FLEX REINFORCED CONCRETE

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ABSTRACT

The manufacturing processes, service industries and municipal solid wastes give rise to countless waste materials. Solid waste management is one of the most important environmental concerns within the world. With the scarcity of space for landfilling and because of its increasing cost, waste utilization has become better than waste disposal. The alarming rate of waste materials and over exploitation of natural resources for building purposes, demands the necessity for sustainable construction materials. Researches are being done on the employment of waste products in concrete. The utilization of waste products to interchange natural resources in concrete may be a sustainable solution not only to the waste disposal problems but also for the conservation of natural resources. Here, this work aims at adding flex fibers obtained from waste flex boards to concrete, to develop a more durable, ductile and eco-friendly concrete composite with improved strength properties than nominal concrete. Landfill sites have become overcrowded and expensive for waste disposal, efforts are made to reduce the quantities of materials that are delivered to landfills. The threat because of leaching of non-biodegradable materials like waste plastics, scrap tyres, e-waste may contaminate the soil and ground water. Therefore utilization of waste materials for the modification of other usable materials is important. Flex board is formed of PVC which is not recyclable till now. National Green Tribunal has already banned the utilization of flex fibre everywhere in India, but still 15000 to 20000 tonnes of flex boards are produced in Kerala day by day. After using these flex boards, they were merely thrown out to the environment or burnt. Since it is non-biodegradable, it remains within the environment and if burned, toxic fumes are produced which causes serious health issues like cancer and infertility. Use of flex fibre in the modification of construction materials helps in the effective disposal of flex board and reducing environmental hazards to a good extent. Modification of concrete with flex fibre materials will increase its strength, durability and improves other properties likewise.

Keyword: - *Solid waste management, Flex fibre, PVC, Waste disposal, Strength and Durability*

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1. INTRODUCTION

Concrete is a basic material for construction. The development of concrete has led to the essential need for additives, both chemical and mineral to spice up its performance. Hence forms of admixtures like fly-ash, coconut fibre are used till date. The use of admixtures is particularly to modify the setting and hardening of cement by influencing the rate of hydration of cement. Use of concrete is helpful because of the fact that it is economical, energy efficient, and an ambient temperature hardened material, highly water resistant, highly temperature resistant and has high consumption of water, ability to cope up with reinforcing steel which also possess the ability to cast and requires very few maintenance. Landfill sites are becoming overcrowded and waste disposal has become expensive. Efforts are made to cut back the quantity of materials that are being delivered to landfills. The threat because of leaching of non-biodegradable materials like used plastics, scrap tyres and e-waste may contaminate the soil and ground water

1.1 ADVANTAGES

- FRC is employed in civil structures where corrosion is to be avoided the most.
- FRC is best suited to reduce cavitation or erosion damages in structures where high velocity flows are encountered.

- When utilized in ridges, it helps to avoid catastrophic failures. In earthquake prone areas, the employment of fibre reinforced concrete will surely minimize the human casualities.
- Fibre reduces internal forces by locking microscopic cracks that is formed within the concrete.

1.2 DISADVANTAGES

The fibres have to be uniformly mixed and spread throughout the concrete mix and at times this can be difficult. Once this can be accomplished this may be one of the economically strongest concrete.

1.3 APPLICATIONS

The use of fibre in concrete can reduce the overall energy consumption of a construction project and thus can contribute to sustainable building practices.

- Blast protection: The fibres utilized in concrete reduce fragmentation by providing high levels of toughness.
- It is used for protection against secondary injuries resulting from energized fragments during blast.
- FRC may be used for concrete elements like beams and columns for building in earthquake prone locations because of its high energy absorption properties.
- Used for industrial floors and machine foundations.
- Used in airport and highway pavements.

