STUDY OF PARTIAL REPLACEMENT OF COARSE AGGREGATES WITH WASTE PLASTICS

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ABSTRACT

The rapid industrialization and urbanization in the country leads lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. This paper deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Usually M20 concrete is used for most constructional works.

The use of plastic is increasing day by day, although steps were taken to reduce its consumption. This creates substantial garbage every day which is much unhealthy. A healthy and sustainable reuse of plastics offers a host of advantages. The suitability of recycled plastics as coarse aggregate in concrete and its advantages are discussed here. The initial questions arising of the bond strength and the heat of hydration regarding plastic aggregate were solved. Tests were conducted to determine the properties of plastic aggregate such as density, specific gravity and aggregate crushing value. As 100%replacement of natural coarse aggregate (NCA) with plastic coarse aggregate (PCA) is not feasible, partial replacement at various percentage were examined. The percentage substitution that gave higher compressive strength was used for determining the other properties such as modulus of elasticity, split tensile strength and flexural strength. Higher compressive strength was found with 20% NCA replaced concrete.

The **"PARTIAL REPLACEMENT OF COARSE AGGREGATES WITH WASTE PLASTICS"** is the project to proper recycling the waste plastic from the household, domestic and industrial etc.

Keywords: Fiber reinforced concrete(FRC), Synthetic fiber reinforced concrete (SFRC),Plastic fiber reinforced concrete (PFRC), Cracked energy absorption in flexure(CEF) ,Toughness Index in flexure (TIF),Total energy absorption in flexure (TEF).

Introduction: Generation of plastic waste is one of the fastest growing areas. Every year more than 500 billion plastic bags are used (nearly one million bag per minute). Hundreds of thousands of sea turtles, whales and other marine mammals die every year from eating discarded plastic bag for mistaken food. On land many animals suffer from similar fate to marine life. Collection, hauling ad disposal of plastic bag waste creates an additional environmental impact. In a landfill or in environment, Plastic bags take up to 1000 year to degrade. Many researches were conducted to use industry by products such as fly ash, silica of concrete. Flume, glass cullet, coir fibers, e-plastic waste in concrete to improve the properties. (17%) is higher than for the plastic industry elsewhere in the world. India has a population of over 1 billion and a plastic consumption of 4 million tonnes. One third of the population is destitute and may not have the disposable income to consume much in the way of plastics or other goods.

Figure: Milled from blocks

Figure: End hooked

Objectives / Aim of the study: - The project aims to use waste plastic in concrete as a partial replacement of Coarse aggregate. Here is some objectives:-

- Utilization of waste plastic.
- To control the environmental pollution.
- To produced Light weight concrete
- This types of concrete used in monumental work.

EXPERIMENTAL ANALYSIS:

Methodology:

For the characterization of the sludge concrete the compressive strength of the specimen are determined along with mechanical properties (like, Density, Specific Gravity, Fineness modulus etc...) to as representative parameter for the modified concrete. Firstly, the values of compressive strength for plain cement concrete are determined (M25). The compressive strength value is compared for 7-days, 14-days and 28-days with the replaced cement with sludge concrete of varying proportions. Sludge collected from water treatment plant. Different size is obtained as a cement particle 90µm, 150µm, 300µm. and use as cement in concrete

Mixing, Casting & Curing:

The sludge concrete is manufactured by as similar to the classical concrete. Initially the dry materials Cement, Aggregates & Sand are mixed. The liquid component of the mixture was then added to the dry materials and the mixing continued for further about 4 minutes to manufacture the fresh concrete. The fresh concrete was cast into the mould immediately after mixing, in three layers for cube specimens. For compaction of the specimens, each layer was given 60 to 80 manual strokes using a rodding bar, and then vibrated for 12 to 15 seconds on a vibrating table. Before the fresh concrete was cast into the mould, the slump value of the fresh concrete was measured.

Figure: - waste plastic

RESULT & DISCUSSION:

TESTING PROCEDURE

Materials & Properties

Plastic Fiber Reinforced Concrete (PFRC) consists of cement binder and filler, usually in the form of natural aggregate and additionally added scrap of plastic pot as fibers. The Constituent materials properties are available in Table 1.

Waste Plastic Fiber (ISSN 2249-6149) **:** Fibers are used in concrete to control crack due to plastic and drying shrinkage. They Provides as impervious layer of concrete which controls permeability. Basically fibers are not Increases flexural strength so it is not possible to replace for structural steel. The amount of fibers added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibers), typically ranges from 0.1 to 3%. In this study we used Waste Plastic Fiber

(Fig.) derived from waste plastic pot possessing aspect ratio 20 and added as 1 – 3% by weight in concrete composite.

Table: Specimen Details

S. No	Properties	Cement	Sand	CA
1	Specific gravity	3.14 kg/m^3	2.55 kg/m^3	2.60 kg/m^3
2	Fineness modulus	2.80 µm	2.38 µm	4.16 µm
3	Water absorption	2.00 %	1.20 %	-------

Mix Design

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain Minimum strength and durability as economically as possible. Mix design is carried out as Per Indian Standard Code Method (IS 10262 – 2009) for concreting the test specimen.

Table: Mix proportion for the Concrete Cube Specimen

S.NO.	Grade of concrete	Target mean strength (n/mm2)	water	Cement
1	M-30	38.25	0.40	1:0.9:2.40

Specimen Casting:

Cube mould of 150 x 150 x 150 mm size, cylindrical mould of 150 x 300 mm size and prism Mould of 100 x 100 x 500 mm size was cast. The moulds were placed on an even surface

And the materials were mixed in mixer machine. First coarse aggregate and fine aggregate Were added and mixed thoroughly in a dry condition then cement and water added to get Fresh concrete mix simultaneously fibers were mixed properly. Compaction was done for all The specimens using vibrating table. The mould is striped after 24 hours. The test specimens Were cured for 7 days, 14 days & 28 days in a curing tank.

Workability:

Workability is the ability of a fresh concrete mix to fill the mould when compaction takes Place without reducing the quality of concrete. The following constituent plays the vital role In workability are water content, shape and size of aggregates, cement and types of fiber Used. During experimentation the PFRC produced good compaction factor i.e. 0.85, hence no Much deviation compared that of conventional concrete.

Experimental Investigation

A Total of 36 cubes, cylinders and prisms were cast with M30 mix for this study adding 0, 1, 2 and 3% of plastic fibers by weight. The specimen details are available in Table 3.

Table: - Specimen Details

Grades	Notations	7 Days	14 Days	28 Days
M30	Conventional	3	3	3
M30	PFRC 1%	3	3	3
M30	PFRC 2%	3	3	3
M30	PFRC 3%	3	3	3

M30	Total Cubes, Cylinders & Prism (36)	12	12	12

Compressive Strength:

Compression test is carried out to find out the compressive strengths of the conventional and PFRC cube specimens by using 20 ton capacity compression testing machine. The Compression test results of the specimen at 7 days, 14 days, & 28 days are discussed in

Table: compressive strength (n/mm^2)

S.NO	Cube Notations	Compressive strength (n/mm2)		
		7 days	14 days	28days
1	CONVENTIONAL	34.67	38.36	44.22
2	PFRC 1%	36.00	40.22	47.02
3	PFRC 2%	39.11	43.78	48.22
4	PFRC 3%	41.78	46.04	49.78

Split Tensile Strength

The split tensile test has been carried out and comparative results of conventional and PFRC Are discussed in Table 4.1.6.

