Study on Polypropylene FRC with 50 percent replacement of M-sand and varying percentage of lathe machine waste

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Abstract— As we know, India is developing country and in future high strength, high performance and economical concrete is necessary for construction works. The mixture of Lathe machine waste steel scrap fibre and polypropylene Fibre reinforced concrete increases its structural integrity. The characteristics of FRC changes with addition of FRC materials, orientation of fibre, distribution and geometries of FRC. Artificial sand (M-sand) is the best option to replace the river sand and M-sand is purposely prepared, fine crushed aggregate formed under controlled conditions from a suitable sand source rock. The basalt rock is the locally available and it is used as a source for artificial sand. Design mix of M40 grade concrete with replacement of 50% of M-sand has been considered for laboratory analysis. Polypropylene fiber is a light weight synthetic fiber. It prevents crack formation and provides reinforcement to the concrete structure. In this study, a comparison have been made between plain cement concrete and the fibre reinforced concrete containing lathe scrap (steel scrap)in various proportions by weight. The fibre used is irregular in shape and with varying aspect ratio. In this study polypropylene fibers of constant percentage (i.e.1%), Lathe machine waste steel scrap fiber of different percentage (0.5%, 1%, 1.5%, and 2%), and M-sand of constant percentage (i.e. 50% replacement of river sand) is added to concrete. Tests on workability, compressive strength, tensile resistance, flexural strength and durability tests are conducted on specimens and the results of various percentages of fibres in concrete have been compared with plain concrete and the result have been projected.

Keywords— M-Sand, Polypropylene fibres, Lathe machine waste steel scrap, Compressive strength, Split Tensile Strength, Flexural resistance tests.

I. INTRODUCTION

The ability of concrete structure to oppose weathering activity, acid rain, wear and tear and other deterioration processes of existence with the negligible repairs is similarly essential as the limit of a structure to oppose the loads connected on it. Even though concrete offers numerous points of interest with respect to mechanical qualities and economic parts of the development, the weak performance of the material remains a bigger issue for the seismic and different applications where the flexibility is required. Recently the improvement of PPF and LMWSS fibres has specified to enhancing these deficiencies. The mix of PPF and LMWSS influences the different properties of wet concrete and hard concrete, compressive quality, elasticity, flexural quality, workability, bond quality, prevent crack, damage of creep, and chloride entrance. Concentration for robo sand for making concrete is expanding step by step as natural sand can't take care of the rising demand of development segment. Characteristic natural sand takes a huge number of years to form and isn't repleneshible. Since of its limited supply, the cost of natural fine aggregate has increased and its expected supply cannot be ensure. Under this condition utilization of M-sand winds up unavoidable. Natural sand in numerous parts of the nation isn't reviewed legally and has over the top sediment and natural contaminations and these can be harmful to reinforcement of concrete while artificial sand has no residue or expected pollutions since it is made in controlled condition. Crushed stone deliver considerably more dashing and stretched aggregates, which have a high surface-volume proportion and very good bond.

