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To Study the Concrete Behaviour by Partial Replacement of Cement with Iron Dust and Addition of Steel Fibre

Anwar Ahmad¹, Adesh Tripathi²

Associate Professor, Department of Civil Engineering, Integral University, Lucknow (UP), India¹

M. Tech (Research Scholar), Department of Civil Engineering, Integral University, Lucknow (UP), India²

ABSTRACT: This paper deals with the study of the effect of partial replacement of cement with iron dust and then addition of steel fibers. Iron dust are industrial by-products generated from the milling industry and factories. It can be mainly obtain by grinding and lathing of the iron product. This is a waste material used as a pozzolanic material in concrete to increase durability and strength. It is very important to take appropriate particle size of iron dust. Iron dust replaced with cement so particle size of iron dust is less than 0.75 micron. Steel fibre produced as a by-product from industrial processes. The use of steel fibre has led to the improvement of the concrete mechanical properties such as material toughness in tension and also durability. Steel Fibres are generally utilized in concrete to manage the plastic shrink cracking and drying shrink cracking. The length of steel fibres is 30mm and diameter is 0.75mm and aspect ratio 40. Commercial production of steel fibres for use in concrete is also available now a day. In present investigation an attempt is made to evaluate the workability, compressive strength, split tensile strength and flexural strength on the replacement of iron dust in the percentage of 0%,2%, 4%,6%, 8% by the weight of cement. Then investigate the result. Fixed the percentage of iron dust in maximum result then adding the steel fibres in the percentage of 0.5%, 1%, 1.5%, 2%. Standard cube of 150X150X150mm will be cast and tested for obtaining 28-day compressive strength. Standard cylinder of 150mm diameter and 300mm height will be cast and tested for split tensile strength. Standard beam of 500X100X100 will be cast and tested for flexural strength. Then analyze all the result mathematically and graphically.

KEYWORDS: iron dust, steel fibres, compressive strength, split tensile strength, flexural strength.

I. INTRODUCTION

Now these days construction cost is very high with using conventional material. Cement reacts with water and release CO₂ gas. We are trying to partial replacement of cement by different kind of material.(iron dust) and addition of steel fibres Which also increases strength, reduces cost and consumption of cement. Investigate the parallel study between replace material iron dust and additive material steel fibers. Find the values of compressive strength, flexural strength and split tensile strength. And investigate the changes in values of their strength properties. The rapid development of construction industry has increased the consumption of cement. But the production of cement involves the depletion of natural resources and greenhouse-gas emissions. Also production cost of cement is increasing day by day. Thus, there is a need to search for alternative materials to cement for use in the construction.

II. EXPERIMENTAL WORK

Material to be used

The present investigation was planned to study and evaluate the effect of replacement of cement with iron dust in the percentage of 2%,4%,6%,8% and addition of steel steel fibers in the percentage of .5%,1%, 1.5%,2% in concrete. First of all, workability of the mix was tested with compaction factor test. For evaluating the compressive strength, cubes of standard-size 150mmx150mmx150mm were cast and tested after 28 days. Standard cylinders of size 150mm x 300mm

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were cast and tested for estimating 28days split tensile strength. Also standard beams of size 500mm x100mm x 100mm were cast and were tested for 28 days flexural strength. The change in these parameters corresponding to the percentage addition of iron dust and SFR were discussed.

Cement

OPC (43 grade) cement is used throughout the project work. The most common cement currently used in construction is the Portland cement. In the dissertation work which has been performed ordinary Portland cement of 43 grades has been used. Generally three grade of OPC is available i.e. 33, 43 & 53. The properties of the cement used are shown in the Table below.

Table 1:Physical Properties of Ordinary Portland cement:

Sr. No.	Physical property	Values
1	Specific gravity	3.15
2	Fineness modulus	3.3
3	Initial setting time	45 min
4	Final setting time	600 min
5	Standard consistency	31%

Aggregate

Aggregates are those chemically inert materials which when bonded by cement paste form concrete. Aggregates constitute the bulk of the total volume of concrete and hence they influence the strength of concrete to great extent.

