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Flexural Strength of Concrete Using Polyethylene Terephthalate (PET) Fibres

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ABSTRACT

Utilization of waste material in concrete would be beneficial in order to find an alternative solution to reduce environmental pollution. One of the waste materials is polyethylene terephthalate (PET) which is a polyester material and is produced in large quantities. In this work fibres are simply cut from waste plastic bottles reducing, in this way, the manufacturing costs of recycled PET fibre concrete. The waste plastic bottles are difficult to biodegrade and involve processes either to recycle or reuse. The construction industry is in requiring of finding cost effective materials for increasing the strength of concrete structures. One possible solution is using RPET as short fibres in concrete. It can provide greater crack control and ductility enhancement capacities for quasi-brittle concrete as well as mass consumption alternative, which is a very important issue in the merit of recycling waste materials. The aim of this work is to explore the possibility of a waste material to be used in concrete as fibre. The dimensions of PET fibres used are 30mm long, 5mm width and 0.6mm thickness it was added to concrete in the various percentages of 0.5 %, 1.0 %. 1.5 % and 2.0% of fibre in total weight of concrete. In this study totally 36 numbers of cubes, cylinders, beams specimens were tested and their compressive strength, split tensile strength, flexural strengths were compared. Then optimum percentage of PET fibre is found out.

Keywords: Plastic Bottles, Polyethylene Terephthalate, Biodegrade, Fibre.

1. INTRODUCTION

Polyethylene terephthalate (PET) is one of the most important synthetic fibres for industrial production. Concrete is strong in compression but weak in tension. To eliminate this problem, the introduction of fiber was brought in as an alternative to developing concrete in view of enhancing its tensile strength as well as improving its ductile property. In India, domestic waste plastics are causing considerable damage to the environment and hence an attempt has been made to understand whether they can be successfully used in concrete to improve some of the mechanical properties.

Among different waste fractions, plastic waste deserves special attention on account non-biodegradable property which is creating a lot of problems in the environment. Plastics constitute 12.3% of total waste produced most of which is from discarded water bottles. The PET bottles cannot be disposed of by dumping or burning, as they produce uncontrolled fire or contaminate the soil and vegetation.

One possible solution is using RPET as reinforcing short fibers in structural concrete. It can provide greater crack control and ductility enhancement capacities for quasi-brittle concrete as well as mass consumption alternative, which is a very important issue in the merit of recycling wasted materials. The main application of PET fibres is to reduce the environmental pollution due to plastic wastes.

2. METHODOLOGY

The first step in this study was optimization of Polyethylene terephthalate (PET) Fibre with correct mix proportion of mortar matrix containing cement, sand. Three cubes, cylinders, beams were casted for in the each fibre percentages. Three specimens were casted without fibre and then second set for each three percentages are 0.5%, 1.0%, 1.5%, 2.0% of total weight of concrete. The mix design of concrete M30.Water cement ratio is 0.46.

