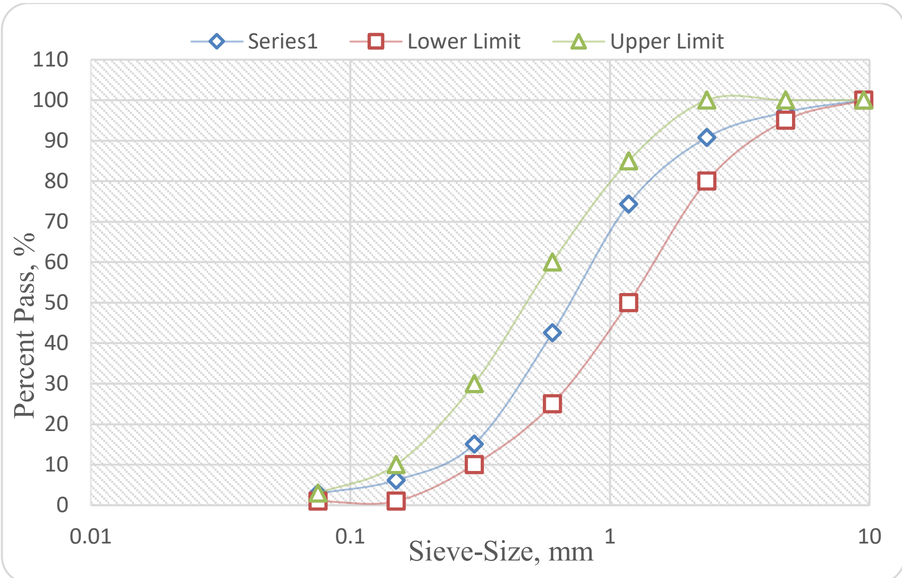

Figure 3 Gradation of fine aggregate

Table 2 Summary of physical properties of aggregates

It.No	Test types	Type of Aggregate: River Sand (Fine Aggregate)	Type of Aggregate: Coarse Aggregate maximum 20mm	Maximum allowable (BS1881, ERA & ASTM C33)
1	Material Finer than No 200 (AASHTO T-11)	2.91	-	Maximum 5%
2	Sand Equivalent (%) (AASHTO T-176)	80	-	Shall be > 75%
3	Organic impurity Plate No. (AASHTO T-21)	No. 1	-	Maximum Plate No. 3
4	Bulk Specific Gravity (AASHTO T-84 & T-85)	2.48	2.73	2.40-2.90
5	Bulk Specific Gravity (SSD) (AASHTOT84, T85)	2.43	2.75	2.40-2.91
6	Specific Gravity apparent (AASHTO T-84 & T-85)	2.60	2.79	2.40-2.92
7	Water Absorption % (AASHTO T-84 & T-85)	1.94	0.74	0.2% - 4%
8	Unit weight loose kg/m^3 (AASHTO T-19)	1528	1617	1200-1750
9	Unit weight rodded kg/m^3(AASHTO T-19)	1632	1705	1200-1750
10	Abrasion value, % (AASHTO T-96)	-	14	Shall not exceed 40%
11	Soundness, % (AASHTO T-104)	-	3.5	Shall not exceed 15%

2.1.5 Water

Drinking pipe water was used for concrete mixing and curing.

2.2 Research design

Nearby available concrete constituent materials were utilized in this study to determine the optimum design value for steel fiber reinforced concrete (SFRC) in terms of mechanical strength and its cost-effectiveness to construct a rigid pavement. The detailed investigation adopted in this study is shown in Figure 4.