Fine aggregate

The material which passed through I.S. Sieve No. 480 (4.75mm)is termed as fine aggregates. The source for fine aggregate used is from natural river bed. The fine aggregate used which have fineness modulus of 3.1, specific gravity of 2.6.

Table 2: Physical Properties of Fine Aggregate:

Sr. no.	Property	Value
1	Specific gravity	2.6
2	Bulk density(a)loos state (b)compacted state	1413kg/cum 1688kg/cum
3	Fineness modulus	3.6

Course aggregate

The material whose particles are of such size as are retained on I.S. Sieve No. 480 (4.75mm) is used as coarse aggregates. The aggregate used which have specific gravity of 2.73 and fineness modulus of 7.5.

Table 3:Physical Properties of Coarse Aggregate:

Sr. No	Property	Value
1	Specific gravity	2.73
2	Fineness modulus	7.5
3	bulk density	1665 kg/cum

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Iron dust

Iron dust are industrial by-products generated from the milling industry and factories. It can be mainly obtain by grinding and lathing of the iron product. Particle size of iron dust is less then 0.75mm



Table no. 4 Chemical composition of iron dust

Sr.no.	Chemical composition	Percentage weight
1	SiO ₂	
2	TiO ₂	0.72
3	Al ₂ O ₃	1.81
4	Fe ₂ O ₃	89.0
5	MgO	0.23
6	MnO	2.16
7	CaO	0.45
8	Na ₂ O	0.66
9	K ₂ O	1.64
10	P ₂ O ₅	0.34
11	Ni	0.002
12	Cu	0.003

Steel fibres

Steel fiber having low carbon and its both end were hooked were used. The steel fibers have a length of 30 mm, diameter of 0.75 mm, aspect ratio of 40, and density of 7.85 g/cm³.

The use of steel fibre has led to the improvement of the concrete mechanical properties such as material toughness in tension and also durability. Steel Fibres are generally utilized in concrete to manage the plastic shrink cracking and drying shrink cracking. The length of steel fibres is 30mm and diameter is 0.75mm and aspect ratio 40.

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Table no. 5 Physical property of steel fibers

S.NO	PROPERTY	VALUES
1	Equivalent Diameter	0.15 to 1.00MM
2	Specific Gravity	kg/m ³ 7840
3	Tensile Strength	345 TO 3000 mpa
4	Youngs modulus	200 gpa
5	Ultimate elongation	4 to 10%
6	Thermal conductivity	1 to 2.74%
7	Aspect ratio	40 to 45

Water: Potable fresh water, which is free from concentration of acid and organic substances was used for mixing the concrete.

Methodology

- BATCHING
- MIXING
- CASTING
- CURING
- TESTING

Design mix proportioning procedure for the concrete was done according to IS 10262:2009. Concrete grade M25 grade were proportioned according to the procedure as mentioned in the ode. Preparing M-25 grade of concrete and cement replaced by iron dust and then addition of steel fiber reinforcement. Taking the percentage of iron dust which gives maximum value The percentage of iron dust is 0%, 2%, 4%, 6%, 8% by the weight of cement. Then adding the steel fibre in the percentage of. 5%, 1%, 1.5%, 2%. Cast the cubes. Give curing for 28 days. Tested all the cubes and making all data mathematically and graphically also.

Mix proportioning

The basic mix proportion for M25 grade of concrete is cement, fine aggregate, coarse aggregate and water: 1:0.41:1.33:2.48. mix 1 contain 0% iron dust . Mix 2contain 2% iron dust. Mix 3 contains 4% iron dust. Mix 4 contains 6% iron dust. Mix 5 contains 8% iron dust. Mix 6 contains 6% iron dust and 0.5% steel fiber. Mix 7 contains 6% iron

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dust and 1% steel fiber. Mix 8 contains 6% iron dust and 1.5% steel fiber. Mix 9 contains 6% iron dust and 2% steel fiber.



Casting a sample and compacted it.

