



## INFLUENCE OF WASTE BLADES ON THE BEHAVIOUR OF CONCRETE

## Engineering

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## ABSTRACT

The present study demonstrates the concept that uses the stainless steel blades as fibres reinforcement in concrete. Present study defines the comparison between compressive strengths of normal concrete and concrete using stainless steel as fiber reinforcement. In the present study, Concrete was made for M25 grade with changing percentage of steel blades i.e 2.5% 5%, 7.50%, 10%, 12.50% and 15%. OPC (Ordinary Portland Cement) Grade 43, Coarse Aggregates (20mm) and sand conforming to Zone II gradation had taken to prepare the mix. It is found that the optimum percentage of blades which imparts more compressive strength is 10%, which increases the strength up to 35.58% to its original strength.

## KEYWORDS

reinforcement, compressive strength, fiber reinforcement, stainless steel as reinforcement.

## INTRODUCTION

The concept of using fibres as reinforcement is not a new one. Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks. In the 1900s, asbestos fibers were used in concrete. In the 1950s, the concept of composite materials came into being and fiber-reinforced concrete was one of the topics of interest. Once the health risks associated with asbestos were discovered, there was a need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic fibers such as polypropylene fibers were used in concrete. Research into new fiber-reinforced concretes continues today as the resources are depleting day by day it is desirable to use some by products for researches. Researchers are more interested in using the industrial waste and by-products as substitute materials in concrete and construction, which in itself is a better alternative to dumping such wastes as it will protect the environment. Industrial wastes can be divided into two types: industrial by-products and recycled wastes. The first type includes coal ash, various slags from metal industries, industrial sludge, waste from industries like pulp and paper mills, mine tailings, food and agriculture, and leather. The second type includes different plastic and rubber wastes. But the present study is focused on review of recent experimental and theoretical studies in the addition of fibre from waste blades in concrete and replacing waste blades as a substitute in concrete. A detailed analysis of concrete with various industrial wastes such as bottom ash, copper slag, ferrochrome slag, GGBFS, Steel slag and Stainless steel slag are also discussed. Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fibers produce greater impact-, abrasion-, and shatter-resistance in concrete. Generally fibers do not increase the flexural strength of concrete, and so cannot replace moment-resisting or structural steel reinforcement. Indeed, some fibers actually reduce the strength of concrete. Stainless steel is a popular class of material for knife blades because it resists corrosion and is easy to maintain. However, it is not impervious to corrosion or rust [1]. In order for a steel to be considered stainless it must have a chromium content of at least 13% [2].

The principle of stainless steel is that in an oxidizing chemical environment the oxide (chromium and sometimes nickel and other metal oxides) is stable, and when in a reducing (shortage of oxygen) environment at least one metal is stable. This usually works, except in an acid environment [3].

Austenitic stainless retains its non-magnetic crystal structure at room temperature, usually because it has high nickel content. It is therefore not hardenable by heat treating as typical hard steels are. So as knife steel it depends on other hardening methods such as alloying elements and cold working. It is highly corrosion resistant, except to stress corrosion cracking. In present research author using blades waste in concrete to increase the strength of concrete. When the industrial wastes like blades are used in concrete for building construction, economically it is beneficial since the material cost is reduced. The

industrial waste has lot of chemicals in it, which reacts with cement and other ingredients which reduce the life of the concrete [4],[5],[6]. Hence, durability studies are very essential even it shows better mechanical properties.

## 1. Material

## 1.1 Waste Stainless Steel Blades

Stainless steel is a popular class of material for knife blades because it resists corrosion and is easy to maintain. However, it is not impervious to corrosion or rust. In order for a steel to be considered stainless it must have a chromium content of at least 13%. The principle of stainless steel is that in an oxidizing chemical environment the oxide (chromium and sometimes nickel and other metal oxides) is stable, and when in a reducing (shortage of oxygen) environment at least one metal is stable. This usually works, except in an acid environment [7],[8].

## 1.2 Concrete

Concrete is a composite material made up of fine and coarse aggregate bonded together cement paste that hardens over time. Most concretes used are lime-based concretes such as ordinary Portland cement concrete [9].

## 2. Experimental Plan and Methodology

The algorithm and point by point procedure which defines more stages from initial stages to the last stage of the project is as under:-

Concrete was made for M25 grade with changing percentage of steel blades (2.5% 5%, 7.50%, 10%, 12.50% and 15%). OPC (Ordinary Portland Cement) Grade 43, Coarse Aggregates (20mm) and sand conforming to Zone II gradation had taken to prepare the mix. Mixing had done uniformly in which water was supply properly along with all other particles. The various test were performed to analyze the behavior of concrete mix with blade are Coarse Aggregates of Fineness Modulus, Coarse Aggregates of Specific Gravity (as per IS: 2386 (Part-3)1963), Coarse Aggregates of Aggregate Crushing Value (IS:2386 – Part-4), Coarse Aggregates of Aggregate Impact value (IS:2386-PART IV-1963), Coarse Aggregates of Bulk Density (as per IS: 2386 (Part-3)1963), Fine Aggregates of Fineness Modulus, Fine Aggregates of Specific (as per IS: 2386 (Part-3)1963), Gravity, Cement of Initial and Final Setting Time (IS:4031-PART 5-1988), Compressive Strength test (IS:516-1959)

## 2.1 Mix design

The mix design the existing method as per IS:10262(1982) and SP23(1983) has been used for selecting the reference mix (25), however new information given in IS 453(2000) was incorporated; procedure is modified to that extent. In order to get the final mix proportion for the reference mix design, the trial mixes had been prepared earlier for the grade 25 and tested at 28 days. The adjustments were made in the value of water and sand for the concrete mix design and trial mixes adopted for M25 are listed. The test results for compressive strengths after 28 days of all trial mixes are listed [10].