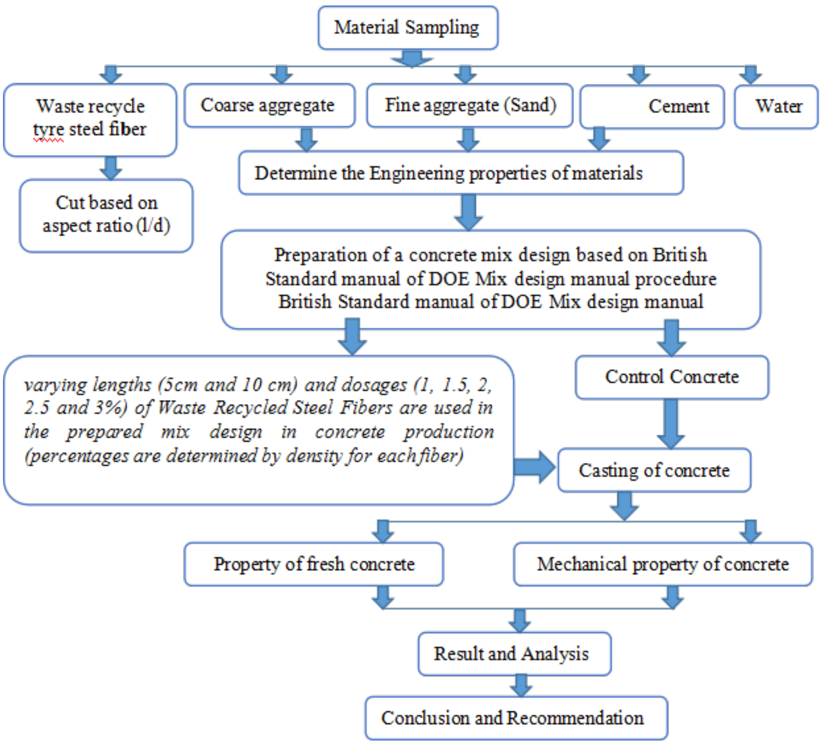

Figure 4 Diagram showing details of the investigation pattern

3.0 RESULTS AND DISCUSSION

3.1 Mixture Proportioning and Test Methods

The mix proportion for a concrete grade of C 30 was based on the British Standard Manual of DOE Mix design procedures. The mix ratio of cement, sand, and coarse aggregate adopted throughout the study was 1: 2: 3 with a constant water-to-cement ratio of 0.53. In this investigation, eleven batches of cubes, prisms, and cylinders were prepared for compressive, flexural, and tensile strength tests respectively. A total of 6 cubes of the size of 150mm, 3 prisms of 100*100*500 mm, and 3 cylinders of 150mm in diameter and 300mm in height were cast and prepared for each batch. One batch was made without recycled tire fibers as a control mix. Each of the five batches was prepared using recycled tire steel fibers of 5cm and 10cm in length. The percentages of WRSF used in this study were 1%, 1.5%, 2%, 2.5% & 3% with varying lengths of 5cm and 10cm. The percentages were determined by the density of each fiber's contents. The mechanical properties such as compressive strength, and flexural and tensile resistance of the concrete for rigid pavement were studied. The schematic pattern showing details of the study is displayed in Figure 4.

3.1.1 Workability of fresh concrete

The consistency of fresh concrete was measured through a slump test immediately after mixing according to ASTM C 143 standard procedures. The slump of the reference mix was 42mm, which was higher than that of waste tyre steel fiber added to concrete. When the percentage was the same, the slump value of 10cm long waste tire steel fibers added concrete was lower than that of 5cm long WSFC. For instance, when the fiber content is 2%, the slump value of 10cm WSFC was 32mm, which is lower than that of 5cm WSFC as shown in Table 3. As indicated in Figure 5 the workability of the mixture decreased as the content and length of fibers increased.