III.RESULT AND DISCUSSION

casting three cube which dimension is 150*150*150mm, three beam of 100*100*500 mm, and three cylinder of 150 diameter and 300 mm length. Casting cube, beam and cylinder by the partial replacement of iron dust in the percentage of 0%, 2%, 4%, 6%, 8%. Total 9 sample were cast for one replacement.

Quantity of material for each replacement

Material for three cube, three beam, three cylinder.

Sr. No.	cement	Fine aggregate	Course aggregate	Admixture	% Iron dust	Iron dust kg	Water
1	22.920	30.49	54.57	-	0%	0kg	9.39lt
2	22.462	30.49	54.57	-	2%	.458kg	9.39lt
3	22.0032	30.49	54.57	-	4%	.9168kg	9.39lt
4	21.5448	30.49	54.57	-	6%	1.3752kg	9.39lt
5	21.0864	30.49	54.57	-	8%	1.8336kg	9.39lt

Result for iron dust replacement (28 days)

Table 7. 28 days compressive strength of concrete

Sr. No.	%iron dust	% of steel fibers	Compressive strength
1	0%	0%	31.5 mpa
2	2%	0%	32.3mpa
3	4%	0%	33.5mpa
4	6%	0%	34.1mpa
5	8%	0%	33.3mpa

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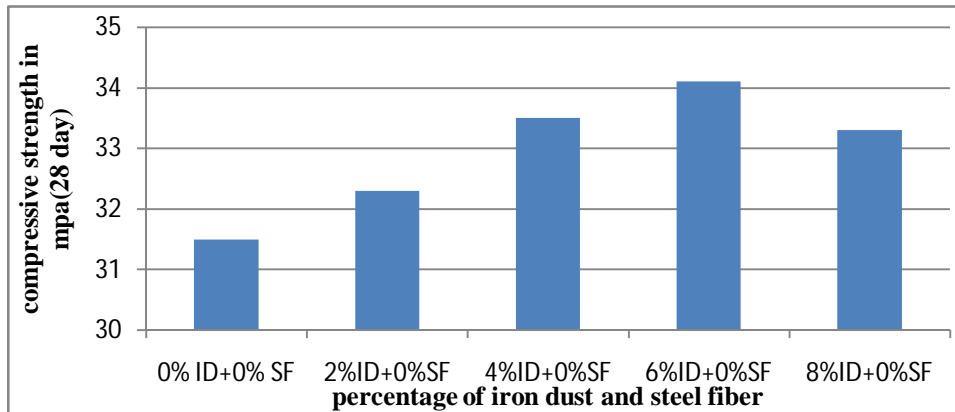


Chart-1 variation of compressive strength



Testing of cube.

Table no. 8. 28 days split tensile strength of concrete

Sr. No.	%iron dust	% of steel fiber	Split tensile strength
1	0%	0%	3.10MPa
2	2%	0%	3.25MPa
3	4%	0%	3.45MPa
4	6%	0%	3.80MPa
5	8%	0%	3.65 MPa

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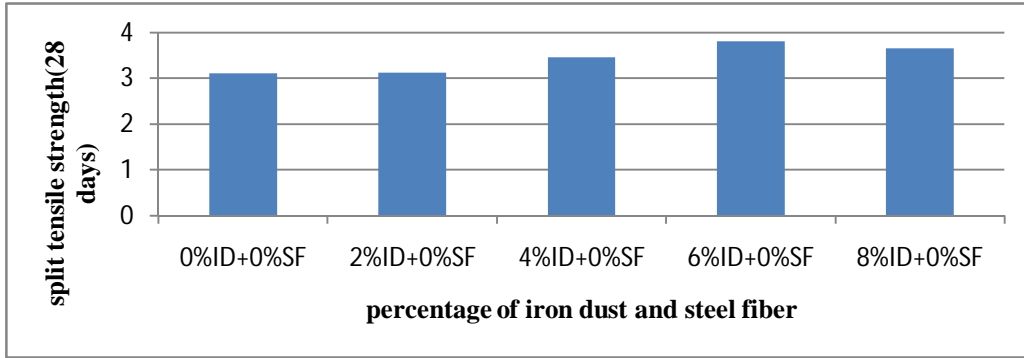