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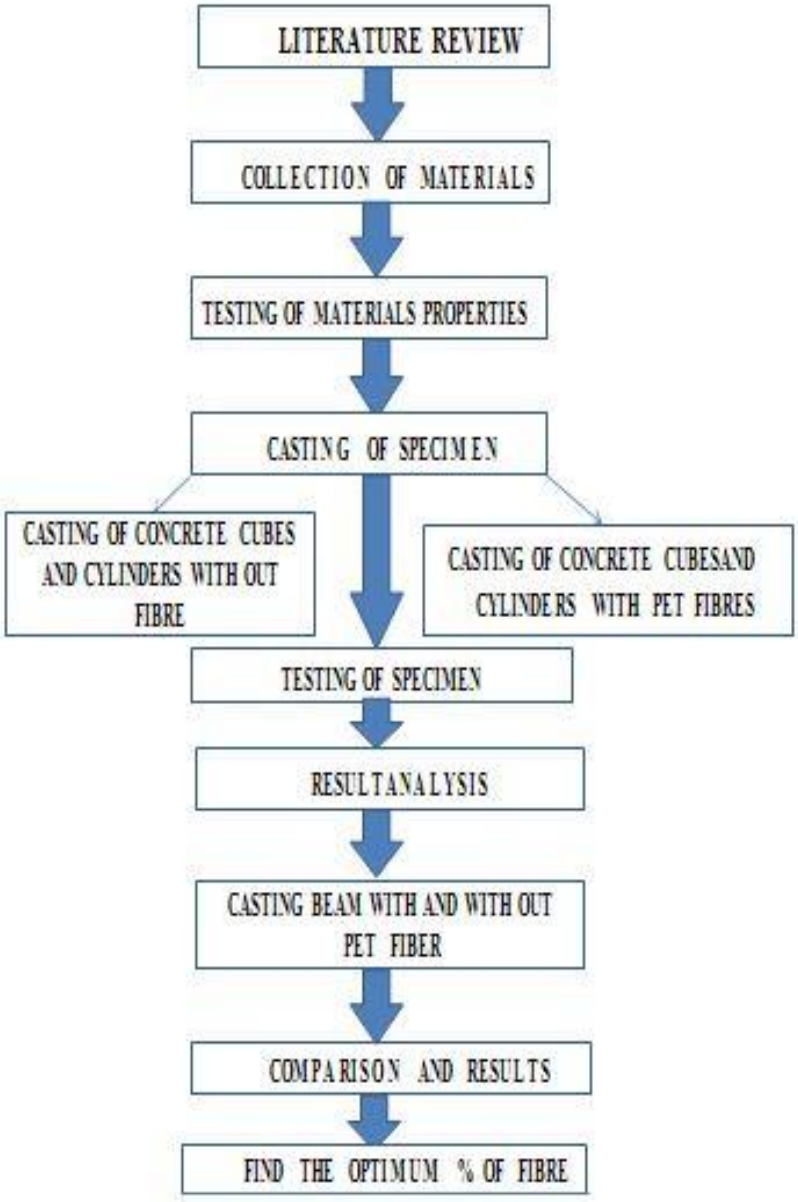

Fig 1: Methodology

3. MIX DESIGN

Table 1: Mix Design

Cement	Fine aggregate	Coarse aggregate	Water
320 kg/m^3	730 kg/ m^3	1120kg/ m^3	147.75 l/m^3
1	2.28	3.5	0.46

4. REINFORCING STEEL

The 10 mm diameter of High Yield Strength Dia (HYSD) bars were used as main reinforcement. 6 mm diameter mild steel bars were used for shear reinforcement.

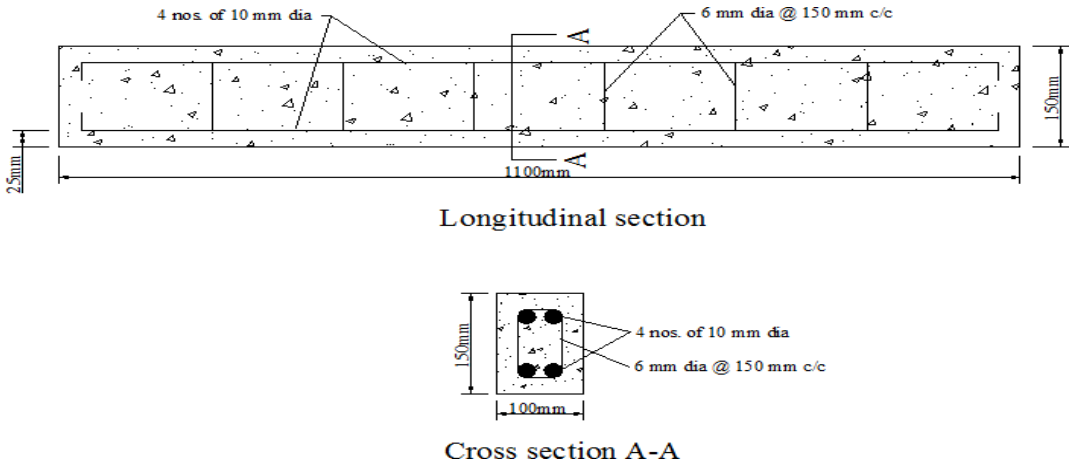

Fig 2: Longitudinal section and Cross Section

The reinforcement cage was then placed in position inside the form work carefully keeping in view a clear cover of 20 mm for the top and bottom bars.