2. MATERIAL AND METHODOLOGY

Present study is an effort to research experimentally the effect of addition of flex fibre to normal concrete. Four sets of mixture proportions were made viz. 0%, 0.25%, 0.5%, 0.75% and 1% flex fibre.
a) Cement: Locally available Ordinary Portland cement (OPC) 53 grade is used in the present investigation. This cement satisfied nearly all requirements of the IS 12269-1987. Tests were conducted to check the initial setting time, specific gravity and standard consistency.
b) Sand: Crushed stone sand with size 150 microns and 4.75mm is used as fine aggregate. Aggregates are the important constituents in concrete. Sieve analysis of fine aggregate was performed in the laboratory as per IS 383 and tested as per IS 2386.
c) Coarse aggregate: Locally available crushed coarse aggregate of size less than 12.5 mm is used for the work. Sieve analysis of the coarse aggregate was performed in the laboratory as per IS 383 and tested as per IS 2386.
d) Water: In line with IS 3025 water used for mixing and curing are free from injurious or deleterious materials. Potable water is usually considered satisfactory. In this investigation, tap water is used for all mixing and curing purposes.
e) Flex Fiber: Flex once used for its actual purpose was cleaned and cut into a fibre form, with length 2.5cm and width 0.1cm. The flex material contains a relatively higher composition of Poly – Vinyl Chloride. The flex is added in the concrete in an increasing percentage of dosage, varying as 0%, 0.25%, 0.5%, 0.75% and 1%, by its total weight.

2.1 Compressive strength

Flex concrete showed improved compressive strength. The test was conducted for conventional concrete as well as the four other mixes of modified concrete with flex. The test was done on 7th and 28th days of curing. Based on the results, the optimum flex content found was mix of 0.25% flex fibre. The decrease in compressive strength is observed when percentage of flex increases beyond 0.25%. One of the possible reasons for this compressive strength reduction may be the weak interface of the flex induced mortar and the conventional coarse aggregates. It is concluded that flex at 0.25 % has higher strength than the nominal mix. The results are shown below for each mixes.

Table-1 Compressive strength values of flex concrete

Days	0%	0.25%	0.5%	0.75%	1%
7	19.11	24.88	22.67	22.2	18.2
28	20	35.55	24.4	24.15	23.9

2.2 Split Tensile Strength

Split tensile strength test was done on cylindrical specimens placed horizontally between the loading surfaces of the compression testing machine. The load was applied until the cylinder specimen failed along the vertical diameter. The results of split tensile strength are tabulated in Table-2. Although the variation of split tensile strength with increasing flex fibre content is similar to that of the compressive strength, the rate of reduction in split tensile strength is very much lower mainly due to the ease with which the cracks can propagate under tensile loads. From 28th day Split Tensile Strength for the various percentage addition of flex in Concrete, the optimum value obtained at 0.25% flex addition which is higher than the nominal concrete. This is due to the holding capacity of the flex which helps in preventing the splitting of concrete. However, after increasing the percentage of flex beyond the optimum value (0.25%) improper mixing of flex occurred.

Table-2 Split tensile strength values of flex concrete

Days	0%	0.25%	0.5%	0.75%	1%
7	10.35	18.75	14.4	13.5	11
28	15.75	22.5	19.5	18.7	17.9

2.3 Flexural Strength

Modulus of rupture (extreme fibre stress in bending) was found out by testing beams under third-point loading. As the flex fibre content was increased, the flexural strength was seen to increase upto 0.25% of addition and then it decreases due to improper mixing of flex. The variation in modulus of rupture of flex induced concrete is almost similar to that of its split tensile strength. Hence the optimum mix obtained from the results is mix of 0.25 %.