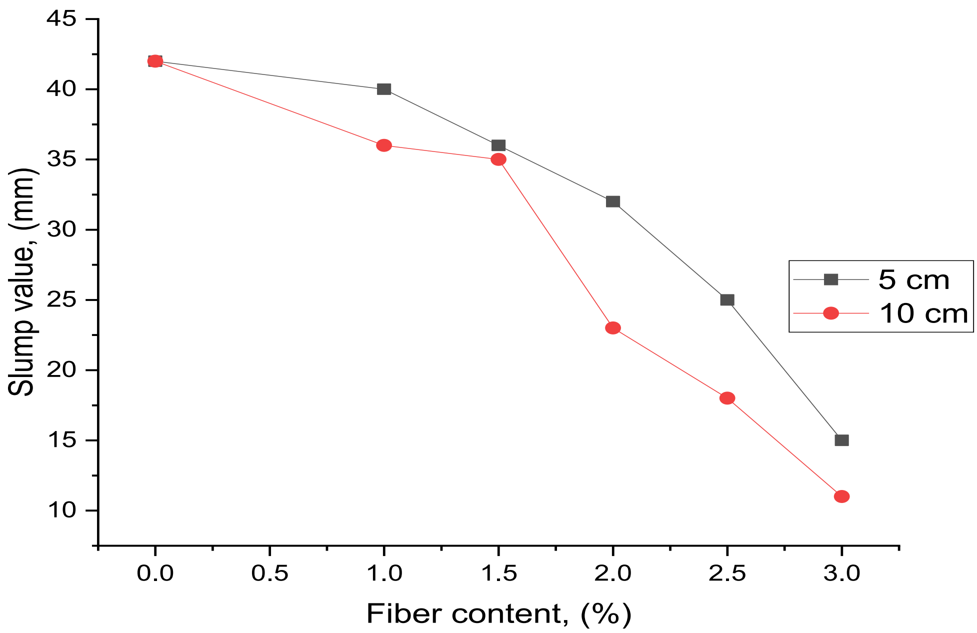

Figure 5 Slump versus fiber content of fresh concrete

3.1.2 Compressive strength

In order to determine the compressive strength of cubic specimens, AASHTO T22 test method was adopted. For compressive strength, each batch of mixes was prepared for tests after the ages of 7 and 28 days. For the fiber length of 5 cm, the compressive strength of waste tyre steel fiber added concrete showed an increasing trend of up to 1.5% content for both 7 and 28 days; beyond that, it showed a decreasing trend. For example, the maximum compressive strength of 5 cm waste tyre steel fiber added concrete was 45.59 MPa at 1.5% fiber content after 28 days and that of 10cm waste tire steel fiber reinforced concrete was 43.85 at 1.0% fiber content after 28 days. When the length of fiber was 10cm, the compressive strength of waste tyre recycled steel fiber added concrete reached its maximum at 1 % fiber content after 28 days, beyond that, it showed a decreasing trend. The decrease of compressive strength beyond 1.5% fiber content is credited to less compaction due to the low workability of specimens. The maximum compressive strength for 5cm long RSF reinforced concrete was obtained at 1.5% contents after 28 days. Thus, 1.5% was the optimum fiber content for 5cm long fibers in terms of compressive strength in the current investigation. When comparing concrete of the same age and fiber content, the compressive strength of 5cm waste tire steel fibers added concrete was higher than that of 10cm waste tire steel fiber reinforced concrete. This shows that there is a significant effect of length on the compressive strength performance. A high content of fibers produces small void pockets that decrease the efficiency of fibers contributing to the compressive strength of concrete as indicated by [11][14]. Findings from prior studies also showed similar effects of dosage and length of fibers on compressive strength performance [20]. According to previous studies [21], the specimen with a higher fiber length showed a decrease in compressive strength because uniform dispersal of the fiber in the matrix is difficult to achieve. The detailed illustration of the compressive strength versus fiber content with 5cm and 10cm long fibers is shown in Figure 6 and Figure 7 respectively.

Table 3 Slump, compressive, flexural, and tensile strengths of concrete

Experimental results of 5 cm waste tire-recycled steel fiber added concrete					
Fiber content, %	**Slump value, (mm)**	**Compressive Strength, (MPa)**		**Flexural Strength, (MPa)**	**Tensile Strength, (MPa)**
		7 days	**28 days**	**28 days**	**28 days**
0.0	42	21.70	37.65	3.46	2.71
1.0	40	22.59	42.33	4.89	3.65
1.5	36	26.30	45.59	5.23	3.93
2.0	32	25.66	44.15	5.48	4.21
2.5	25	23.31	39.56	5.78	4.58
3.0	15	18.68	35.90	5.88	4.74
Experimental results of 10 cm waste tire-recycled steel fiber added concrete					
Fiber percentage, %	**Slump value, (mm)**	**Compressive Strength, (MPa)**		**Flexural Strength, (MPa)**	**Tensile Strength, (MPa)**
		7 days	**28 days**	**28 days**	**28 days**
0.0	42	21.70	37.65	3.46	2.71
1.0	36	25.41	43.85	3.95	2.94
1.5	35	24.43	43.10	4.20	3.19
2.0	23	24.50	41.91	4.74	3.32
2.5	18	20.79	39.11	4.99	3.42
3.0	11	17.22	34.22	5.09	3.50