Table 4.1.6: Results of M30 Grade Concrete Average Split Tensile Strength

S.NO	Cube Notations	tensile strength (n/mm2)		
		7 days	14 days	28days

1	CONVENTIONAL	2.26	2.34	2.39
2	PFRC 1%	2.38	2.41	2.48
3	PFRC 2%	2.45	2.49	2.53
4	PFRC 3%	2.49	2.55	2.60

Flexural Strength:

The flexural strength test has been carried out and comparative results of conventional and PFRC are discussed in Table

Table: Results of M30 Grade Concrete Average Flexural Strength

S.NO	Cube Notations	tensile strength (n/mm2)		
		7 days	14 days	28days
1	CONVENTIONAL	4.16	4.46	4.68
2	PFRC 1%	4.24	4.54	4.74
3	PFRC 2%	4.38	4.69	4.83
4	PFRC 3%	4.52	4.72	5.06

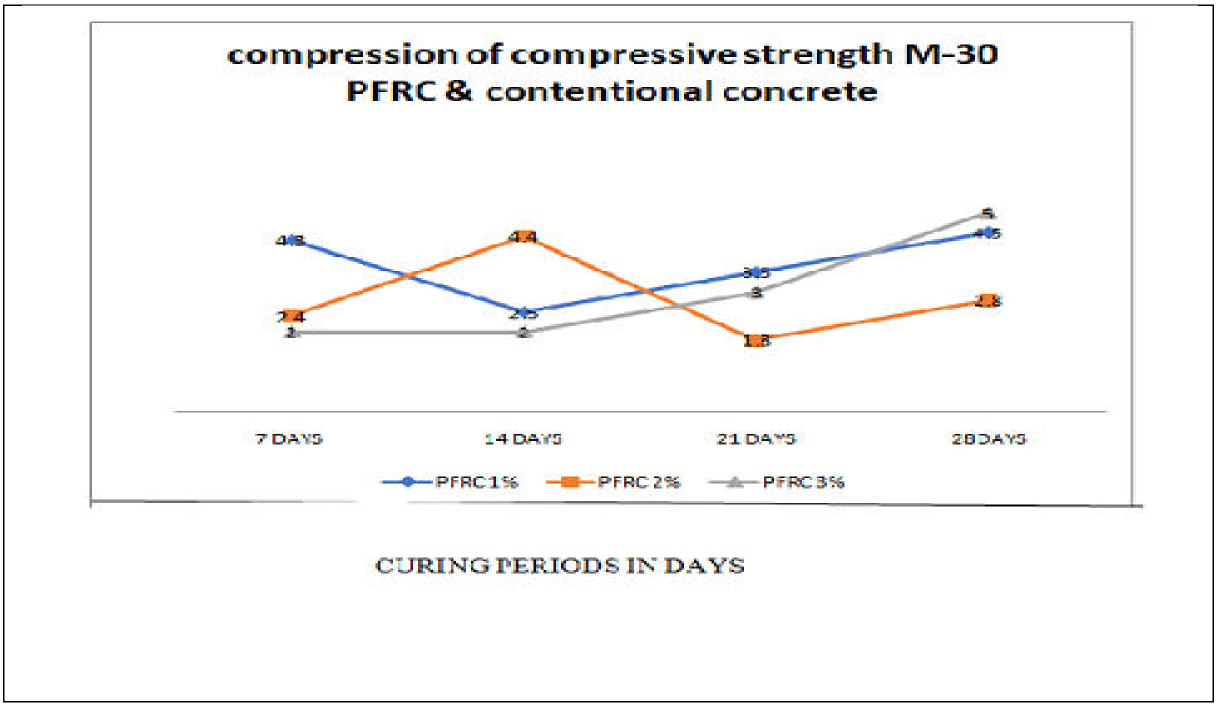


Figure: (a) Compression of compressive strength m-30 PFRC & conventional concrete

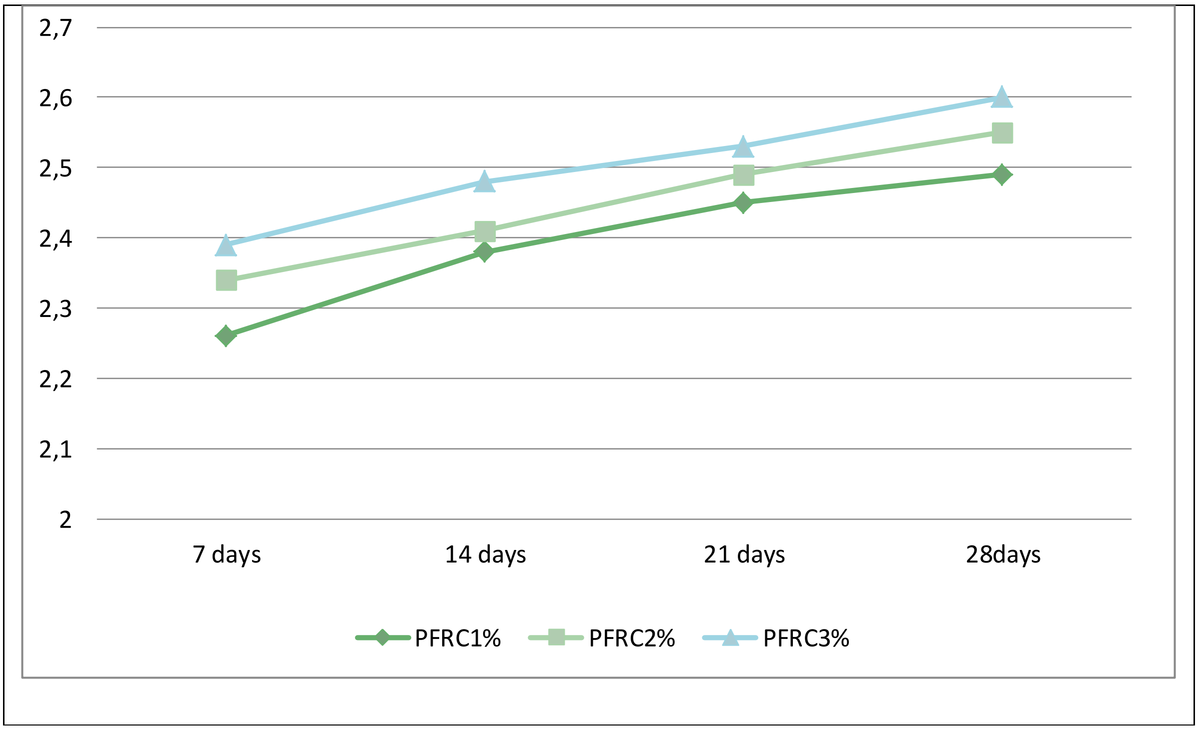


Figure: (b) compression of compressive strength m-30 PFRC & conventional concrete of PFRC1%, PFRC2% &PFRC3%.

From Table (a) & Fig. (b) The comparison of the compressive strength of the conventional concrete and PFRC, it is very clear that PFRC gives better results than the conventional concrete. It is also clearly visible that every percentage increase in plastic fiber clearly increases the compressive strength. 3% addition of fiber provides 12.5% increase in compressive strength than that of conventional concrete specimen According Table (a) & Fig.(b), split tensile strength of PFRC performed exceptionally well

Table (a) & Fig. (b) exhibits the flexural strength of PFRC which performed exceptionally well Compared than conventional concrete in all the percentages. Especially 3% addition of fiber In concrete mix gives nearly 8.12% increases in flexural strength compared with conventional Concrete.