Table-3 Flexural strength values of flex concrete

Days	0%	0.25%	0.5%	0.75%	1%
7	1.415	2.65	1.98	1.64	1.62
28	2.122	2.624	2.3	2.26	2.21

3. COMPARISON OF RESULTS

The compressive strength test results for both 7th day and 28th day shows that there is a significant change in the strength with the addition of 0.25% of flex fibre to the concrete; ie. compressive strength was found to be 24.88KN/mm^2 after 7 days and 35.55 KN/mm^2 after 28 days which are the optimum values. Although the variation of split tensile strength with increasing flex fibre content is similar to that of compressive strength, the rate of reduction in split tensile strength is much lower mainly due to the ease with which the cracks can propagate under tensile loads. An optimum split tensile strength value of 18.75 KN/mm^2 was obtained with the addition of 0.25% of flex fibres after 7 days and after 28 days it was 22.5 KN/mm^2. The variation in modulus of rupture of flex induced concrete was almost similar to that of its split tensile strength. Here an optimum value of 2.65 KN/mm^2 was reached after 7 days and 2.624 KN/mm^2 was obtained after 28 days.

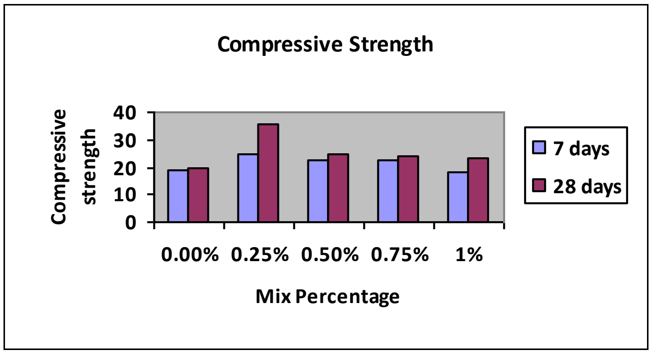

Fig-1 Comparison of Compressive strength

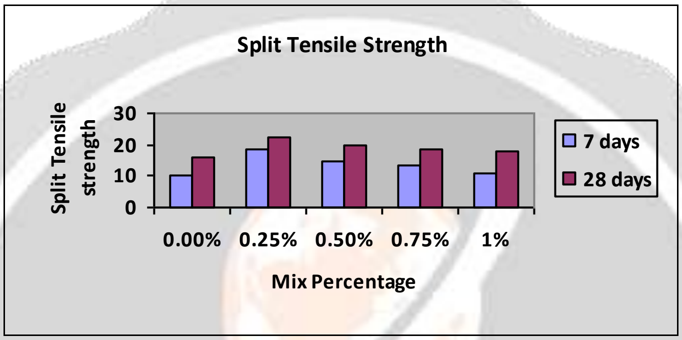

Fig-2 Comparison of split tensile strength

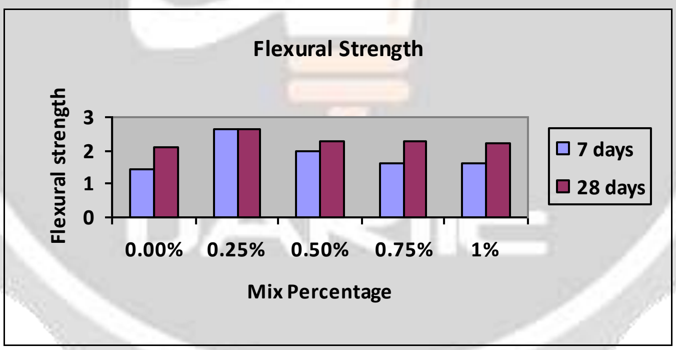

Fig-3 Comparison of flexural strength

4. CONCLUSION

It was observed that the concrete flex can be used as a component of concrete without affecting its workability to a great extent. The strength properties of the concrete improved on fibre addition upto 0.25% of weight of total weight. Beyond that, the strengths seemed to be decreasing. The flex concrete showed its optimum strength on mix of 0.25%. The compressive strength test, split tensile strength and flexural strength test shows a similar trend in graphs. The strength decreased after 0.25% of flex is due to balling effect of flex which means that fibres that higher volume fractions found to ball up during the mixing process. This process called ‘balling’ affects the workability and strength characteristics of concrete.

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