**2.2 Compressive strength test**

The tests are required to determine the strength of concrete and therefore its suitability for the job as per IS: 516-1959 – Methods of tests for strength of concrete. Concrete was made for M25 grade with changing percentage of steel blades 2.5% 5%, 7.50%, 10%, 12.50% and 15%. Total of 42 experiments were carried out on the several proportions of concrete and blades to evaluate the compressive strength of concrete. The test performed was compressive strength test as per IS: 516-1959 – Methods of tests for strength of concrete. Table.1 presents the percentage of proportions and designation against the compressive strength.

**Table 1 Scheme of proportion for laboratory testing.**

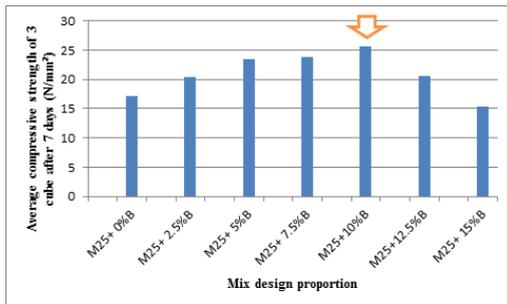
Property of mix design	Designation
Compressive Strength (N/mm <sup>2</sup> ) (42 mix)	M- 25+ 0%B ( 6 Sample)
	M-25 + 0.5% B (6 Sample)
	M-25 + 1%B (6 Sample)
	M-25 + 1.5%B (6 Sample)
	M-25 + 2%B (6 Sample)
	M-25 + 2.5% B (6 Sample)
	M-25 + 3% B (6 Sample)

B – Blades percentage (from out of six sample 3 were tested after 7 days and 3 were tested after 28 days)

**Table.3 Showing average compressive strength of three cube of each composition after 7 and 28 days.**

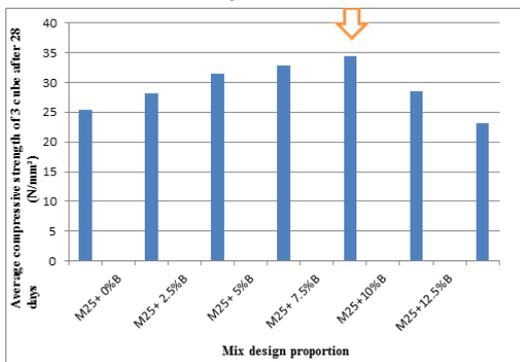
Average compressive strength of three cube of mix	M25+ 0%B (N/mm <sup>2</sup> )	M25+ 2.5%B (N/mm <sup>2</sup> )	M25+ 5%B (N/mm <sup>2</sup> )	M25+ 7.5%B (N/mm <sup>2</sup> )	M25+ 10%B (N/mm <sup>2</sup> )	M25+ 12.5%B (N/mm <sup>2</sup> )	M25+ 15%B (N/mm <sup>2</sup> )
After 7 days	17.12	20.48	23.4	23.84	25.62	20.51	15.4
After 28 days	25.32	28.22	31.44	32.88	34.33	28.55	23.1

**Fig.1** Showing average compressive strength of three cube of each composition after 7 days, it is clear that the maximum strength attain for the mix with proportion of M25 + 10%B. The strength after seven days for the mix is 24.62 N/mm<sup>2</sup>. There is an increase in strength up to 49% after 7 days.



**Fig.1** Showing average compressive strength of three cube of each composition after 7 days

Similarly, the strength after 28 day for all composition show that design mix M25+10%B show maximum compressive strength as shown in Fig.2. Therefore, the optimum proportion found to be M25+10%B, which show strength 34.39N/mm<sup>2</sup>. The strength obtained after 28 days for M25+ 0%B is 25.32 N/mm<sup>2</sup>. It is found that there is an increase in strength up to 35.58% after addition of 10% blades in concrete. This is because the blades act as reinforcing material that increases the strength of concrete.



**Fig.2** Showing average compressive strength of three cube of each composition after 28 days

**3. Result and Discussion**

The various test result are as shown in table.2

**Table.2 showing materials testing results**

Materials	Results
Coarse Aggregates of Fineness Modulus	6.6
Coarse Aggregates of Specific Gravity	2.72
Coarse Aggregates of Aggregate Crushing Value	27%
Coarse Aggregates of Aggregate Impact value	14.54%
Coarse Aggregates of Bulk Density	1.54KN/m <sup>3</sup>
Fine Aggregates of Fineness Modulus	2.39
Fine Aggregates of Specific Gravity	2.6
Cement of Initial Setting Time	35 MIN
Cement of Final Setting Time	320 MIN
Compressive Strength of Cement after 7 DAYS	14N/MM <sup>2</sup>
Compressive Strength of Cement after 14 DAYS	20N/MM <sup>2</sup>

**Compressive strength test results** Compressive strength tests were carried out on concrete mixed with 0%, 2.5%,5% and 7.5%, 10%, 12.5% and 15% blades as per IS : 516-1959 – Methods of tests for strength of concrete. Six cube of each composition were made out of all three were tested after 7 days and remaining were tested after 28 days. Table 3, showing the average compressive strength of three cube of each composition after 7 and 28 days.

**4. Conclusions**

The Following conclusion can be drawn based on the results + analysis:

- i) According to the test performed it is observed that there is remarkable increment in properties of concrete according to the percentages of blades by weight of in concrete.
- ii) The optimum percentage which impart great strength is found to be the M25 +10%B, that increases the strength up to 35.58% to its original strength.
- iii) As author used waste blades in concrete which showed significant increases in Compressive strength of concrete, which is also alternate to dispose such waste material and have a step towards reducing solid waste disposal.

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