II. LITERATURE REVIEW

Past detail investigation gives the information regarding previous studies performed of mixture polypropylene fibre, steel waste scrub used as fibre and use of M-sand in hybrid fibre reinforced concrete project work and its strength parameters, material used, material proportions, different grades of concrete strength, Future project ideas. With the help of the literature review, we can determine how to investigate in future works.[1] Priti Patel et.al. [2012]The exploration program on the assessment of the execution of ppf strengthened cement. The proximity of fibre in solid cautions is the disappointment of material. It is discovered that the disappointment method of conventional cement is mostly because of spilling, while the disappointment method of fibre solid twists in transverse ways. Compressive power change ranges from 8% to 16% for PFRC. Fortifying of quality in ductile cleavage because of the expansion of polypropylene fiber ranges from 5% to 23%. The most extreme increment in twisting level of PFRC is 36%.[2] Mehul J. Patel, S. M. Kulkarni [2013]Were considered on the impacts of expansion of different extents of PPF on the properties of High quality cement. A trial program was done to investigate its consequences for compressive, malleable, flexural, shear quality and plastic shrinkage splitting. An outstanding increment in flexural, ductile and shear quality was found. The investigation on the impact of fibrillated Ppf with various cut length can in any case be a talented job as there is dependably require beat to the issue of cement weakness. Compressive strength increments with the expansion in the level of Fly cinder and ppf up to expansion of Cement in Concrete of various blend.[3] Dr.S.Elavenil: et.al. [2013]Express that the blend with assembling fine aggregate as 100% fine total impart beginning usefulness of 170mm, which is significantly superior than that of the blends with 100% river fine aggregate and crusher clean. The standard blend with 100% fabricated sand has shown significantly superior compressive quality 53 MPa. The standard blend with 100% of waterway sand has displayed compressive quality of 49MPa, 7.5% lower than that of produced sand. Research results inferred that, contrasted with concrete produced using river sand, high fines concrete by and large had higher flexural quality and high unit weight and lower pores because of adding the pores with small scale fines.

[4] Irwan lie keng Wong:[2013]"Study of utilization of waste lathe scrap on increasing compression force and tension force of cement concrete" In this research method, they have mixed the lathe waste in three proportions, i.e. 0.5, 1 and 2%. The results show that the compressive strength

increased by 16.4% and tensile strength increased by 25.3% due to addition of waste lathe by 2% as compared to plain cement concrete.[5] Sirule Pravin.et.al: [2012]"utilization of lathe machine steel waste scrap as fibre reinforce material to improve properties of concrete" In this study, a comparison has been made between plain cement concrete and steel scrap (i.e. 0.5%, 1%, 1.5%, 2%) by weight of cement has been taken into account. Compressive force, tensile force and flexural strength of SSFRC is initiate to be maximum for volume portion of 1.5% steel scrap fibre.[6]AliAkbar Merati, Masud Latifi, Hamidd Pakravan.[2013] The use of PPF is contemplated in dissimilar proportions and strings distance end to end to improve the presentation characteristics of the light heaviness binding compound. PPF are performed as part of 2 unique length of 6 mm-12 mm and fibre 0.15% - 0.35% by mass in the mixture. Contrary to immobile LWC, reinforced light concrete composites (PPf) with a fiber ratio of 0.35% and 12 mm fiber length, the 30.1% increase in flexural quality and an increase of 27% in the partial rigidity. Extensive fiber accessibility despite the capacity of PPf strings to connect to smaller scale fractions is recommended as the objectives behind the improvement in mechanical properties. All reinforced lght weght concrete examples show changes in their mechanical quality due to FRC implementation in concrete frameworks. Under all fibers and lengths, the PPf with 12 mm distance end to end and the extent of 0.35% perform improved in all compliments, in contrast to the mechanical and physical property of FRC lightweight cement concrete.[7] N.B.Navale: .[2015]From Sinhgad College of Engineering Sholapur, India The paper presents review of research work experimental investigation on ppfrc and concrete mixture of fabricated sand. Use of fibre reinforce polymer in civil engineering increase rapidly. Various type of fibre is used such as glass, carbon, steel, asbestos, polyester and polypropylene. The various experimental investigations for determination of properties of polypropylene fibre are discussed in paper work. This investigation gives the information of effect of ppf on different properties of concrete. [8] Amit Rai1, Dr. Y.P. Joshee: .[2013]SATI Govt. engineering collage department of Transportation Engineering Vidisha Madhypradesh. Give the detailed information of approximately normal concrete, due to volume change or temperature change, the shrinkage cracks are obtained before loading and when structure is loaded micro crack exposed to atmosphere. Result in sturdy buckles in concrete. Non-fragile concrete filaments cement unbreakable concrete mixtures with more or less randomly divided small fibers. In this specific concrete small ppf, randomly mixed, and concrete features in all directions. These fibers help to take the load without cracking. It is fertile in construction industry with its outstanding flexible tensile strength, resistance to spit, accident battle and impermeability. This method help to increase hardness and plastic shrinkage of the mortar are resisted.