Natural Fibers in Normal Strength Concrete:-

The mechanical properties of concrete can be enhanced by using natural or artificial fibers Eswari et al. reported that concrete strength, ductility, damage tolerance in flexure, and energy absorption capacity can be enhanced by the incorporation of fibers in the concrete. The addition of fibers delays crack propagation and improve the stress distribution in the matrix at the time of loading .Nowadays, natural fibers are incorporated in concrete to produce materials with improved strength and toughness. Natural fibers have been used by researchers as alternatives to synthetic fibers in composites like concrete .Natural fibers are very cheap compared to synthetic fibers, and are locally available in many countries. Natural fibers include coconut, bamboo, jute, palm, sisal, hemp, and banana; knead bats, pineapple leaf, flax, ramie bats, sugarcane, abaca leaf, and cotton fibers. The use of these fibers as a reinforcement can improve the properties of the composite at a relatively low cost. Compared to synthetic fibers like steel, natural fibers are flexible and easy to handle, especially when they are used in large quantities .Coconut fibers have the highest toughness among all known natural fibers, and are capable of taking 4–6 times more strain than other fibers. A study by Ali et al. was based on the mechanical and dynamic properties of coconut fiber reinforced concrete (CFRC). The influence of variations in the length and content of coconut fibers was analyzed. The lengths of the fibers were 25, 50, and 75 mm and the percentages by mass were 1%, 2%, and 3%. Two types of mix design were adopted for two types of concrete for a comparison between plain concrete (PC) and CFRC. The mix design ratio for cement, sand, and aggregates of PC was 1, 2, and 2, respectively, with water: cement (w: c) ratio of 0.48. The same mix design of PC was adopted for CFRC with an increased w: c ratio. The increment of water for the CFRC mix was done stepwise; this practice was adopted to avoid the bleeding of concrete. The w: c ratio of the CFRC mix varied from 0.49 to 0.62. It was also observed from our experimental work that the value of the water: cement ratio of all CFRCs was higher than that of PC. It was also noted that as the fiber content increased, the value of slump decreased, so the value of slump of all CFRCs was shown to be less than that of PC. The experimental test results indicated that concrete with coconut fibers has improved toughness and flexural strength. The compressive strength (σ), compressive toughness, modulus of rupture (MOR), and flexural total toughness index of CFRC were improved to 4%, 21%, 2%, and 910% with 50 mm long fibers length. The compressive strength, splitting tensile strength (STS), modulus of rupture, and toughness index for PC and CFRC reported in the study by Baruah and Talukdar are shown in Table 4.6. The best overall performance was reported for CFRC with a 2% volume fraction.

Table : Comparison of PC and CFRC mechanical properties accords to Baruah and Talukdar.

Fiber Volume Fraction (%)	Compressive Strength (MPa)	Split Tensile Strength (MPa)	Modulus of Rupture (MPa)	Toughness Index (I5)
0.0	21.42	2.88	3.25	1.934
0.5	21.70	3.02	3.38	2.165
1.0	22.74	3.18	3.68	2.109
1.5	25.10	3.37	4.07	2.706
2.0	24.35	3.54	4.16	2.345

Slump of Fresh Concrete:-

The effect on slump with increasing fiber length and content is shown in Figure. The solid straight line indicates the slump of the HSC. All CFR-HSCs showed decreased slump compared to HSC. With increasing the fiber length from 25 to 50 mm, the slump first improved and then deteriorated. The possible reasons are: (i) For 25 mm-long fibers, the fibers are more numerous, which decreases the workability of concrete; (ii) For 50 mm-long fibers, the fibers are less numerous, which results in increased slump, and (iii) For 75 mm-long fibers, the number of fibers further decreased, but longer fibers reduced the workability of concrete. With an increase in fiber content, slump is reduced.

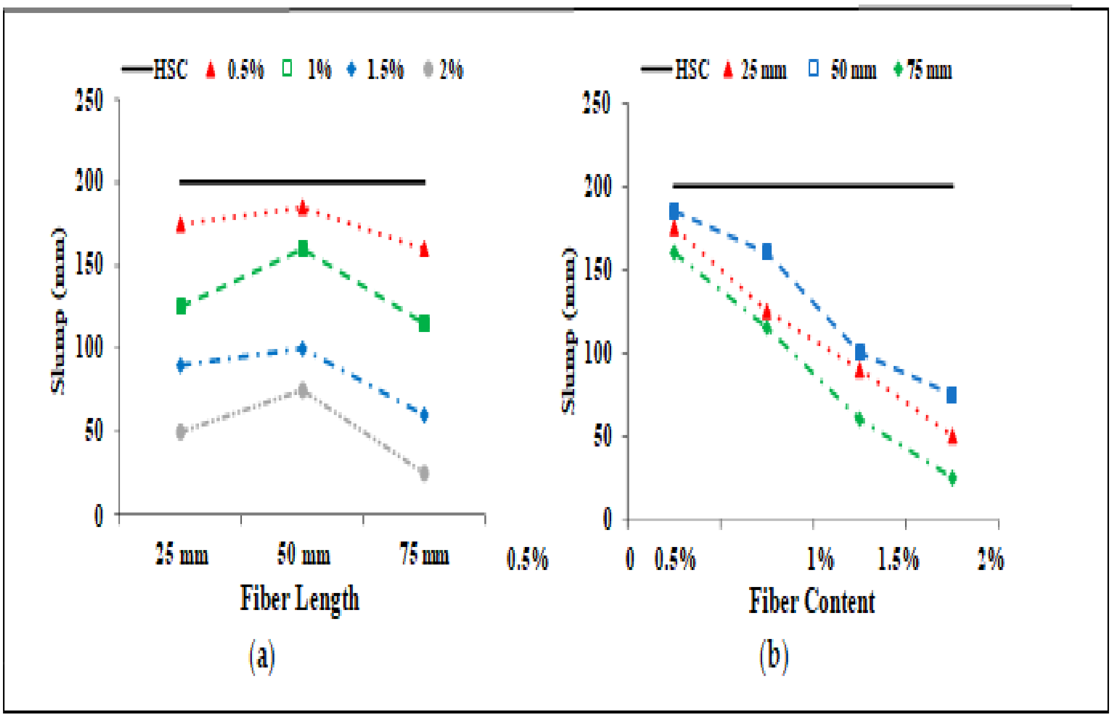


Figure 4.2. Influence on slump: (**a**) Fiber length; (**b**) Fiber content.

Density of Hardened Concrete

As expected, the density of the CFR-HSC was less than that of HSC. The influence on density with increasing fiber length and content is shown in Figure. With the increase in fiber length, the density of CFR-HSC was enhanced and then reduced. With a further increase in fiber content, the density of the specimens decreased. As fibers are light, their addition to concrete creates voids in the matrix which decrease its density. The addition of low density coconut fibers results in a so-called filled void effect, which ultimately reduces the density compared to that of plain concrete. The decreased density with the incorporation of fibers is also reported in the literature. The density of CFR-HSC with 75 mm fiber length and 2% content was reduced by 2.6% compared to HSC.

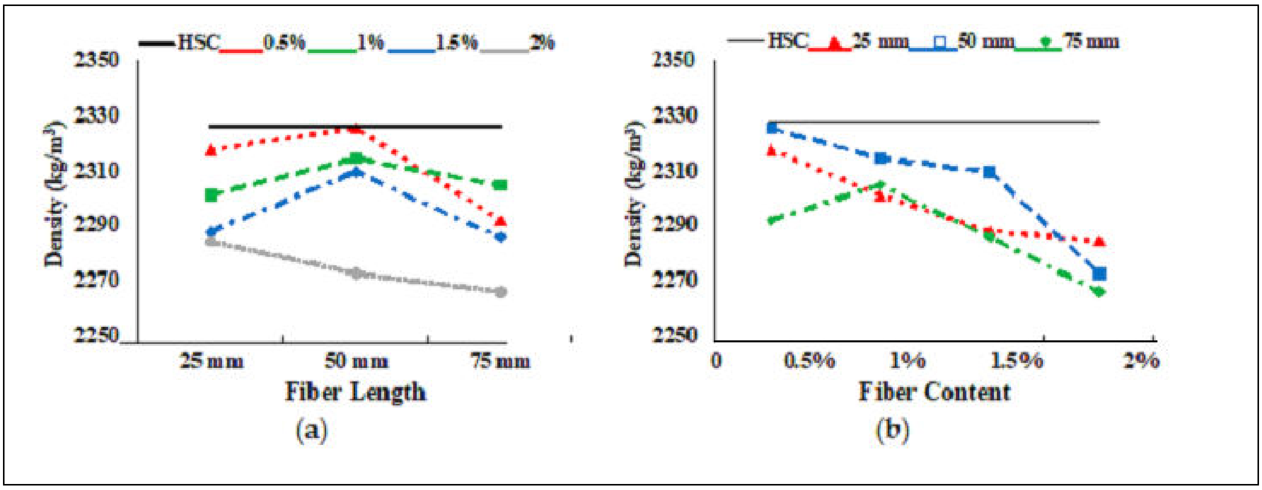


Figure: Influence on density: (a) Fiber length; (b) Fiber content.