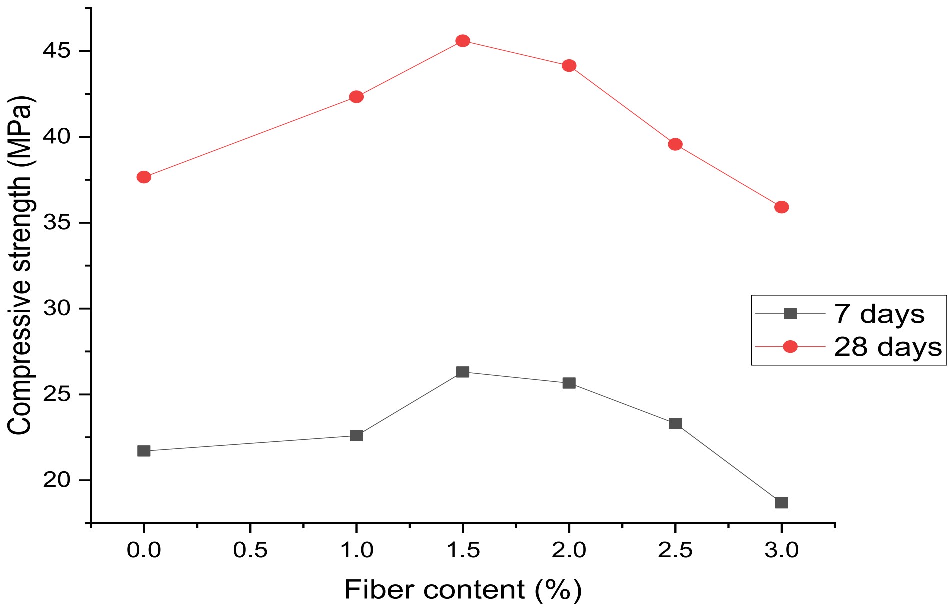

Figure 6 Graph of compressive strength versus concrete with 5cm fibers

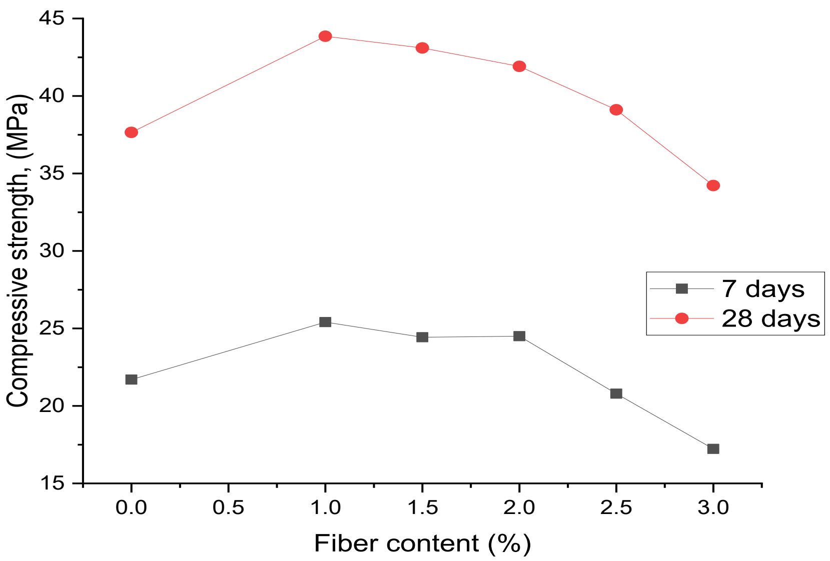

Figure 7 Graph of compressive strength versus concrete with 10 cm fibers

3.1.3 Flexural strength

For each mix, the flexural strength of waste steel tyre fiber reinforced concrete was determined after the age of 28 days. In order to determine the flexural strength, AASHTO T97 test procedure was followed as shown in Figure 8. As the fiber content increased, the flexural strength of the concrete also increased for both 5cm and 10cm long waste tire steel fibers. When comparing mixes of the same fiber content, the flexural strength of 10cm long waste tire steel fiber concrete was lower than that of 5cm long waste tire steel fiber concrete. Interestingly, all plain concrete samples were broken in half after flexural testing while the samples modified with waste tire steel fibers were held together by the steel filaments at the crack adjacent surfaces, indicating the fiber bridging effect. The flexural strength in waste tire steel fiber reinforced concrete increases because the steel fibers have more tensile strength that gives the concrete low brittleness and improved ductility. Prior research has shown similar trends

[11][12][14][16]. As per the study [19], as the volume of the fibers increased, the flexural strength increased significantly. The relationships between waste tire steel fiber content and the modulus of rupture for the two lengths of steel fibers are illustrated in Figure 9.