[9]James E. Shoenberger, Joe G. Tom.: [2014]Investigate PFRC to provide enhanced effect opposition with expanding volumes of strings. A PFRC mixture gives a decrease in permeability, so that the water concrete ratio remains below 0.5. Expanded scales of filaments also reduce the porosity, as the blend was serviceable. The investigation shows a decrease in plastic shrinkage with the extension of measures of strings.

III. AIM AND OBJECTIVES

The aim of the work: Intend of the current experiments is to learn the strength and characteristics of polypropylene Fibres and lathe machine waste steel scrap fibre using M-sand replacement with river FA in cement concrete.

Objectives:

[1]To learn the properties of different mix proportion of fibres which are reinforced in concrete when fine aggregate is replaced by manufactured sand and with the addition polypropylene fibres and lathe machine waste steel scrap. [2]To determine the changes in compressive and tensile strength when river sand is replaced 50% with M-sand, 1% polypropylene fibers and partial replacement i.e 0.5,1.0,1.5,2.0 percentage of LMWSS. [3]To obtain high strength value of concrete. [4]To produce a concrete which is dense-compactable and having high resistance towards environmental effects. [5]To study the compatibility of fibers in obtaining a high strength concrete

IV. MATERIALS AND METHODS

A. CEMENT

53 Grade of OPC (Ordinary Portland Cement) Ultratech Company according to IS 12269:1987 used in this project. The details of basic tests conducted are as follows.

Table no. A. Basic test on cement.

Sl. No.	Properties of Cement	Result values	According to IS12269-1987
1	Fineness	2.5 percent	<10 percent
2	Soundness of sample	1mm	<10 percent
3	initial setting time	56 minute	<30 minute
4	Standard Consistency	32 percent	-
5	Specific gravity	3.09	-

B. Coarse Aggregates

CA used were 20 mm down size locally available from crusher plant and free from chemical compounds, salinity, dust etc. The source of CA is basalt rock. According to IS:383-1970 both 10mm and 20mm CA are confirmed as well graded and the detail of basic tests conducted are as follows.

Table No.B. Test Results of CA

Sl. No.	Test	Results
1	SG of 20 mm CA	2.7
2	SG of 10 mm CA	2.59
3	Fineness Modulus	6.42
4	Water Absorption	0.67
5	Impact Value 10,20mm	13,15

C. Fine Aggregates (River Sand)

FA passing 4.75mm has considered for experimental investigation. According to IS: 383-1997 the river sand placed to zone II and the details of tests on river sand are as follows.

Table No.C. Test results of FA

Sl. No.	Test	Result
1	Fineness of FA	3.87
2	SG of FA	2.61
3	Bulk density of FA at loose and dense condition	1.32 g/cc, 1.75 g/cc
4	Silt content	3.1%

D. M-Sand

Manufacture sand or robo sand was used at 50% constant replacement to natural fine sand. The robo sand used in this study was obtained from locally available crusher plant of size less than 4.75 mm. In Kalaburagi area abundant availability of basalt rock is used as the row material for artificial sand under controlled condition and confirming to IS: 383-1997 this fine aggregate comes under zone II. The results of various basic tests were conducted is given as below table.

Table No.D. Test results of M-sand Aggregate

Sl.no	Test	Result
1	Fineness of M-sand	3.815
2	SG of M-sand	2.85
3	Bulk density of M-sand at loose and dense condition	1.65 g/cc , 2.12 g/cc
4	Silt content	1.8%

E. WATER

A portable drinking water has used for mixing of concrete ingredients. It was found to be free from chemical and organic impurities.

F. Polypropylene Fibers

Fine polypropylene mono filaments were used as the fibre. Balaji reinforcements textile company Hydrabad, Telangana supplied the fibres. The technical details of polypropylene fibre used are tabulated below.