Compressive Behavior:- The stress-strain curves for HSC and CFR-HSC with the same fiber length but different content ratios are shown in Figure 3 As expected, CFR-HSC showed greater strength and strain values than HSC. Also, CFR-HSC showed substantially improved strain energy absorption after peak stress compared to HSC. With a 25 mm fiber length (Figure3a), a little increase in peak stress was observed with all fiber contents, while a substantial increase in strain at peak stress was observed at higher fiber contents. At 50 mm fiber length (Figure b), a further increase in peak stress was observed at lower fiber contents, while maximum strain at peak stress was observed for 1.5% fiber content. For 75 mm fiber length (Figure c), the peak stress as well as strain at peak stress were reduced compared to 50 mm fiber length, but were higher than those of HSC and CFR-HSC with 25 mm fiber length. The HSC and CFR-HSC specimens after the compressive strength test are shown in Figure. At maximum load, concrete pieces from HSC were chipped off, while for CFR-HSC, pieces of concrete were held together. The reason for this is the presence of fibers which provided a bridging effect in the CFR-HSC. Also, it was visually observed that crack width and length, and the number of cracks, were greater in HSC than in CFR-HSC.

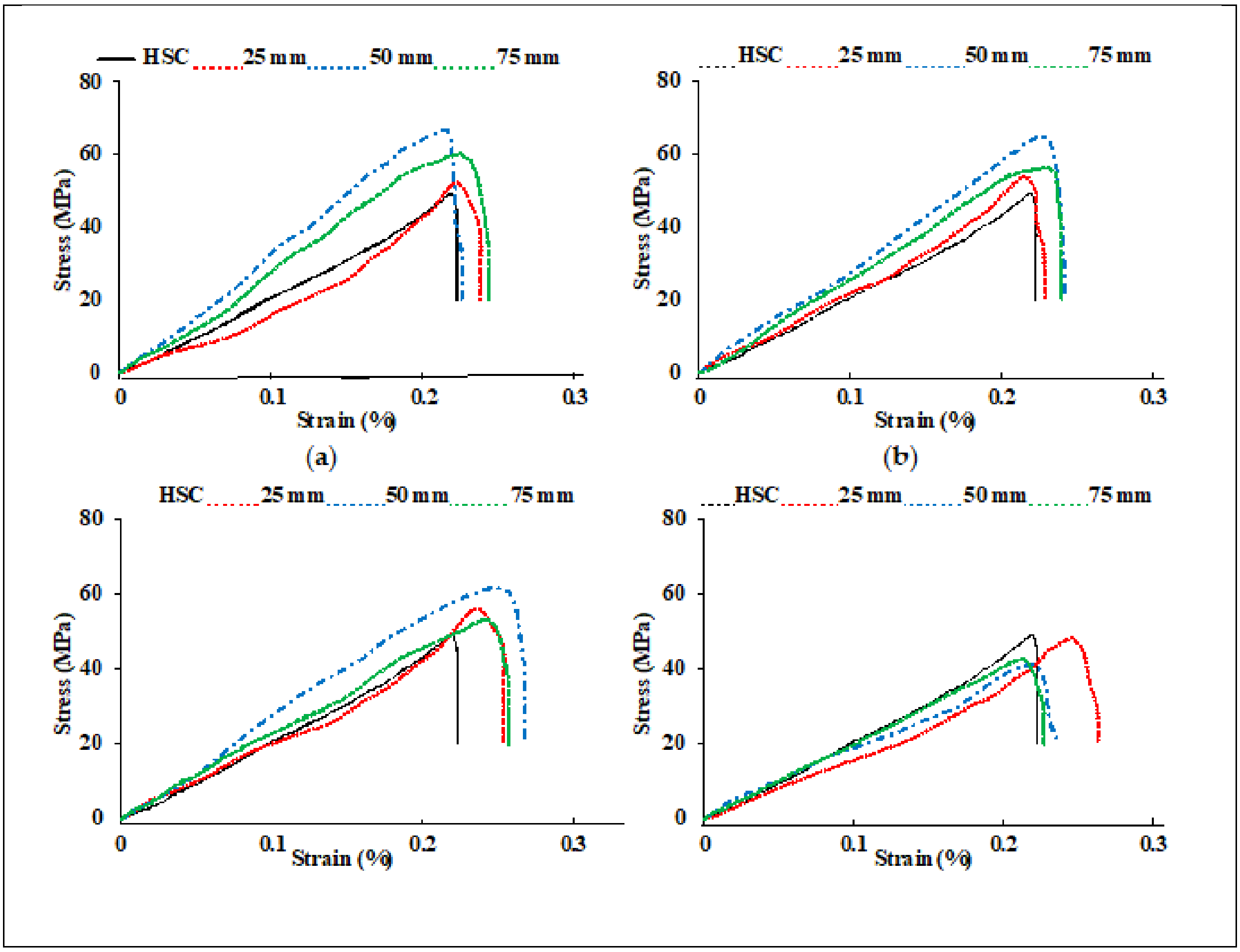


Figure: **(a) Stress**-strain curves for HSC and CFR-HSC with (**a**) 0.5%, (**b**) 1%, (**c**) 1.5%, and (**d**) 2% fiber content.

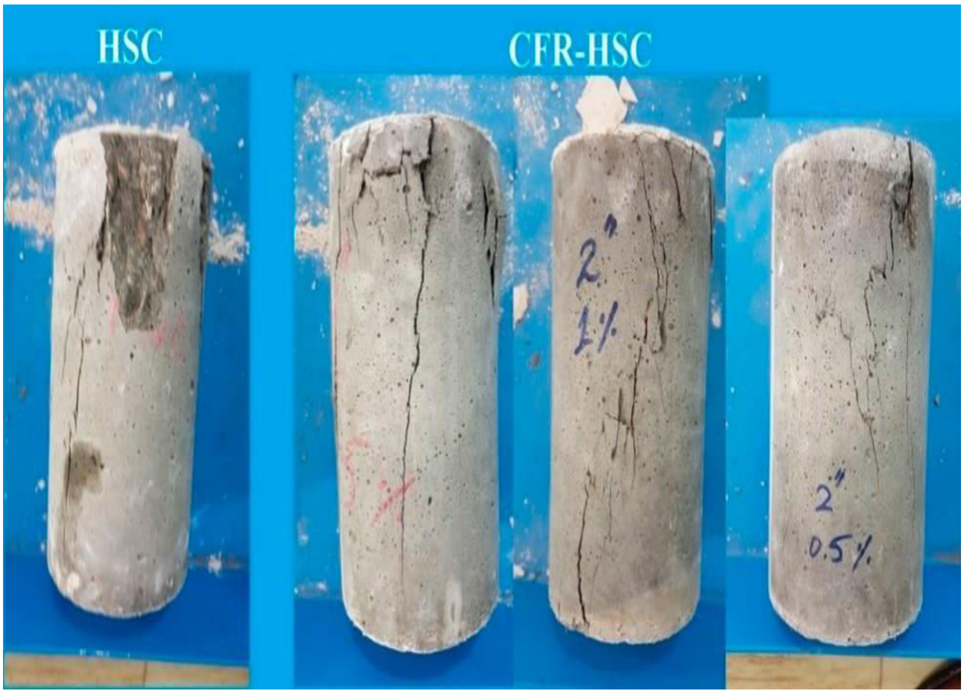


Figure: (b) HSC and CFR-HSC specimens after compressive strength tests.

Static Modulus of Elasticity ($E_{cstatic}$) :

Figure: (b) shows the e*ff*ect on $E_{cstatic}$ with increasing fiber length and content. The solid straight line shows the $E_{cstatic}$ of HSC. The $E_{cstatic}$ of CFR-HSC is reduced with the increase in fiber length and content. A similar trend was also reported by Ali et al. Only the CFR-HSC with 25 mm fiber length and 0.5% and 1% content showed enhanced $E_{cstatic}$ compared to HSC. All the other CFR-HSCs showed less $E_{cstatic}$ than HSC. The $E_{cstatic}$ of CFR-HSC with 50 mm and 75 mm fiber lengths and 2% content was reduced by 13.4% compared to HSC. A reduction in $E_{cstatic}$ due to the addition of fibers in concrete is also reported in the literature.

