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MECHANICAL PROPERTIES OF FIBRE REINFORCED CONCRETE WITH PARTIAL REPLACEMENT OF RIVER-SAND BY FOUNDRY WASTE

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Abstract: Day by day construction industry is growing. In construction industry concrete is prime element that is used in most of regions due to its properties and durability. Concrete made up with mainly three elements are Cement , Sand and Aggregate. In those one of the important material is sand , now a days sand (Well Graded River Sand) is most difficult part to get it. To overcome that most researches are done and lots are in process. In this research Fibres are added in concrete in mono and in hybrid way to recover strength losses from addition of waste foundry sand in concrete. In this paper river sand is partially replaced with Waste Foundry Sand. Foundry Industries are also growing, so alternatively foundry waste generation is also increased. That foundry waste is called Waste Foundry Sand. That Waste Foundry Sand is also has three quality classifications. Foundry Sand is mainly generated by moulds or it is by product of burning of Coal Sand. Foundry Industries are mainly divided into three types. First class Foundry Industry uses coal sand for casting after that its waste sand is used by second class foundry industry to cast materials. Later on that class II industry waste sand is used by third class foundry industry to produce casting and then class III industry waste is then called as Waste Foundry Sand. That waste is mainly used for Landfill purpose. That sand is used to in this research, to partially replace the river sand in concrete. Fibres are one of the most convenient mode by which strength of concrete can be increased. In this research paper Steel and Galvanized Iron fibres are reinforced in concrete. Fibres in concrete acts as like root of tree adheres soil. Different types of fibres increases different types of strengths. In this research paper 1.5 % of volume of concrete ,fibres are added.

Index Terms **–Fibre Reinforced Concrete, Waste Foundry Sand (WFS).**

1. Introduction –

Waste Foundry Sand is mainly used for landfilling purpose. This sand has no use in current scenario. That Waste Foundry Sand is used in this research to partially replace the river sand in concrete. Again the strength losses occurred due to addition of Waste Foundry Sand are recovered with addition of fibres in mono and hybrid way. Fibres used are Stainless-Steel and Galvanized Iron. In this paper River sand is partially replaced with Waste Foundry Sand in percentage of River sand and losses in concrete with it, is recovered with addition of Fibres in mono and in hybrid way. The future research scope is vast in this area because there are two main problems are covered in this research paper. First one is Waste Foundry Sand is issue of Solid Waste Management and River sand required for concrete is decreasing day by day. Second one is concrete also has many defects due to things like poor workmanship, lack of quality material or material variation in different locations, lack of mix design that type of problems can be recovered with addition of fibres in concrete. Foundry sand replacement will be possible up to 30-40% [1]. However its depends upon foundry sand gradation.

The main aim of this research paper is to find optimum percentage of replacement of Waste Foundry Sand with river sand in concrete. And the second objective is to recover losses occurred in concrete with addition of fibres. The fibre addition is done in two ways , one is in mono way , in this fibres are added in 1.5% of volume of concrete in fixed l/d ratio and second is in hybrid way in this fibre two different fibres are added in 0.75% each of volume of concrete in fixed l/d ratio.

2. Materials -

2.1. Waste Foundry Sand –

Waste foundry sand used in this research paper is from class III industries in Kolhapur MIDC (Maharashtra) area. These foundry sand contains both ferrous and non-ferrous metal castings. Class of Waste Foundry Sand is given below in table –

Table .1 Foundry Sand Indusrty Classes

No.	Industry Class	Raw Material Used (Input)
01.	Class I	Coal Sand – 96 % potential
02.	Class II	Waste Sand from Class I
03.	Class III	Waste Sand from Cass II
04.	Landfill	Waste Sand From Class III 0% Coal.

Waste Foundry sand used in this research is taken from "Siddhi Industries, MIDC , Kolhapur."This industry comes under Class III Industry category where its waste foundry sand has no further use in industrial work.This Foundry Waste sand is land-filled. These type of Foundry sand has low particle size. as it creates air pollution if it gets spread in air. This sand is black in colour.Waste Foundry Sand has Specific Gravity – 2.39.