Table No.F. Technical Specifications of Polypropylene Fiber of 26 mm Length

Sl.no.	Particulars	Characteristics
1	Length of PPF	12 mm
3	Number Of Filament Per Kilogram	59,000
4	Surface Texture	Embossed
5	Specific Gravity	0.90-0.92

Fig.No.F. Polypropylene Fibre

G. Lathe machine scrap

LMWSS is the waste material or byproduct of lathe machine which are used as FRC to study the mechanical property of the concrete and are compare to plain concrete. It is locally available in steel industries and workshops at very low cast i.e 15 rupees per kilogram.

Table No.G. Lathe machine Scrap (LMS)

Sl. No.	Property	Lathe Machine Scrap (Lms)
1	Type	Turned And Deformed
2	Length	40-60mm
3	Diameter	0.4-0.8mm

Fig.No.G. Lathe Machine Waste Steel Scrap

H. BUILD PLAST ADMIXTURES

This admixture were experimented on ppfrc to know the changes in workability and flow ability of concrete.VISTA CHEMTECH PVT.LIMITED Pune. confirming to is: 9103-1999 supply the admixture that shows in figure bellow.

DOSAGE:

For flowing concrete : 0.5 – 1 % by weight of cement.

For high strength through water reduction : 1 – 2 % by weight of cement.

In our study 2% dosage of this admixture by weight of cement were used.

Fig. No.H. Buildplast admixture

I. Mix Proportion of Design

Table No.I.Mix proportion

Grade	Cement (kg/m^3)	Fine Aggregate and M-sand (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (lit./m^3)	Chemical admixture (lit./m^3)
M_{40}	350	685.31	1242.92	164.12	7
	1	1.95	3.55	0.4	-

J. Designation of concrete mix

Table No.J. Type of Different Mix

Designation of concrete mix. Grade	River sand (%)	M-sand (%)	PPF (%)	LMWSS (%)
Normal CC	100	0	0	0
FRCMS-I	50	50	1	0.5
FRCMS-II	50	50	1	1.0
FRCMS-III	50	50	1	1.5
FRCMS-IV	50	50	1	2.0

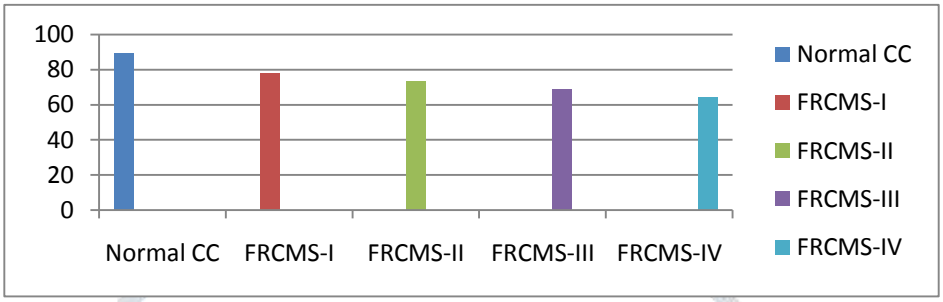
V. Test Conducted on This Projects

I. Slump Cone Test

Fig. No.I. Slump Cone Test

Table No.I. Shows the result of workability test.

Sl. No	Mix ID	Obtained slump value in mm
1	Normal CC	89
2	FRCMS-I	78
3	FRCMS-II	73
4	FRCMS-III	69
5	FRCMS-IV	64

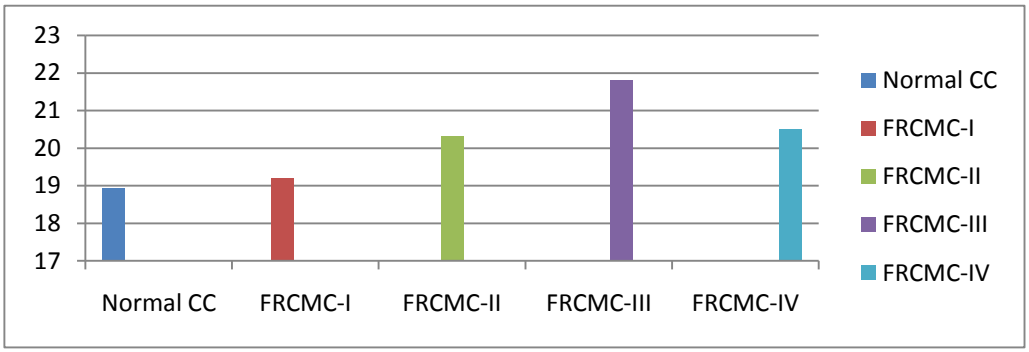


Graph I shows the workability test.