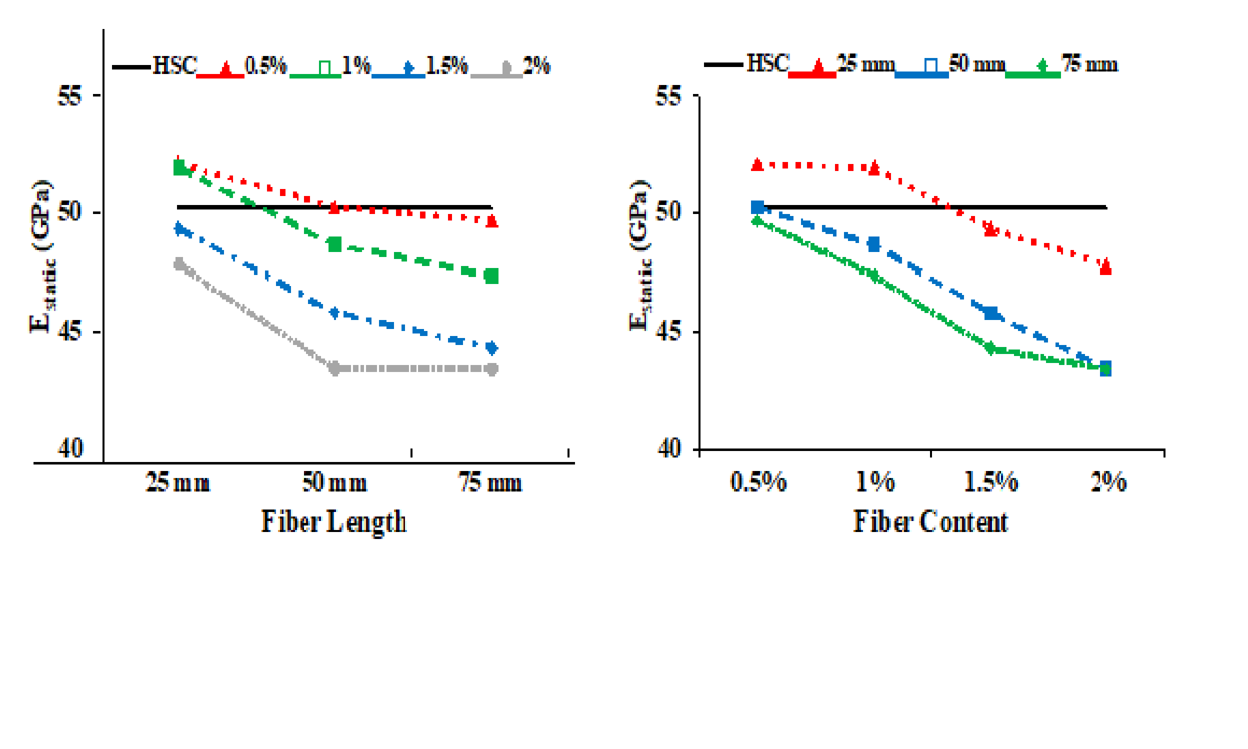


Figure: Influence on E_{static}: (**a**) Fiber length; (**b**) Fiber content

Compressive Strength (σ)

The influence on σ with increasing fiber length and content is shown in Figure 7. The solid straight line shows the σ of the HSC. The σ of CFR-HSC first increased and then reduced with increasing fiber length. For the 25 mm long fiber, the σ was enhanced with an increase in fiber content up to 1.5% and then decreased when the fiber content was increased to 2%. However, for 50 mm and 75 mm long fibers, the σ is decreased with the increase in fiber content. The reduction in σ may be due to:

(i) The workability of fresh concrete decreasing due to the higher content and longer length of fibers, and because proper compaction was not done during the casting of the specimens, resulting in the creation of air voids; or (ii) the dilution of the cement matrix/hardened cement paste due to the addition of fibers. The improvement in σ due to the addition of fibers is also reported by Afroughsabet and Ozbak kaloglu, Ali et al., and Ramble et al.

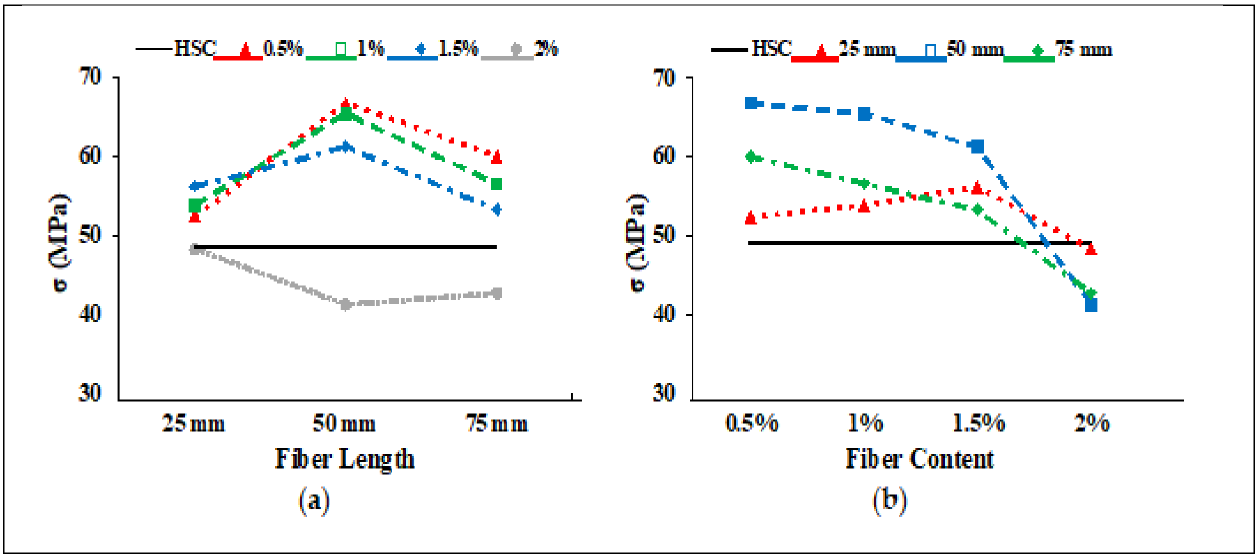
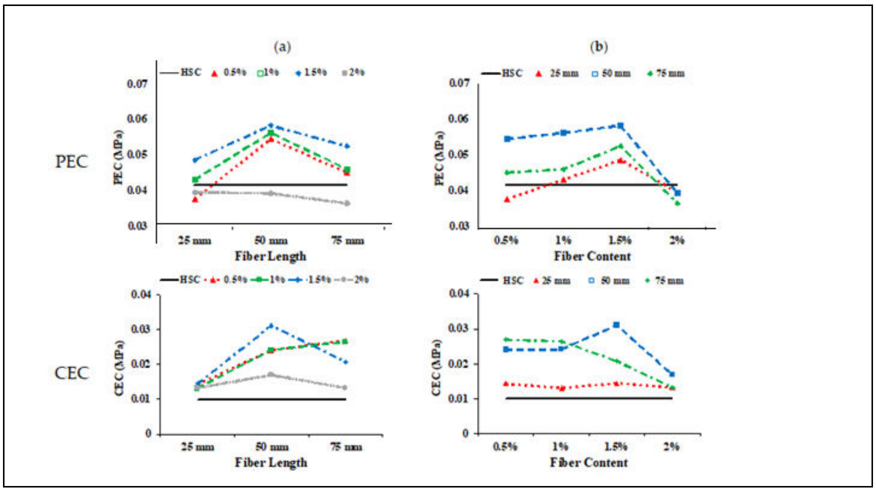


Figure: Influence on σ: (**a**) Fiber length; (**b**) Fiber content.