2.2. Fibre –

In this research, two types of fibres are used , one is Steel Fibre and another is Galvanized Iron fibre.

Table 2 Physical Properties of Fibres

No.	Fibre Name	L=Length mm	D=Diameter mm	L/D ratio
01	Steel	16	0.2	80
02	GI	16	0.2	80

Steel Fibres – Fibres used in this research work is manually created from steel wire according to aspects ratio shown in table 2.
GI Fibres – Fibres used in research work is manually created from locally available GI wire.

2.3. Cement –

In this research work , " Birla Super PPC Cement " is used.

2.4. Course Aggregate –

In this research work , locally available course aggregate is used. (Well graded Course Aggregate . Retained on 4.75 mm sieve.)

2.5. Fine Aggregate –

In this reseach work , locally available fine aggregate is used (Grading Zone – II , specific gravity – 2.5)

2.6. Water –

In this research work , potable water is used for experimentation.

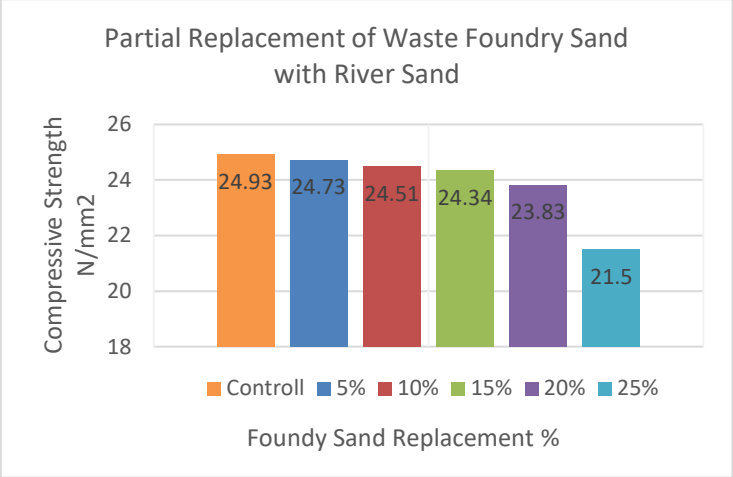
3. Results

3.1. Partially Replacement of Foundry Waste Sand in Concrete with River Sand –

Following table shows result of Waste Foundry Sand partially replaced with River Sand in concrete.

Table 3 Compressive Strengths of Waste Foundry Sand replacement in different percentages with river sand.

Sr. no.	WFS % rep. / Specimen	Compressive Strength N/mm^2					
		Plain Concrete 0%	5 %	10 %	15 %	20 %	25 %
1	C1	24.75	24.20	24.45	24.37	24.60	21.80
2	C2	25.14	24.90	24.27	24.54	22.41	20.60
3	C3	24.90	25.10	24.83	24.12	24.49	22.10
4	Avg	24.93	24.73	24.51	24.34	23.83	21.50



In this research work Mix Proportion used is 1: 1.43 : 2.62 . Water Cement Ratio used is 0.5 .In this work Waste Foundry Sand percentage replacement are with volume of river sand in concrete. The optimum percentages of replacement are from 20 to 40 % [2] but as safety factor and practical usage of this will not exceed of 30% replacement[3] . As the result in table 3 , Optimum Percentage replacement of Waste Foundry Sand is 20 % without gaining strength below grade of concrete.(As observed from table strength of 25 % replacement is getting strength 21.50 N/mm^2 which is still greater than M 20 grade – 20 N/mm^2 but considering factor of safety and influence of different materials , different methods of mixing , 20 % replacement is taken as optimum percentage to use in practical situations.)

Second stage of this research work is to add fibres in mono and in hybrid way in partially replaced river Waste Foundry Sand in concrete.