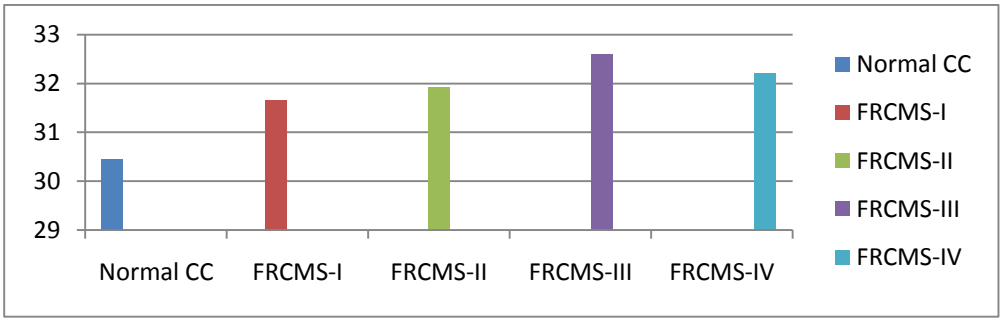
II. Compressive strength

Table no.II Compressive strength results at 3,7&28 days.

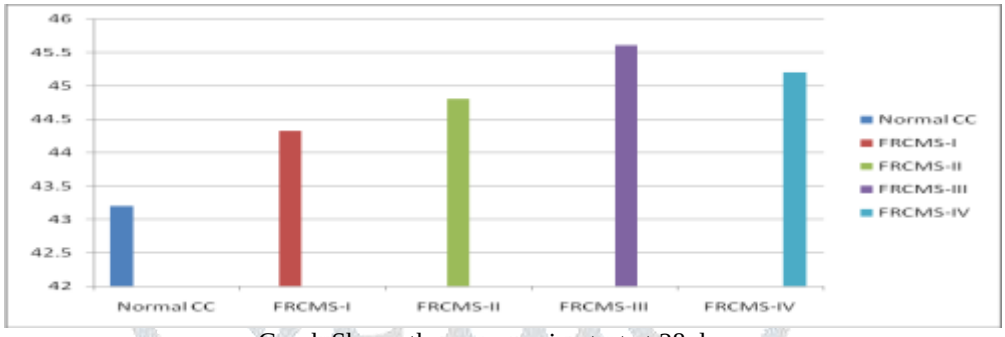
CURING PERIOD	Designation of CC mix. grade M40	AVG. COMPRESSIVE STRENGTH N/mm^2
3 days	NORMAL CC	18.93
	FRCMS-I	19.20
	FRCMS-II	20.32
	FRCMS-III	21.80
	FRCMS-IV	20.50
7 days	NORMAL CC	30.44
	FRCMS-I	31.66
	FRCMS-II	31.91
	FRCMS-III	32.60
	FRCMS-IV	32.20
28 days	NORMAL CC	43.20
	FRCMS-I	44.32
	FRCMS-II	44.80
	FRCMS-III	45.60
	FRCMS-IV	45.20



Graph shows the compression test at 3 days.



Graph Shows the compression test at 7 days.