Energy Absorption in Compression and Toughness index:-

The areas below the stress–strain curve up to the first crack, from the stress of the first crack up to the ultimate stress, and from zero to the ultimate stress, are taken as the pre cracked energy absorption in compression (PEC), cracked energy absorption in compression (CEC), and total energy absorption in compression (TEC), respectively. The ratio of TEC to PEC was calculated as the toughness index in compression (TIC). Figure shows the influence of coconut fiber on di*ff*erent parameters with increasing fiber length and content. The CFR-HSC showed increased PEC compared to HSC. The PEC of CFR-HSC first improved and then deteriorated with increasing fiber length. With increasing fiber content up to 1.5%, the PEC was enhanced and then deteriorated. The PEC of CFR-HSC with 50 mm fiber length and 1.5% content had the maximum value, i.e., 40% higher than that of HSC. As expected, the CEC of CFR-HSC was higher than that of HSC. The addition of fibers provided significant stress resistance after the first crack by bridging the cracks, resulting in higher CEC. The CEC of CFR-HSC with 0.5% and 1% fiber content increased with increasing fiber length. In contrast, the CEC of CFR-HSC with 1.5% and 2% fiber content first improved and then deteriorated with increasing fiber length. The CEC of CFR-HSC reduced with increasing fiber content.



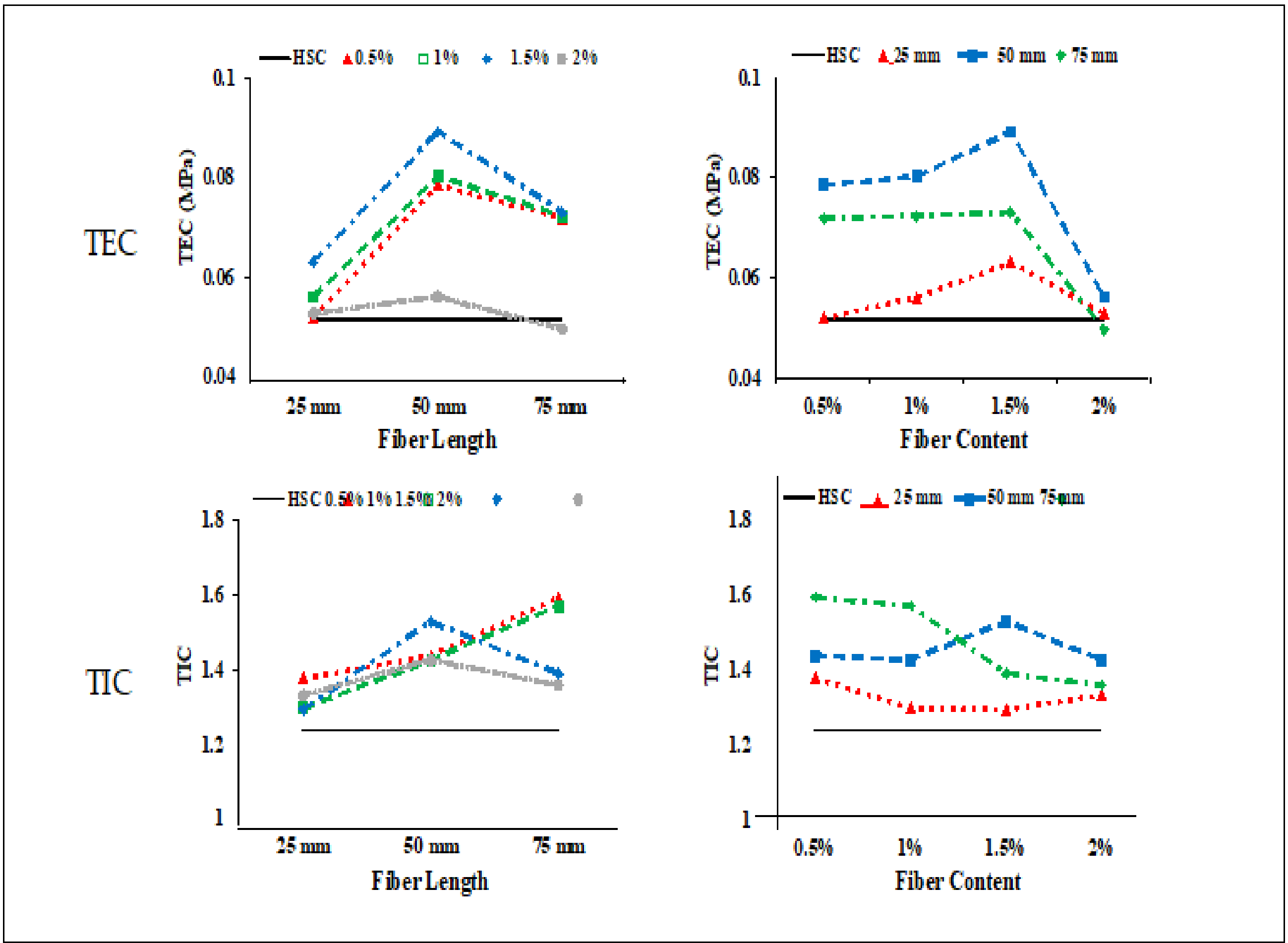


Figure :- Influence of coconut fiber on PEC, CEC, TEC, and TIC: (**a**) Length; (**b**) Content.

The possible reason for this may be improper compaction due to less workability of the fresh mix and the creation of air voids in the matrix because of higher fiber content, resulting in lower energy absorption after the first crack occurred. The CFR-HSC with 50 mm fiber length and 1.5% content had the highest CEC value. The solid straight line is the TEC of HSC. With increasing fiber length, the TEC of CFR-HSC was first enhanced and then deteriorated. For each fiber content, 50 mm long fibers had the maximum TEC value. The possible reasons for this are: (i) at 25 mm fiber length, the fibers are more for bridging the cracks, but their embedment length is short, resulting in fiber pull-out;

(ii) When the fiber length is 50 mm, relatively fewer fibers are present, but the embedment length is sufficient to hold the cracks together, resulting in a higher TEC value; (iii) when the fiber length is 75 mm, the embedment length is improved the presence of fewer fibers results in fiber breaking and a reduced TEC value. The TEC of CFR-HSC increases with increasing fiber content up to 1.5%, and then deteriorates. The possible reasons for this may be improper compaction due to less workability of the fresh mix, and cement paste dilution at higher fiber contents and longer lengths. The TEC of CFR-HSC with 50 mm fiber length and 1.5% content was improved by 73.2% compared to HSC. The TIC of CFR-HSC was always higher than that of HSC, as the incorporation of fibers provided stress resistance, especially after the maximum load by bridging across the cracks. The energy absorption capacity of concrete and toughness index, in compression, was improved by the addition of fibers, as also reported by Ali et al.Zia and Ali, and Khan and Ali.

Splitting-tensile Properties :

The STS was calculated from the maximum load taken from the splitting-tensile load-time curve. Figure shows the effect on STS with increasing fiber length and content. The solid straight line shows the STS of HSC. With increasing fiber length, the STS of the CFR-HSC with 0.5% and 1% fiber contents kept increasing, while at 1.5% and 2%, the STS was first enhanced and then slightly deteriorated. The STS is reduced with increasing fiber content. However, in the case of 50 mm fiber length, the STS has a maximum value at 1.5% fiber content, which is 20.4% more than that of HSC. For shorter fiber lengths, the STS of CFR-HSC was less than that of HSC because of insufficient embedment length to bridge the cracks. For longer fibers, the sufficient embedment length was available for bridging the cracks, resulting in increased STS compared to HSC. At higher fiber contents, the STS of CFR-HSC was reduced because of the creation of voids in the matrix and improper compaction due to higher fiber contents, which resulted in less workability. A similar trend in CFRC is also described by Ali et al. The improvement in STS due to the addition of fibers in concrete is also reported in the literature .The presence of fibers in CFR-HSC results in a bridging effect that holds the two pieces together. The samples of HSC and CFR-HSC after testing are shown in Figure 4.10. The CFR-HSC samples were intentionally separated after testing to observe the fiber failure. It was visually observed that some fibers were pulled-out, and that most were broken at the fracture surface. The embedment length of the fibers in the concrete increased with increasing fiber length, resulting in a reduced amount of fiber pull-out.