3.2. Fibre Reinforced partially replaced river sand with Waste Foundry Sand in Concrete –

Steel Fibre is added in concrete with 1.5 % by volume of concrete. Steel fibre reinforcement gets slow down after addition of 1 % upto 2 % and then after its starts decreasing slowly [7] . Also GI fibre is added in 1.5 % by volume of concrete in concrete. And also Steel and GI fibres are added in combined with percentage of 0.75% each by volume of concrete in concrete. The result is as shown in below Table 4. As % of steel fibres increases workability starts to decrease [8].

Table 4 Compressive Strength of Concrete with addition of Fibres in mono and hybrid way.

Sr. no.	Specimen	Compressive Strength N/mm^2			
		Control	Steel (S)-1.5%	Galvanized iron (G.I)-1.5%	S+G.I (0.75+0.75)%
1	C1	24.60	25.10	26.27	25.95
2	C2	22.41	26.15	27.15	26.70
3	C3	24.49	27.13	27.92	27.45
4	Avg	23.83	26.12	27.11	26.70
5	% Increased in strength	-	+ 9.60 %	+ 13.76 %	+ 12.04 %

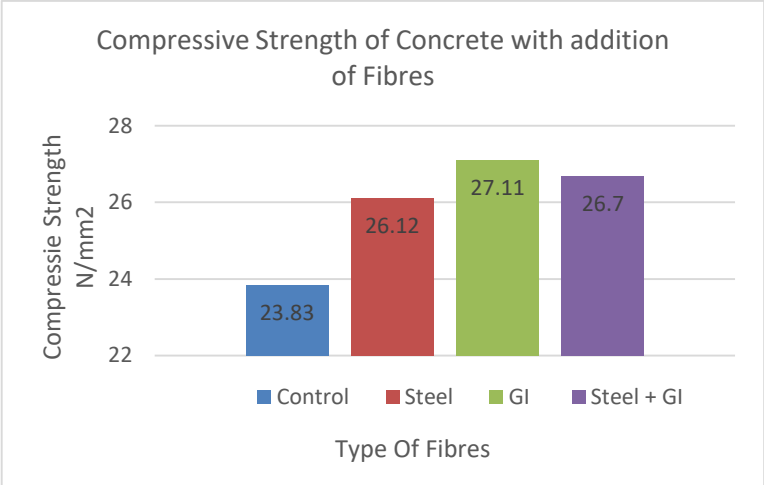


Table 5 Flexural Strength of Concrete with addition of Fibres in mono and hybrid way.

Sr. no.	Specimen	Flexural Strength N/mm^2			
		Control	Steel (S)-1.5%	Galvanized iron (G.I)-1.5%	S+G.I (0.75+0.75)%
1	B1	3.264	4.219	4.202	4.752
2	B2	3.278	4.532	4.380	4.906
3	B3	3.238	4.558	4.260	4.972
4	Avg	3.260	4.436	4.280	4.876
5	% increased in strength	-	+ 36.07 %	+ 31.28 %	+ 49.57 %