Chart-2 variation of split tensile strength

Table no.9.28 days flexural strength of concrete

Sr. No.	%iron dust	% of steel fibers	Flexural strength
1	0%	0%	3.9 MPa
2	2%	0%	4.1MPa
3	4%	0%	4.22 MPa
4	6%	0%	4.58MPa
5	8%	0%	4.29MPa

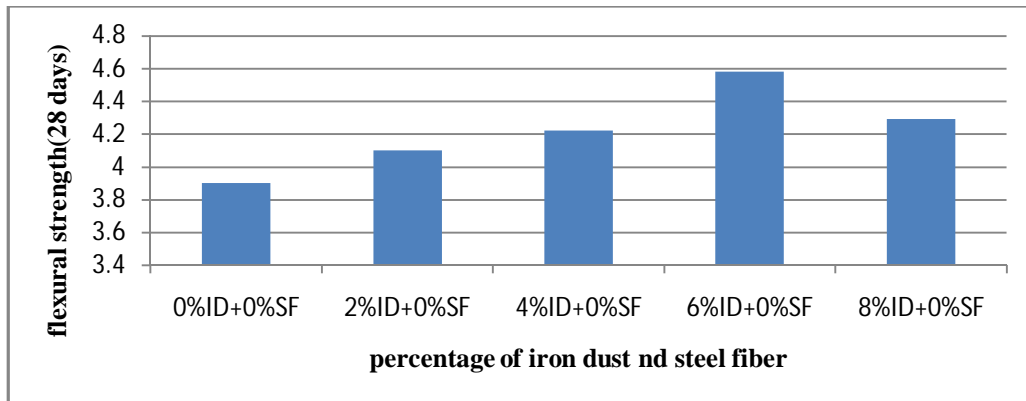


Chart-3 variation of flexural strength

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Testing of beam.

We can see the above result of partial replacement of iron dust at 6% gives the maximum compressive, split and tensile strength. Then fixed the amount of iron dust and added the steel fibers in the percentage of 0.5%, 1%, 1.5%, 2%.

Result for 6% iron dust and addition of steel fibre in following percentage.

Table 10. 28 days compressive strength of concrete

Sr. No.	% of iron dust	% of steel fibers	Compressive strength
1	6%	0%	34.1 mpa
2	6%	0.5%	34.9mpa
3	6%	1%	35.5mpa
4	6%	1.5%	36.4mpa
5	6%	2%	36.1mpa

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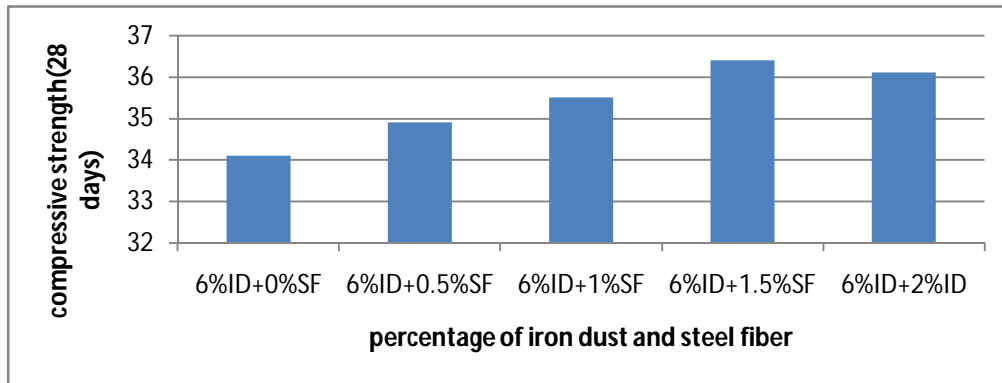


Chart-4 variation of compressive strength

Table no. 11. 28 days split tensile strength of concrete

Sr. No.	% of iron dust	% of steel fiber	Split tensile strength
1	6%	0%	3.6 MPa
2	6%	0.5%	3.90 MPa
3	6%	1%	4.0 MPa
4	6%	1.5%	4.2MPa
5	6%	2%	3.95 MPa