Fig 3: RCC Frame Work Design

5. TESTING RESULTS

The test result were the cubes, cylinders, beams in the compressive strength, split tensile strength and flexural strength test in the variation of results.

A. COMPRESSIVE STRENGTH RESULTS

The compressive strength of concrete in the cubes were Tested. Then test results were compared. From the results, the 1.5% percentage of fibre used in cube it had low compressive strength compare to 0% percentage of fibre cube.

Table 2: Compressive strength Result

S .No	Percentage of pet fibre added	Average compression strength in 28 days(N/mm^2)
1	0	31.4

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2	0.5	36.5
3	1.0	38.4
4	1.5	30.3
5	2.0	30.1

B.SPLIT TENSILE STRENGTH RESULTS

From split tensile strength of concrete were results of the 0, 0.5%, 1.0% of fibre added in to concrete, the split tensile strength high in 1.5 %, compared to 1.0% fibre concrete cylinder.

Table 3: Split Tensile Strength Result

S .No	Percentage of pet fibre added	Average split tensile strength in 28days(N/mm^2)
1	0	3.96
2	0.5	4.10
3	1.0	4.26
4	1.5	4.01
5	2.0	4.0

C. FLEXURAL STRENGTH RESULTS

The flexural strength tests were 0.5% and 1.0% of fibre added to concrete increase it strength. The 2.0% of the fibre added to concrete the flexural strength is low compared to 0% fibre reinforced concrete. Load and deflection curve is shown below.

Table 4: Flexural strength result

S.No	Percentage of pet fibre added	Average ultimate load capacity (KN)	Deflection (kN)
1	0	55	9.0
2	0.5	62.5	8.0
3	1.0	70	7.7
4	1.5	52.5	8.2
5	2.0	45	8.28

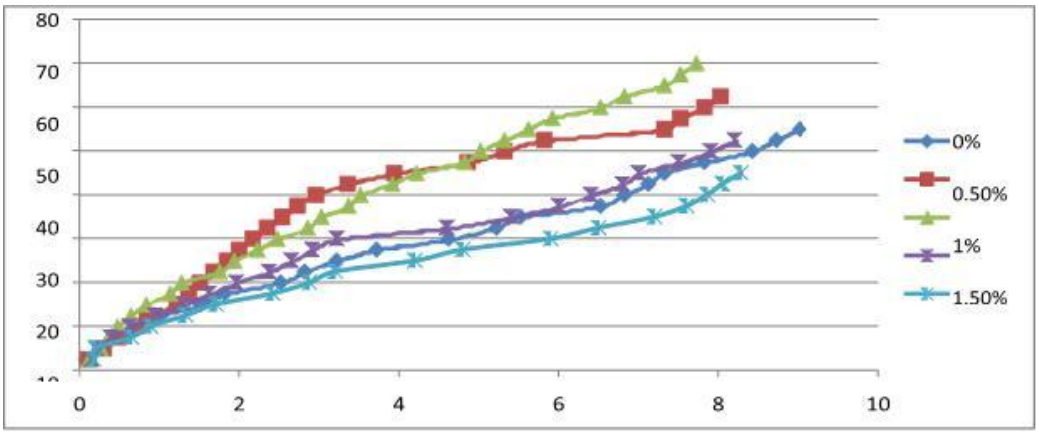

Fig 4: Flexural strength result chart

6. CONCULSION

An Experimental Investigation was done to find the behavior of PET fibre in concrete. The following Percentage of PET fibres (0%, 0.5%, 1%, 1.5%, and 2%) were added into concrete .It increase the flexural Strength when added up to 1.0% compared to conventional concrete beam. For cubes and beams results with 1.5% of fibre, concrete strength decreased compared to conventional concrete. For cylinder up to 1.0% of fibre added, split tensile strength increased compared to conventional concrete. Deflection of the concrete beam decreased with the 1.5% of fibre. The fibre is compatible as a building material up to 1.0%. As a result show optimum percentage of 1.0% of PET fibres can be used as a building material.

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