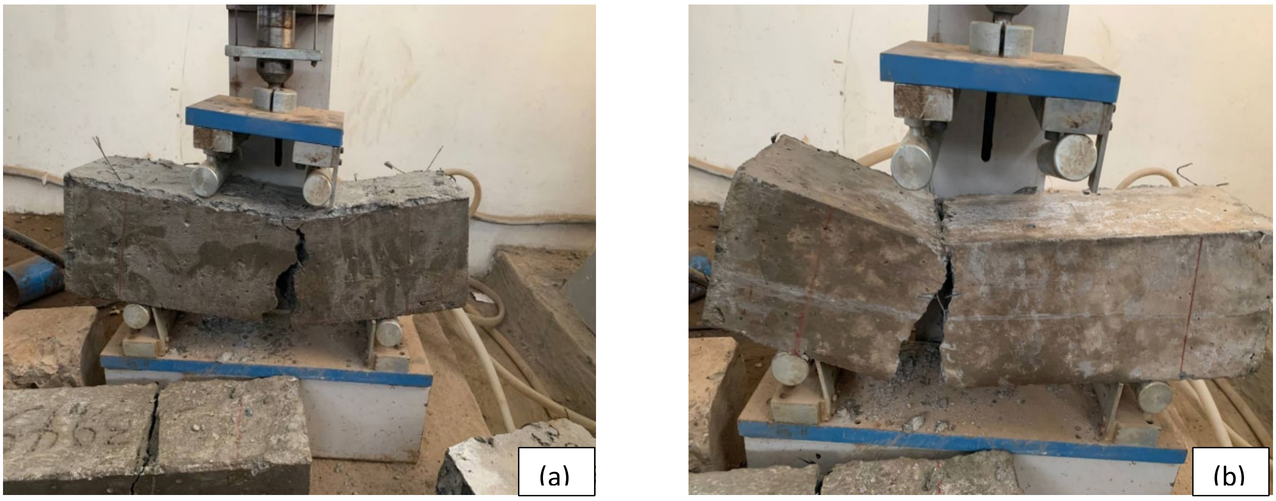

Figure 8 Rupture of the concrete after testing a) for 5cm and b) for 10cm long RSFs