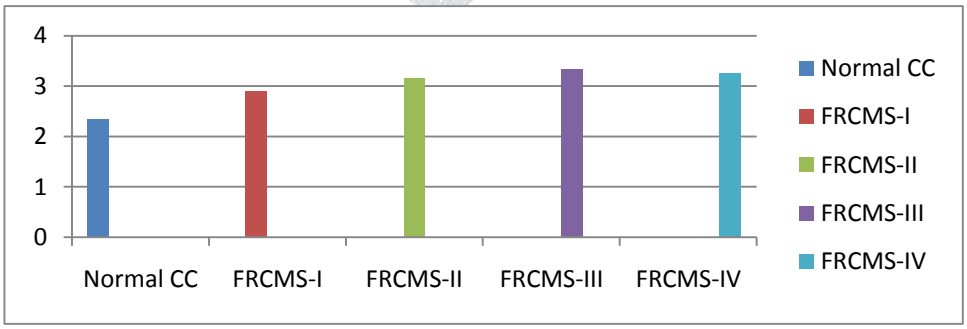


Graph Shows the compression test at 28 days.

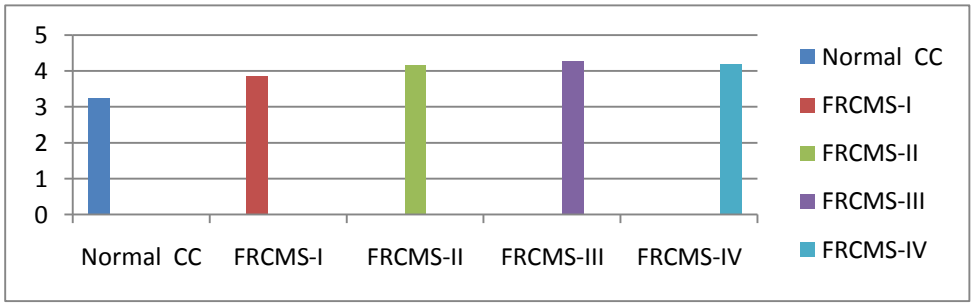
III. Split Tensile Strength

Table No.III Split Tensile strength results at 7&28 days.

Curing Period	Designation of CC mix. grade M40	Avg. Split Tensile Strength N/Mm^2
7 days	NORMAL CC	2.35
	FRCMS-I	2.9
	FRCMS-II	3.15
	FRCMS-III	3.34
	FRCMS-IV	3.26
28 days	NORMAL CC	3.25
	FRCMS-I	3.85
	FRCMS-II	4.15
	FRCMS-III	4.28
	FRCMS-IV	4.19



Graph Shows the tensile test at 7 days.

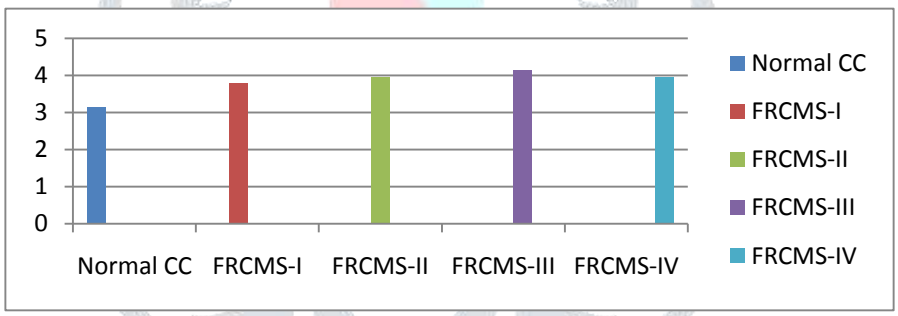


Graph Shows the tensile test at 28 days.

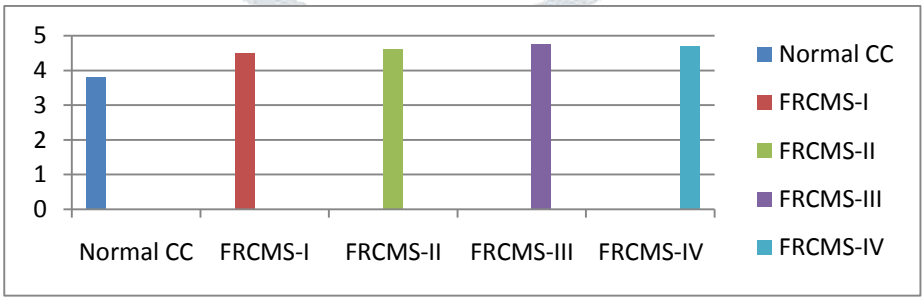
IV. Flexural Strength

Table No. IV Flexural Strength results at 7&28 days.