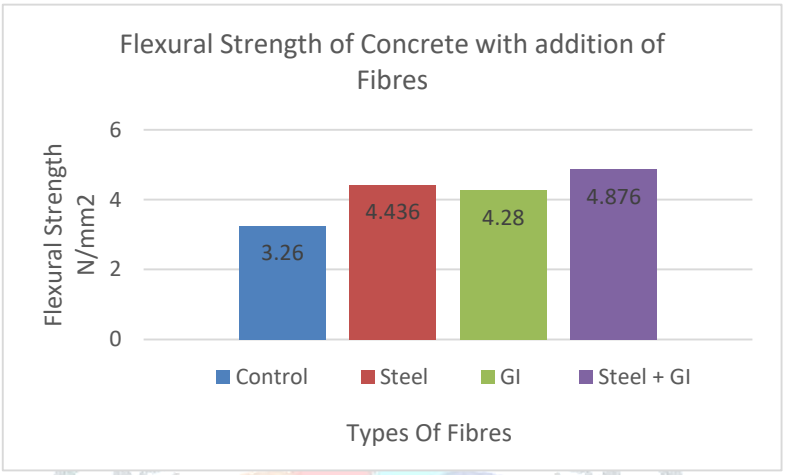
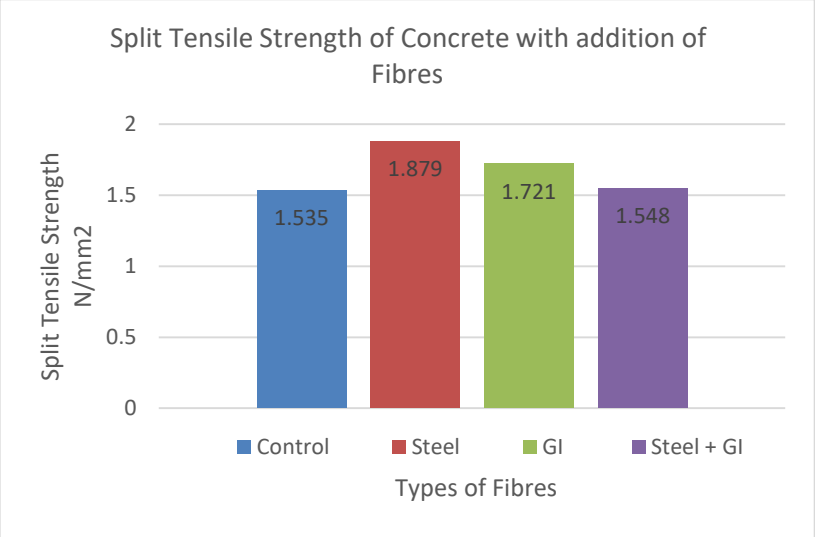


Table 6 Split Tensile Strength of Concrete with addition of Fibres in mono and hybrid way.

Sr. no.	Specimen	Split Tensile Strength N/mm^2			
		Control	Steel (S)-1.5%	Galvanized iron (G.I)-1.5%	S+G.I (0.75+0.75)%
1	CL1	1.559	1.819	1.675	1.531
2	CL2	1.529	1.929	1.728	1.560
3	CL3	1.519	1.889	1.760	1.553
4	Avg	1.535	1.879	1.721	1.548
5	% Increased in strength	-	+ 21.41 %	+ 12.11 %	+ 0.84 %



4. Conclusion –

1. In this research , optimum percentage of waste foundry sand replacement is 20% of volume of fine aggregate in concrete. Although addition of waste foundry sand decreases the compressive strength of concrete but 20 % replacement of foundry sand will get strength of 23.83 KN/mm2 which is greater than M20 Strength. As the percentage of waste foundry sand increases strength decreases.

2. Compressive Strength - Addition of Steel fibres (1.5%) in concrete increases compressive strength by 9.60 % , GI Fibre (1.5%) increases strength by 13.76 % and Steel and GI (0.75 + 0.75 %) increases strength by 12.04 %. Max Strength observed in addition of GI Fibres.

3. Flexural Strength - Addition of Steel fibres (1.5%) in concrete increases Flexural strength by 36.07 % , GI Fibre (1.5%) increases strength by 31.28 % and Steel and GI (0.75 + 0.75 %) increases strength by 49.57 %. Max strength observed in addition of Steel and GI Fibres .

4. Split Tensile Strength - Addition of Steel fibres (1.5%) in concrete increases Split strength by 21.41 % , GI Fibre (1.5%) increases strength by 12.11 % and Steel and GI (0.75 + 0.75 %) increases strength by 0.84 %. Max Strength observed in addition of steel fibres.

(Note – This values are according to control block's strength. Control Block – Replacement of Waste Foundry sand with river sand with 20 % by volume of river sand.)

5. Refrence-

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