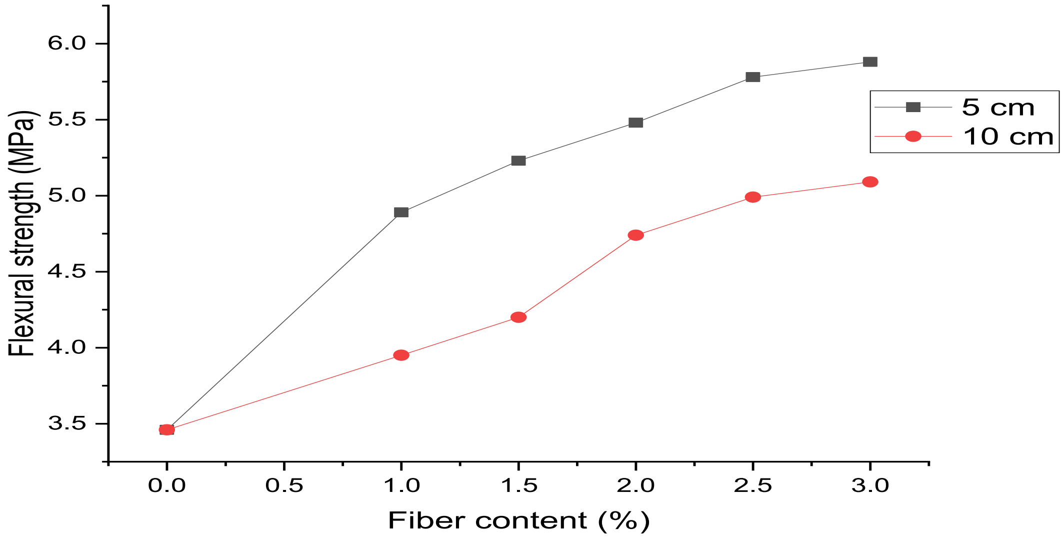

Figure 9 Flexural strength versus fiber content

3.1.4 Splitting tensile strength

The splitting tensile strength of the concrete was performed using AASHTO T198 test methods after 28 days. In this tensile strength test, specimens were tested by applying an increasing load along with the vertical diameter until the failure stage occurred. The failure of the specimens occurred along its vertical diameter, due to tension developed in the transverse direction. As the fiber content increased, the splitting tensile strength of the concrete also increased for both 5cm and 10cm long waste tire steel fibers. During the splitting of steel fiber-reinforced concrete specimens, the stress transfers from the cement matrix to fibers and improves the tensile strength of the concrete [18]. When comparing the same fiber content, the splitting tensile strength of 10cm long waste tire steel fibers added concrete was lower than that of 5cm long waste tire steel fiber added concrete. A significant problem could be the inability of concrete mixes to achieve homogeneity at higher aspect ratios of RSFs [13][17][18]. Prior research found that the splitting tensile strength of steel fiber-reinforced concrete was significantly enhanced for both lengths (7.62cm and 10.16cm) of RSF [11]. The comparisons of split tensile strength are summarized in Figure 10.

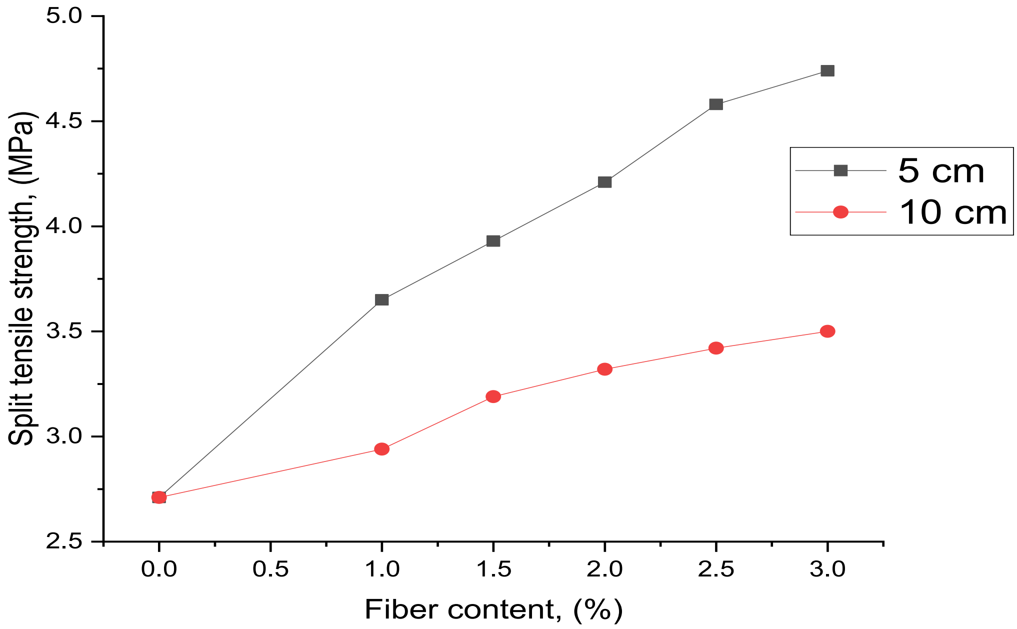

Figure 10 Split tensile strength versus fiber content

3.1.5 Strain vs. fiber content relationship

The strain value for the control mixes was 0.00245. For the 5cm long RSF, the strain value had equal values at 1.5% and 2% which was 0.0019 and the strain value was at the highest in 3% RSF which was 0.003 followed by 2.5% and 1% with strain values of 0.00235 and 0.0021, respectively. For 10cm length RSF, the strain value had equal values with 1.5% and 2% which was 0.002 and the strain value was at the highest in 3% RSF which was 0.53 followed by 1% and 2.5% with strain values of 0.0022 and 0.0021, respectively. When the strain value of plain concrete was compared with RSF-reinforced concrete, the strain values increased with the addition of steel fibers. The greater values of strain at a high percentage of RSF showed that the steel fibers can play an effective role in a ductile manner due to the bridging of fibers between the cracked inter-surfaces of concrete [11]. Figure 11 shows the strain vs. fiber percentage.