Curing Period	Designation of CC mix. grade M40	Avg.Flexural Strength N/Mm^2
7 days	NORMAL CC	3.15
	FRCMS-I	3.80
	FRCMS-II	3.95
	FRCMS-III	4.15
	FRCMS-IV	3.95
28 days	NORMAL CC	3.80
	FRCMS-I	4.50
	FRCMS-II	4.61
	FRCMS-III	4.75
	FRCMS-IV	4.69



Graph: Shows the flexural test at 7 days.



Graph Shows the flexural test at 28 days.

V. Acid test

A concrete specimen sample of different mixtures with a size of 150 mm was casted & the sample was taken out from the water and dried for 24 hours after curing for 28 days. Take the weight of the concrete cube sample. The acid corrosion test of the concrete cube was carried out by curing the cube in acidic water for 28 days. H_2SO_4 (Sulphuric acid) having 2 PH value in 5% by mass of water was added to the water in which the specimen was stored. After 28 days of immersion, the concrete cubes were removed from the acidic water. Then the opposition of the specimen to acid attack is established by the % of weight loss of the sample. And it is observed that the average weight loss in normal CC 4.12% and optimum mix FRCMS-III is 2.37%

Table V: Represents Test results of acid attack with the weight loss in percentage

Sl.No	Mix	Initial weight of cube after 7 days	Weight of cube after 7 days	Percentage loss in weight
1	Normal CC	8.890	8.500	4.38
		9.108	8.730	4.16
		8.973	8.607	4.07
2	Optimum mix FRCMS-III	9.276	9.020	2.76
		9.398	9.094	3.23
		9.146	8.873	2.98

VI. CONCLUSION

I) Up to 1.5% adding of lathe machine waste with 1% of polypropylene fibre and 50% of M-sand there is optimum percentage to increase in all mechanical properties.
II) Compressive strength of specimen improved with addition of steel scrap fibre content up to 1.5% Strength enhancement up to 15.16% for FRCMS-III.
III) Strength improvement in splitting tensile and flexural strength due to mix of FRCMS-III is 31.69% and 25%.
IV) The durability of concrete improves and addition of lathe waste polypropylene fibers greatly improves the fracture parameters of concrete. Polypropylene fibre is Reduce number of joints And Reduce repair due to subsequent damage.
V) The compressive strength, split tensile strength enhanced with the adding of fibre content as compared with normal concrete.
VI) The flowability of PPF concrete has been observed to reduce with increase in PPF content.
VII) To improve the economy of construction industry with usage of M-sand which is easily accessible than natural sand.
The experimental work shows that the compressive, flexural and split tensile strength appear to increase gradually till 1.5% of lathe scrap added concrete and then a gradual decrease in the strength is observed. The compressive strength is increased by 15.16%. The flexural strength is increased by 25% and the split tensile strength is increased by 31.69% at 28 days curing period.

VII. Future Scope

I. The effect of rusting of the steel lathe scrap on the strengths of concrete can be determined. Also, the effect of addition of lathe scrap on the reinforcement provided in R.C.C structure can be determined.
II. Use of different plasticizers or additives for study the strength behaviour of mixture of Pfrc & lathe machine waste steel scrap fibre concrete with various proportions of mixing.
III. To study the details durability properties of mixture of Pfrc & lathe machine waste steel scrap fibre concrete like acid attack and other chemicals attack.
IV. To study the detailed structural behaviour of mixture of Pfrc & lathe machine waste steel scrap fibre using replacement M-sand of different percentages in concrete.
V. Add different types of fibres to investigate the strength characteristic of artificial sand with fibre reinforced concrete.

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