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Experimental Investigation on Effect of Flat Crimped Steel Fibre on Concrete Strength

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ABSTRACT
This concrete is a composite material made of cement, water and aggregates that hardens into a solid substance concrete has relatively high compressive strength but much lower tensile strength . The concrete structures crack to some extent, due to shrinkage and tension so, for this reason it is usually reinforced with materials that are strong in tension the compressive strength of concrete should be increased by the adding of steel fibre, glass fibre, synthetic fibres.... Etc. Fibre reinforced concrete is containing fibrous material which increases the structural resistance and designed strength and its control cracking and excellent tensile properties in the concrete. In this study we are used crimped steel fibre for this testing specimens i.e. Cubes and beam were cast by addition of crimped steel fibre with different percentages of 0%,1%,2%,3% m30 grade concrete is chosen as the mix. The prepared cubes of size (150x150x150) mm and beams of size (500 x100x100) mm. These specimens are cured in portable water for a periods of 7 and 28 days. Then further tests are such as compressive strength and flexural strength tests on specimen to study their structural behaviour of concrete.
Keywords: *concrete, flat crimped fibre, compressive strength, flexural strength*

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I. 1.INTRODUCTION

Fibre reinforced concrete(FRC) have a huge historical background in construction in 90's to till now. Fibre reinforced have many different types of steel fibres like round crimped steel fibre, flat, hooked steel fibre and so on. This flat crimped steel fibres are added as a addition material to concrete for increases the strength.

Advantages :

- By using FRC the compressive and flexural strength.
- It helps to reduce the shrinkage and cracks in concrete.

Disadvantage :

- Cost of construction increases.
- Corrosion of steel may effects the concrete strength.

II. OBJECTIVE

1.To induce the mechanical properties by adding flat fibre as a secondary reinforced concrete.
2.To study on the use of flat fibre in concrete mix to improve performance of construction component.
3.To study the compressive, flexural strength behaviour in concrete with flat fibre

III. METHODOLOGY

As a initial step, we collect the required materials for casting. After collection of materials we conduct the preliminary testes for fine aggregate, course aggregate and cement.
Tests are fineness modulus of fine aggregate , specific gravity of fine aggregate, bulking of sand ,water absorption test. for fine aggregate and fineness modulus of course aggregate , specific gravity of course aggregate, water absorption tests for course aggregate and tests like fineness modulus of cement, specific gravity of cement, normal consistency, initial and final setting time for cement .
After obtained the preliminary test results , we use various IS codes and get a mix proportion ratio as [1 : 1.44 : 2.76 :0.45] . based on this mix design, casting the cubes and beams with addition of 1%,2%,3% of flar crimped

fibre. After completion of curing for 7 and 28 days , finally conducting the compressive and flexural tests results.

IV. MATERIALS PROPERTIES

1. Cement : Ordinary Portland Cement (OPC) 53 Grade is a high-strength cement that meets the specifications of IS 12269:2013. With a minimum compressive strength of 53 MPa at 28 days, OPC 53 Grade Cement is widely used in construction projects that require high strength and durability.

Table 1 PROPERTIES OF CEMENT

SL.NO	PROPERTIES	TEST RESULTS	CODES
1	Normal consistency	31%	----
2	Initial setting time	30mins	IS 4031 (part 6)
3	Final setting Time	10hrs	IS 4031 (part 6)
4	Fineness	6%	33 IS 4031 (part 2)
5	Le-Chatelier soundness	4mm	IS 4031 (part 3)
6	Specific Gravity	3.15	IS 4031(Part 11)

2. Fine Aggregate: Fine aggregate, also known as sand, is a crucial component of concrete, playing a vital role in determining its strength, durability, and workability. Fine aggregate typically consists of natural or crushed sand particles with a diameter of less than 4.75 millimeters.