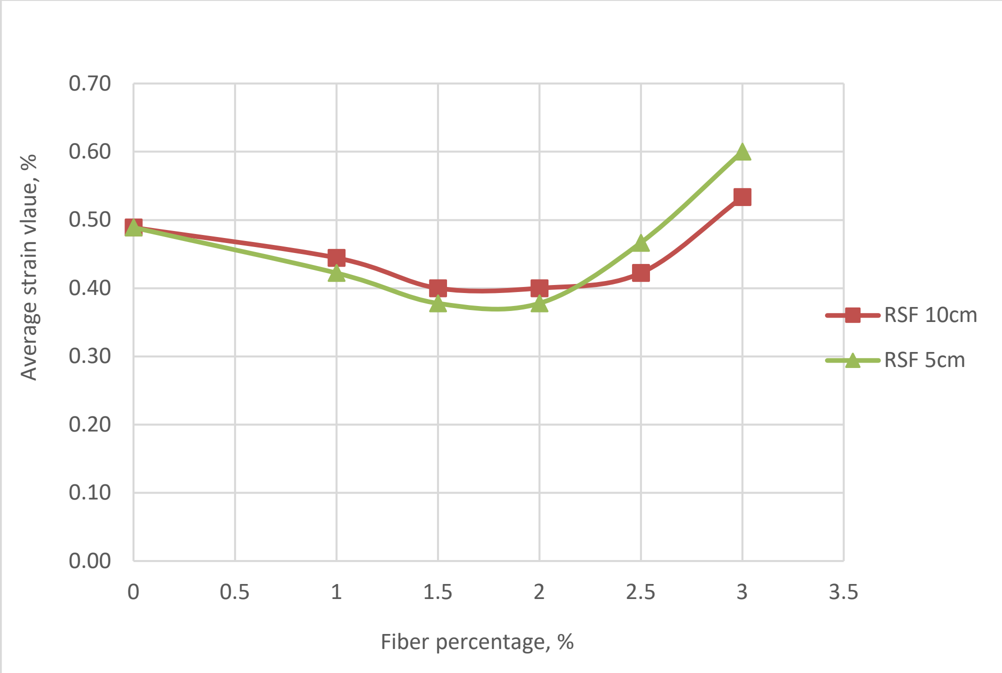

Figure 11 Strain vs. fiber percentage graph

3.1.6 Water permeability test

The test was carried out according to German Standard DIN 1048 on concrete specimens of size 150x150x150 mm, at the age of 28 days. Once the specimens were assembled in the test cells, a water pressure of 500 KPa (5 bar) was applied for 72 hours. As shown in Figure 12, concrete cubes with 1.5% of 10cm long waste tyre steel fiber reinforced mixes (maximum compressive strength obtained) were compared with reference specimens (concrete cubes with 0 % RSF) to analyze the penetration of water into the concrete. According to Germany's national standards (DIN 1045 and DIN 1048), concrete can be classified as water resistant if the average maximum depth of penetration of the waterfront, measured in all tested specimens, is no higher than 50 mm. The study found that the mean penetration depth of 1.5% of 10cm waste tyre steel fiber reinforced concrete specimens was 14.33mm and that of 0% waste tyre steel fiber reinforced concrete was 15.17mm. From this, it can be concluded that the addition of fiber increased the capacity to prevent water permeability than the reference mixes. For both mixes, the maximum penetration depth was less than 50mm so the concrete's durability is unaffected.

Table 4 Water permeability values of concrete

Sample No.	Age of Specimen (days)	Dimensions (cm)			Max. penetration depth, (mm)	Remark
		L	W	H		
1	28	15	15	15	14.33	1.5 %, 10 cm fibers
2		15	15	15	15.17	For reference mixes

Figure 12 Photo of water permeability test conditions

3.2 Economic Analysis

The economic analysis was done by comparing the control mix with the optimum 1.5 % RSF concrete. Table 5 and Table 6 present the cost breakdown, and BOQ is prepared to compare the cost of normal concrete with waste tyre steel fiber added to concrete by taking a 1m×1m area of the roadway. When comparing the control mix with the maximum concrete strength which was obtained from the laboratory test result, the slab thickness for 1.5 % RSF was 220mm and the slab thickness for the control mix was 260mm. Thus, it can be concluded that 40mm slab thickness was reduced with the addition of RSF. The thickness of the slab can be reduced by 40mm due to 1.5% addition of waste tire steel fibers in concrete pavements.