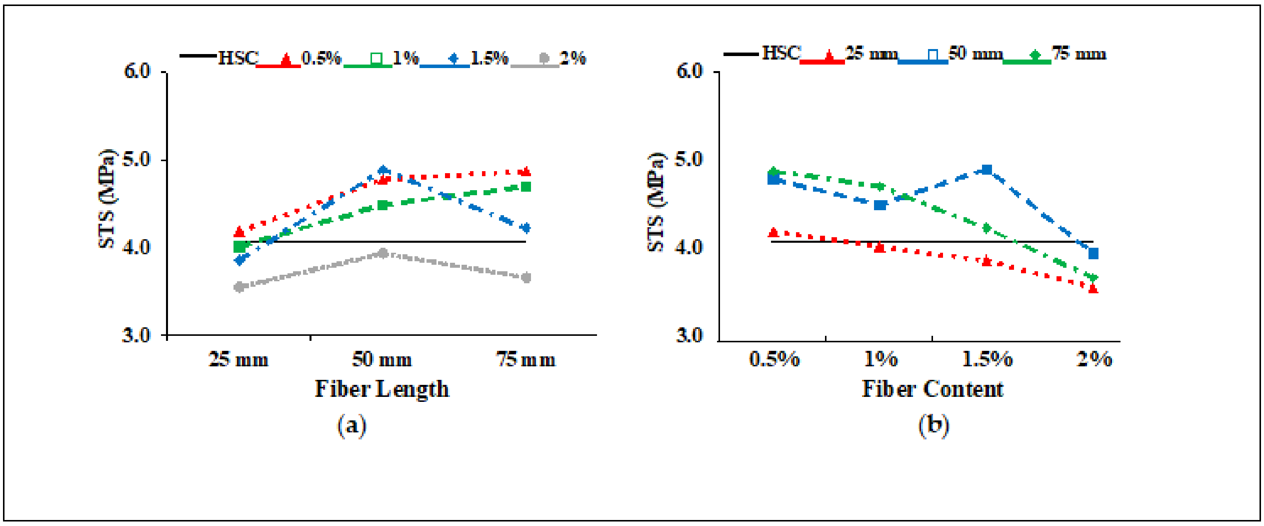


Figure: (a) Influence on STS: (**a**) Fiber length; (**b**) Fiber content

The possible reason for this may be improper compaction due to less workability of the fresh mix and the creation of air voids in the matrix because of higher fiber content, resulting in lower energy absorption after the first crack occurred. The CFR-HSC with 50 mm fiber length and 1.5% content had when the fiber length is 50 mm, relatively fewer fibers are present, but the embedment length is sufficient to hold the cracks together, resulting in a higher TEC value; (iii) when the fiber length is 75 mm, the embedment length is improved the presence of fewer fibers results in fiber breaking and a reduced TEC value. The TEC of CFR-HSC increases with increasing fiber content up to 1.5%, and then deteriorates. The possible reasons for this may be improper compaction due to less workability of the fresh mix, and cement paste dilution at higher fiber contents and longer lengths. The TEC of CFR-HSC with 50 mm fiber length and 1.5% content was improved by 73.2% compared to HSC. The TIC of CFR-HSC was always higher than that of HSC, as the incorporation of fibers provided stress resistance, especially after the maximum load by bridging across the cracks. The energy absorption capacity of concrete and toughness index, in compression, was improved by the addition of fibers, as also reported by Ali et al. Zia and Ali, and Khan and Ali.

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Flexural Properties :

Flexural Behavior:-During the flexural-strength testing of beams, flexural load-displacement curves were recorded for all specimens. The HSC beams suddenly fragmented into two pieces at peak load (Figure a). However, CFR-HSC were held together even after the peak load (Figure b–d). This is due to the bridging effect of the fibers in the CFR-HSC beams, which held the beam together after cracking. The flexural load-displacement curves for HSC and CFR-HSC are shown in Figure. To observe the fiber failure mode in CFR-HSC, the beams were intentionally broken into pieces. The fiber failures were of two types, fiber pull-out and fiber breakage. The fiber pull-out failure was reduced with increasing fiber length. The reason for this was that for shorter fiber lengths, the embedment length of the fiber in the concrete was shorter, resulting in increased pull-out failure; whereas for longer fibers, embedment length increases, thereby resisting the pull-out of fibers and resulting in increased fiber breakage failure.

(i)

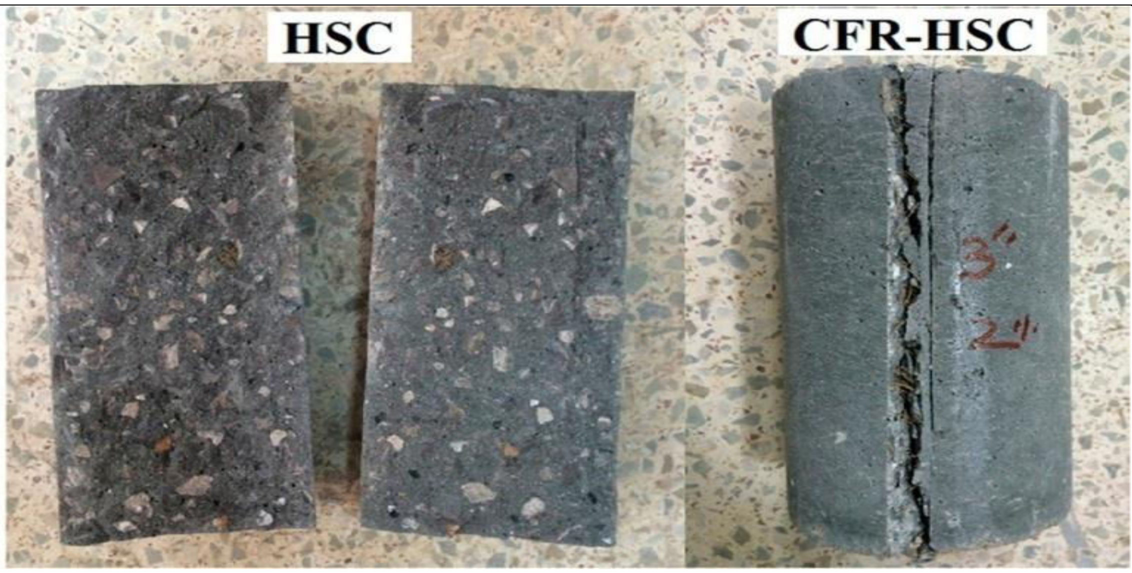


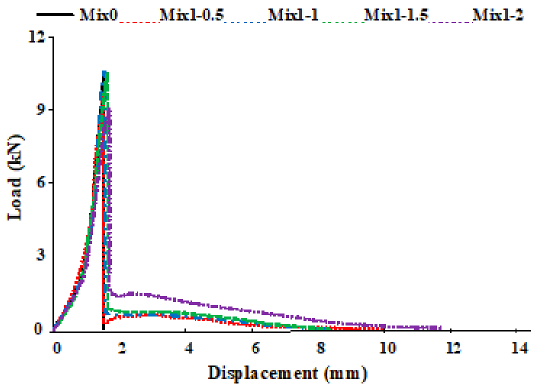
Figure (b) Influence on STS: (**a**) HSC; (**b**) CFR-HSC

(ii) When the fiber length is 50 mm, relatively fewer fibers are present, but the embedment length is sufficient to hold the cracks together, resulting in a higher TEC value; (iii) when the fiber length is 75 mm, the embedment length is improved the presence of fewer fibers results in fiber breaking and a reduced TEC value. The TEC of CFR-HSC increases with increasing fiber content up to 1.5%, and then deteriorates. The possible reasons for this may be improper compaction due to less workability of the fresh mix, and cement paste dilution at higher fiber contents and longer lengths. The TEC of CFR-HSC with 50 mm fiber length and 1.5% content was improved by 73.2% compared to HSC. The TIC of CFR-HSC was always higher than that of HSC, as the incorporation of fibers provided stress resistance, especially after the maximum load by bridging across the cracks. The energy absorption capacity of concrete and toughness index, in compression, was improved by the addition of fibers, as also reported by Ali et al. Zia and Ali, and Khan and Ali.