TABLE 2 PROPERTIES OF FINE AGGREGATE

SL.NO	PROPERTIES	TEST RESULTS	CODES
1	Sand zone	ZONE-3	-----
2	Fineness modulus	4.28	IS 383-2016
3	Specific gravity	2.65	IS 2386-1963(Part-3)
4	Water absorption	0.5%	IS 383-1970,BS6349
5	Bulking of sand	11.66%	IS 2386-1963(Part-3)

3. Coarse aggregate: The size and shape of coarse aggregate particles also play a crucial role in determining the strength and durability of concrete. Aggregate particles with a rough texture and irregular shape tend to provide better bond strength with the cement paste, resulting in higher concrete strength.

TABLE 3 PROPERTIES OF COARSE AGGREGATE

SL.NO	PROPERTIES	TEST RESULTS	IS CODES
1	Nominal size	20mm	-----
2	Fineness modulus	7.631	IS 383-1970
3	Specific gravity	2.74	IS 383-1970
4	Water absorption	1%	IS 2386-1963 (PART-3)

4. Water: Water plays a vital role in concrete as it hydrates the cement, allowing it to harden and bind the aggregate particles together. The quality and quantity of water in concrete significantly impact its strength, durability, and workability. During the hydration process, water reacts with cement to form a hardened paste, binding the aggregate particles together.

5. Flat Crimped Steel Fibre: Flat crimped steel fibres are a type of steel reinforcement used in concrete to enhance its tensile strength, durability, and resistance to cracking. These fibres are characterized by their flat, crimped shape, which provides a mechanical bond with the surrounding concrete.

Figure 1 Flat Crimped Steel Fibre

Table 4 PROPERTIES OF CRIMPED STEEL FIBRE

PROPERTIES	VALUES
length	35mm
Width	0.5mm
Thickness	0.2mm
Aspect ratio	59
Tensile strength	1150mpa
Density	7850 kg/m^3
Strain failure	<4%

V. EXPERIMENTALS RESULTS

1.Compressive strength: A total number of 24 cubes of size 150 X 150 X 150 mm were casted and tested for7 days and 28 days after conducting the workability test. The results are tabulated below.

Table 5 Compressive strength results of M30 grade of concrete for 7,28 days

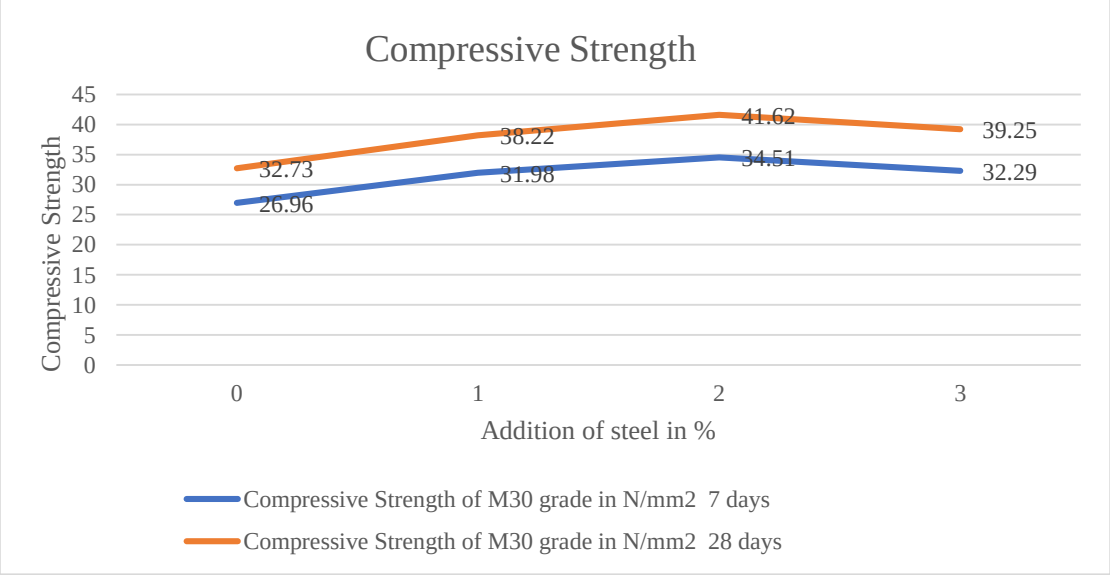
S.no	% of flat crimped fibre	Compressive strength of $m_{30\ in\ n/mm^2}$	
		7 days	28 days
1.	0	26.96	32.73
2.	1	31.98	38.22
3.	2	34.51	41.62
4.	3	32.29	39.25

