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A Study on Steel Fibre Reinforced Concrete

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Abstract:

Ordinary cement concrete possesses a very low tensile strength, limited ductility and little ductility to cracking leading to brittle failure of concrete. Modification in traditional cement concrete has become mandatory to meet the functional and durability requirements of structures. Many attempts are being made to improve the mechanical properties, durability and serviceability of the structure by adding different types of fibres in specific percentage to concrete. In this work, the effect of steel fibres on the strength properties of concrete of M40 grade have been studied by varying the percentage of fibres in concrete and it is found that optimum dosage of steel fibre is around 1.5%.

Keywords —Compressive strength, Split Tensile Strength, Flexural Strength, Steel fibres

I. INTRODUCTION

The strength and durability of concrete can be changed by making appropriate changes in its constituents and by adding some special ingredients. Hence concrete is suitable for wide range of applications. However concrete has some deficiencies such as low tensile strength, brittleness and low ductility, limited fatigue life, low impact strength etc.

The presence of micro cracks in the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. The inclusion of fibres in to the concrete matrix leads to improvement in its ability to resist crack growth. The fibres help to transfer loads at the internal micro cracks. Such a concrete is called fibre reinforced concrete.

Different types of fibres made up of metals, natural, glass or organic materials are being used in practice. These fibres are available in various shapes and sizes. A convenient parameter describing a fibre is its aspect ratio which is defined as the fibre length divided by an equivalent fibre diameter. Typical aspect ratios range from about 30 to 150 for length dimensions of 6.4 mm to 76 mm. Each type of fibre has its own physical properties.

II. MATERIALS

Following materials are used for this experimental study.

- OPC of 43 grade having specific gravity 3.149 (confirming to IS 269-2015)
- Locally available river sand of zone II having specific gravity 2.42. (conforming to IS 383-1970)
- Coarse aggregates of crushed granite stones of size 10 mm having specific gravity 2.7 and 0.26% of water absorption (conforming to IS 383-1970)
- Potable water
- Steel fibres of length 35 mm and diameter 0.5 mm

III. METHODOLOGY

The methodology adopted in this study is as below.

i. Determination of physical properties of constituents of concrete

ii. Mix design of M40 grade concrete

iii. Casting and testing of cubes, cylinders and beam specimen to evaluate compressive, split tensile and flexural strength respectively for different percentage of steel fibres and also control specimen at the age of 7 and 28 days.

iv. Tabulation of results and their analysis.

IV. EXPERIMENTAL PROGRAM

1. EVALUATION OF COMPRESSIVE STRENGTH

A total of 30 cubes of size 150mm were cast for 0% (control specimen), 0.5%, 1%, 1.5% and 2% steel fibres and tested for 7 days and 28 days compressive strength and results are tabulated in Table I.

2. EVALUATION OF SPLIT TENSILE STRENGTH

15 cylindrical specimen of diameter 150 mm and height of 300 mm were cast for 0% (control specimen), 0.5%, 1%, 1.5% and 2% steel fibres and tested 28 days split tensile strength and results are tabulated in Table I.

3. EVALUATION OF FLEXURAL STRENGTH

15 beam specimen of size 100x100x500 mm were cast for 0% (control specimen), 0.5%, 1%, 1.5% and 2% steel fibres and tested 28 days flexural strength and results are tabulated in Table I.

V. RESULTS, DISCUSSIONS AND CONCLUSIONS

TABLE I- VARIATION OF STRENGTH PARAMETERS WITH DIFFERENT % of STEEL FIBRES

% of steel fibres	Compressive strength (N/mm^2)		Split tensile strength- 28 days (N/mm^2)	Flexural strength- 28 days (N/mm^2)
	7 days	28 days		
0	29.44	44.34	4.63	7.22
0.5	32.96	46.66	5.42	8.13
1	33.32	48.14	6.38	9.13
1.5	33.77	49.62	6.73	10.48
2	30.51	45.3	7.35	11.60

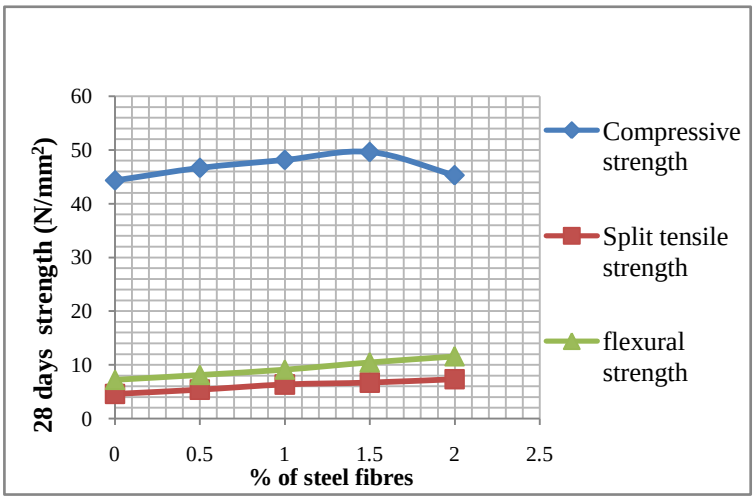

Fig.1Variation of strength parameters with different % of steel fibres

From the results (Fig.1), it is observed that in case of compressive strength, the strength is increasing up to 1.5% of steel and beyond that it decreasing. Hence the optimum % of steel fibres that can be considered for the design of concrete mix is 1.5.

In case of split tensile and flexural strength it is observed that, there is increase in strength up to 2% of steel fibres. By observing (Fig.3) visually it is seen that post failure, the specimen with higher % of steel keeps on taking the load without collapsing, till the load do not exceed the pull out resistance of the fibres

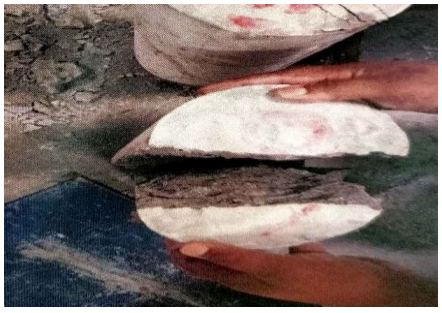

Fig.2 Test specimen after failure (Nominal concrete)

Fig.3 Test specimen after failure (2% steel fibres)

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