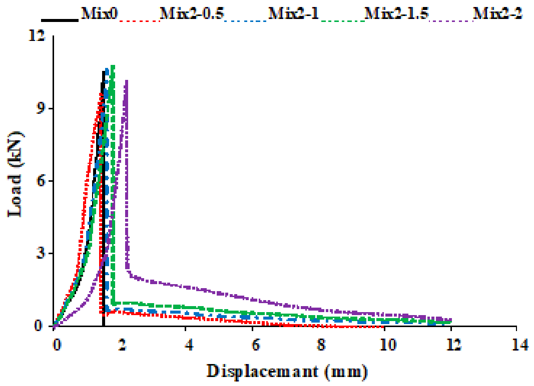
(a) (**b**)

(c) (d)

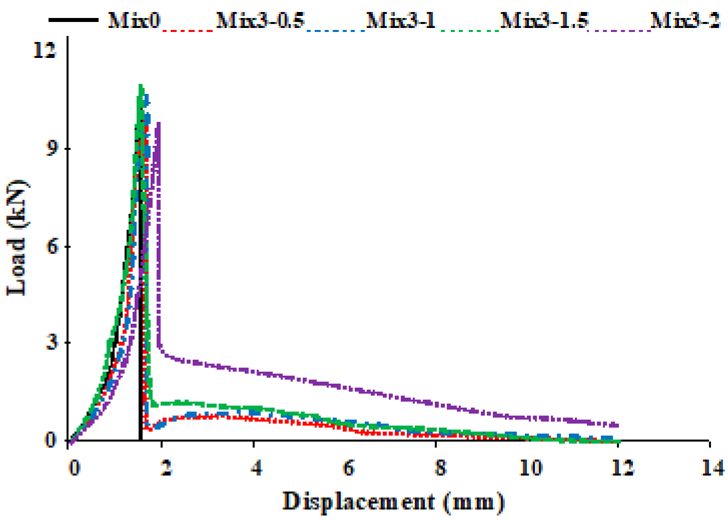
Figure: (a) Beams test: (**a**) Tested HSC beam; (**b**) Tested CFR-HSC beam; (**c**) Fiber


Mix0
Mix1-0.5
Mix1-1
Mix1-1.5
Mix1-2
Load (kN)
Displacement (mm)

(a)


Mix0
Mix2-0.5
Mix2-1
Mix2-1.5
Mix2-2
Load (kN)
Displacemant (mm)

(b)


Mix0
Mix3-0.5
Mix3-1
Mix3-1.5
Mix3-2
Load (kN)
Displacement (mm)

(c)

Figure: (b) Load-displacement curves for HSC and CFR-HSC beams with (**a**) 25, (**b**) 50, and (**c**) 75 mm long fibers

Modulus of Rupture (MOR) :

The MOR was calculated from the peak load in the load-displacement curve. **Figure (b) show** the effect on MOR with increasing fiber length and content. The solid straight line indicates the MOR of HSC. The MOR was enhanced with increasing coconut fiber length; a similar trend was also reported by Ali. Et al. Only with 2% fiber content, the MOR of CFR-HSC first improved and then deteriorated with increasing fiber length. With increasing fiber content up to 1.5%, the MOR was greater, while a low MOR was observed upon further increasing the fiber content. Compared to HSC, the MOR of CFR-HSC with a 1.5% fiber content and 75 mm length was enhanced by 5.4%. The MOR of CFR-HSC with 0.5% fiber content was less than that of HSC. The reason for this is that at 0.5% fiber content, the fibers are fewer, and unable to resist flexural load. The MORs of CFR-HSC with 1% and 1.5% fiber contents were higher than that of HSC because there was a sufficient amount of fibers to resist flexural load. With a 2% fiber content of CFR-HSC, the MOR was again less than that of HSC. The possible reasons for this may be: (i) the workability of fresh concrete decreased due to a higher content and longer length of fibers, and because proper compaction was not done during the casting of the specimens, resulting in the creation of air voids; (ii) the dilution of cement matrix/hardened cement paste due to the addition of fibers. The addition of fibers in concrete resulted in enhanced MOR; this finding is consistent with the results of Afroughsabet and Ozbakkaloglu, and Iqbal et al.

CONCLUSION: It was noted that the compressive strength decreased up to 2% replacement of the fine aggregate with PET bottle flakes and it drastically decreased for 3% replacement. Hence replacement of fine aggregate with 2% replacement will be reasonable. It was noted that the flexural strength decreased up to 2% replacement of the fine aggregate with PET bottle fibbers and it gradually decreased for 3% replacement. Hence replacement of fine aggregate with 2% replacement will be reasonable. It was noted that the split tensile strength decreased up to 2% replacement of the fine aggregate with PET bottle flakes and it drastically decreased for 3% replacement. Hence, the replacement of the fine aggregate with 2% replacement will be reasonable with high split tensile strength compared to the other specimens casted and tested. Hence, the replacement of the fine aggregate with 2% of PET bottle flakes will be much more reasonable than other replacement percentages like 1% and 3% as the compression, flexural and split tensile strength reduces drastically. It is concluded that a 2% replacement of fine aggregate gives lesser reduction in strength and gives adequate cost savings of Rs 9.5 per cubic meter of concrete. The concrete with PET fibers' reduced the weight of concrete and thus if mortar with plastic fibres can be made into light weight concrete based on unit weight.

Following are the conclusions can be made based upon the studies made by various researches:

1. Plastics can be used to replace some of the aggregates in a concrete mixture. This contributes to reducing the unit weight of the concrete. This is useful in applications requiring non-bearing lightweight concrete, such as concrete panels used in facades.
2. For a given w/c, the use of plastics in the mix lowers the density, compressive strength and tensile strength of concrete.
3. The effect of water –cement ratio of strength development is not prominent in the case of plastic concrete. It is because of the fact that the plastic aggregates reduce the bond strength of concrete. Therefore, the failure of concrete occurs due to failure of bond between the cement paste and plastic aggregates.

Advantages:

- Light weight concrete is prepared for special structure.
- Utilization of waste plastics.
- Reduction of environment pollution due to plastic.
- The growth in the use of plastic is due to its beneficial properties, which include:
- Extreme versatility and ability to be tailored to meet specific technical needs.
- Lighter weight than competing materials reducing fuel consumption during transportation. x Durability and longevity.
- Resistance to chemicals, water and impact.
- Excellent thermal and electrical insulation properties.
- Comparatively lesser production cost.
- At melting point the bonding capacity increases as the temperature increases. The following are the main disadvantages of using the plastics in concrete:
- Plastics are having low bonding properties so that the strength of concrete gets reduced such as compressive, tensile and flexural strength.
- Its melting point is low so that it cannot be used in furnaces because it gets melt as its comes in contact with the heat at high temperature.

Limitation:

- Only Up to 10%sludge can be used.
- Not used in road work and mass concrete.
- Sludge only which passes through 90-micron sieve used.

Future scope

We get most of the aggregates by quarrying the stones and then crushing. As quarrying of stones cause change in geological aspects of the area, crushing causes the entry of dust particles in the environment. So causing bad impact to the environment in dual manner. To minimize these researchers focused on the usage of waste materials that were also adversely affecting the environment. Some of these are already in use such as Iron slag, Crusher Dust, etc. and many others are under research. So usage of these waste materials helping in dual role by minimizing the usage of raw material of concrete and by using the waste materials that are affecting the environment. The other advantage of using these waste materials is that they are helping in improving the properties of concrete. The waste materials we have taken for our study is Plastic. Plastic has very bad impact on our environment but due to some of its properties it can be used in concrete.We have performed the experimental investigation to check the strength and performance of design mix concrete i.e. M25 grade as various replacement of NCA with PCA. Various tests performed in the laboratory are compressive strength, split tensile strength, and flexural strength by curing the specimen at 7 days, 14 days and 28 days. In future, it can be tested for durability conditions and effect of various chemical reactions on it. It can also be tested for higher grades of concrete. The strength of concrete containing PCA for a longer age of curing can also be tested

Different applications of waste plastic :

- Bituminous pavement
- Concrete block
- (PET) waste as building solution
- Roof tiles
- Plastic formwork

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