2.Flexural Strength: A total number of 16 beams of size 500 X 100 mm were casted and tested for 7 days and 28 days after conducting the workability test. The below table noticed the results

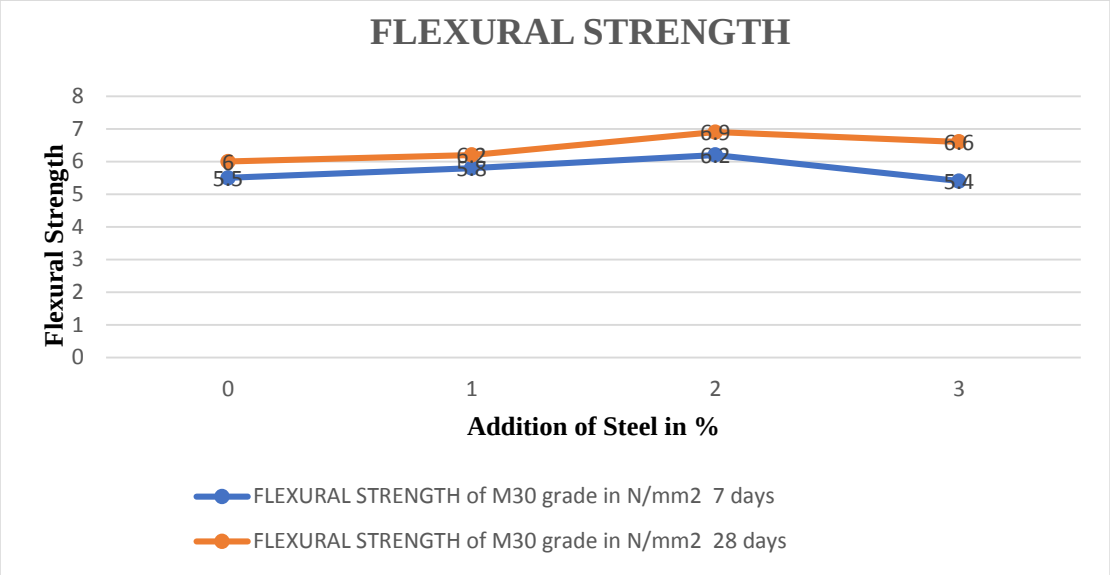
Table 6 Flexural strength results for M30 grade of concrete

S.no	% of flat crimped fibre	Flexural strength of $m_{30\ in\ n/mm^2}$	
		7 days	28 days
1.	0	5.5	6
2.	1	5.8	6.2
3.	2	6.2	6.9
4.	3	5.4	6.6

VI. GRAPHICAL REPRESENTATION



Graph 1 Compressive Strength Comparison At 7 And 28 Days For M30 Concrete



Graph 2 Flexural Strength Comparison At 7 And 28 Days For M30 Concrete

VII. CONCLUSION

From this experimental investigation, it can be concluded that,

1. Flat crimped steel fibre concrete increase the compressive and flexural strength as compared with the conventional concrete.
2. For conventional concrete the average compressive strength at 28days is about 32.73 N /mm² and the average flexural strength at 28 days is about 6 N/mm² .
3. The steel fibre reinforced concrete with flat crimped fibre gives optimum compressive strength at 2% of fibre content is about 41.62 N/mm².
4. The fibre reinforced concrete with flat crimped fibre gives optimum Flexural Strength at 2% of fibre content is about 6.9 N/mm$^{2.}$
5. From these results we can see the fibres gives optimum strength at 2% of fibre content.
6. Addition of steel fibre to the concrete improve concrete resistance to degradation shrinkage and cracking.
7. By using of steel fibre in concrete increases the compressive, flexural strength and helps to resist the shrinkage under loads.

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