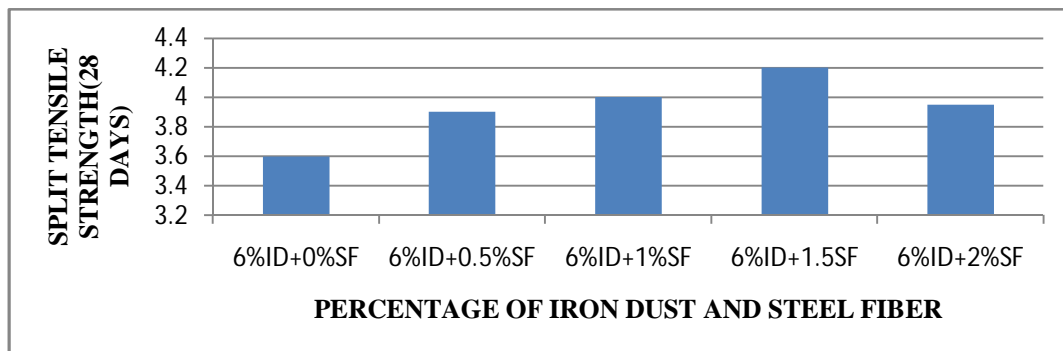


Chart-5 variation of split tensile strength

Table no.9.28 days flexural strength of concrete

Sr. No.	% of iron dust	% of steel fiber	Flexural strength
1	6%	0%	4.58Mpa
2	6%	0.5%	4.86Mpa
3	6%	1%	5.21Mpa
4	6%	1.5%	5.15Mpa
5	6%	2%	4.98Mpa

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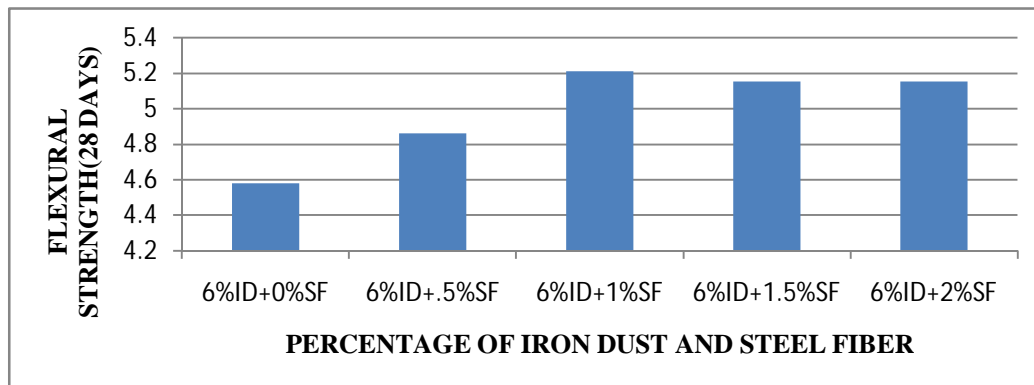


Chart-6 variation of flexural strength

VI. COCLUSION

In this work, experimental investigation was made to understand the behavior of concrete with replacement of cement by iron dust and addition of varying quantities of steel fiber and compressive strength, split tensile strength and flexural strengths were tested:

1. It has been found that compressive strength and split tensile strength gives maximum values for addition of 1.5% steel fiber and replacement of cement with 6% iron dust.
2. 1% iron dust and 6% steel fiber gives maximum value for flexural strength.
3. The compressive strength is increased by 18%, split tensile strength by 34 %, flexural strength by 33 %,
4. To the study of above result 6% iron dust gives the maximum result before the addition of steel fiber. Then at 8% values of compressive strength, split tensile strength and flexural strength give decreasing values.
5. 6% iron dust and 0% steel fiber increasing the compressive strength around 8% as compared to conventional concrete.
6. Split tensile strength increases 22% and flexural strength around 17% at replacement of 6% iron dust and 0% steel fiber as compared to conventional concrete.

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