Table 5 BOQ for control (reference) mix (0% RSF)

It. no.	Item of work	Unit	Quantity	Rate	Amount
I) Concrete works					
1.1	C-30 Portland Cement Concrete Slab (260 mm thick)	m^3	0.26	4,597.64	1,195.39
1.2	**Formwork**				
	Side Formwork of 50 cm Depth	m^2	1.6	494.65	791.44
1.3	Sub-base material beneath the PCC Slab				
	150 mm thick sub-base	m^3	0.45	452.75	203.74
1.4	Capping material beneath sub-base material				
	200mm thick capping material	m^3	0.6	198.59	119.15
Grand Total					*2,309.72 ETB*

Table 6 BOQ for Recycled steel fiber reinforced concrete mix (1.5% RSF)

It. no.	Item of work	Unit	Quantity	Rate	Amount
I) Concrete works					
1.1	C-30 Portland Cement Concrete Slab (220mm thick)	m^3	0.22	4597.64	1011.4808
1.2	Formwork				
	Side Formwork of 50 cm Depth	m^2	1.6	494.65	791.44
1.3	Sub-base material beneath the PCC Slab				
	150 mm thick sub-base	m^3	0.45	452.75	203.7375
1.4	Capping material beneath sub-base material				
	200mm thick capping material	m^3	0.6	198.59	119.154
1.5	Waste steel fiber	kg	0.0056	100	0.56
Grand Total					*2,125.81 ETB*

4.0 CONCLUSION

Based on the findings of this study, the following conclusions can be drawn:

- The workability of concrete decreases as the length and fiber content increase in the mix design. The slump value of concrete with a fiber length of 5cm and 10cm was 64% and 74% lower than that of the control mix design, respectively, at a fiber content of 3%.

- Waste tyre steel fibers in concrete also improved the compression performance of concrete. The compressive strength had a higher value at 1.5% of RSF with 10cm followed by 1%, 2%, 2.5%, and control mix. However, the compressive strength for 3% RSF was lower than the control mix and other volume fractions of fiber. For 5cm length, the maximum compressive strength was at 1% followed by 1.5%, 2%, 2.5%, and decreased for 3% RSF. Thus, it can be concluded that the compressive strength increased as the length and percentages of RSF increased up to 2.5% and started to decrease with 3% RSF. Thus, to achieve the maximum compressive performance of concrete, the amount of waste tyre steel fiber should be 1.5% for both 5cm and 10cm lengths.

- The flexural strength value increases as the percentage and length of RSF increase. This flexural strength has a maximum value at 3% of RSF with a length of 10 cm. When compared with the control mix, the flexural strength increased with the addition of RSF for 1%, 1.5%, 2%, 2.5%, and 3%. It is also true for RSF with 5cm length, the flexural strength increased as the percentage of RSF increased. Generally, it can be concluded that RSF with 10cm length has a lower value of flexural strength than 5cm. At 3% fiber contents, the flexural strength with a fiber length of 5cm and 10 cm was 32% and 52% higher than that of the reference mix.

- The splitting and flexural test shows that concrete reinforced with WTSF has much greater toughness compared to plain concrete. The tensile strength peaked at 3% of RSF with 10cm. The tensile strength value increases as the percentage of RSF increases. When compared with the control mix, the tensile strength increased with the addition of RSF for 1%, 1.5%, 2%, 2.5%, and 3%. It is also true for WTSF with 5cm length, the tensile strength increased as the percentage of WTSF increased. It can be concluded that RSF of 10cm in length has a lower value of tensile strength than 5cm.

- A greater strain value was observed at 3% compared to the control mix and RSF with 1%, 1.5%, 2%, and 2.5% for both 5cm and 10cm of RSF. The strain value was equal for 1.5% and 2% with both 10cm length and 5cm length RSF and it had greater value for 0%, 1%, and 2.5% following 3% RSF. For 5cm length 2.5%, 1%, 2%, and 2.5% had higher strain values following 3% RSF. The strain value was also equal to 1.5% and 2% RSF.

- When comparing the control mix with the maximum concrete strength which was obtained at 1.5 % fiber contents, the slab thickness for 1.5% RSF was 220mm and the slab thickness for the control mix was 260mm. Thus, it can be concluded that 40mm slab thickness was reduced with the addition of RSF. The reduction in slab thickness reduces the construction cost of concrete pavements.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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