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Experimental investigation on high strength concrete with polypropylene fiber and M sand

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ABSTRACT

The importance in the use of fibers for the reinforcement of composite has improved during the last a number of years. A combination of high strength, stiffness and thermal resistance favorably characterize the fibers. Polypropylene Fiber Reinforced Concrete is an developing construction material which can be described as a concrete having high mechanical strength, Stiffness and durability. In this study mixture of M sand and polypropylene fiber of volume fractions of 0.25%, 0.50%, 0.75%, 1.00% and 1.25% was used for all M sand concrete mixes. Each series consists of cubes, cylinders and prisms as per IS standard with M40 design ratio. A series of tests were carried out to find out the compressive strength, flexural strength at the age of 28 days. In this study analyze the compassion of different fibers to concrete with different strength.

Keywords: Concrete, River sand, M-sand, Polypropylene fiber, Admixtures.

INTRODUCTION

The fiber dispersion into concrete is one of the technique to improve the building properties of concrete. Polypropylene fibers are synthetic fibers obtained as a by-product from textile industry. These are available in different aspect ratios and are cheap in cost. Polypropylene fibers are characterized by low specific gravity and low cost. The fiber bundles are cut into specified lengths and fibrillated. Therefore, it is important to reduce the crack width and this can be achieved by adding polypropylene fibers to concrete. Thus addition of fibers in cement concrete matrix bridges these cracks and restrains them from further opening. In order to achieve more deflection in the beam, additional forces and energies are required to pull out or fracture the fibers. An experimental program was carried out to explore its effects on workability, compressive, flexural, split tensile strength and modulus of elasticity of concrete.

Objectives

- To study about high strength concrete using Polypropylene fiber and M sand.
- Discuss about various properties of high strength concrete using Polypropylene fiber and M sand.
- Discuss about advantages and disadvantages of high strength concrete using Polypropylene fiber and M sand.

LITERATURE REVIEW

Salahaldein Alsadey and Muhsen Salem (2016) Based on the experimentation conducted, on the cubes with different percentage of polypropylene fiber the following some conclusions were drawn. The reduction of slump is noticed with increase in polypropylene fiber content, especially beyond 2 % dosage, the mix become fibrous which results in difficulty in handling. The compressive strength tests reveal that, the strengths were increased

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proportionately with the increase in volume ratios of polypropylene fiber with reference to the control mix without fiber. The percentage increase of compressive strength of polypropylene fiber concrete mixes compared to the mix without fiber is observed from 4 to 12 %.

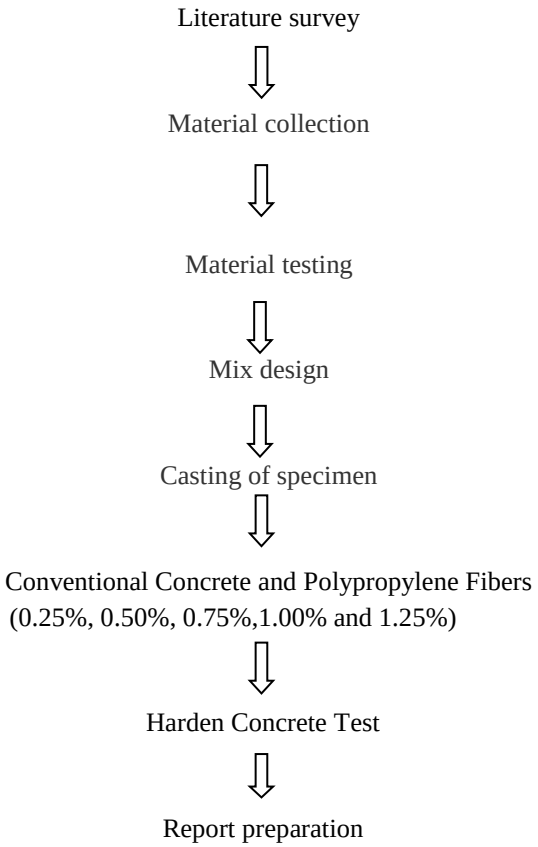
Milind V. Mohod., et al (2015) done an investigation program is to study the effect of Polypropylene fibre mix by varying content such as 0% ,0.5%,1%,1.5% & 2% by volume of cement and finding the optimum Polypropylene fibre content. result shows Compressive strength of concrete, split tensile of concrete, flexural strength of concrete increases with increase in fibre dosage of 0.5%.

Kolli.Ramujee., et al (2013) The interest in the use of fibers for the reinforcement of composites has increased during the last several years. A combination of high strength, stiffness and thermal resistance favorably characterizes the fibers. In this study, the results of the Strength properties of Polypropylene fiber reinforced concrete have been presented. The compressive strength, splitting tensile strength of concrete samples made with different fibers amounts varies from 0%, 0.5%,1% 1.5% and 2.0% were studied. The samples with added Polypropylene fibers of 1.5 % showed better results in comparison with the others.

Manjula., et al (2017) carried out experimental investigation on concrete due to the effect of silica fume and quarry dust with and without steel fibers and coir fibers on ordinary Portland cement.

In this study, high strength concrete of M70 is tried using silica fume as partial replacement for cement at 0%,5%,10%,15%,20% and quarry dust as partial replacement for sand at 0%,10%,20%.30%,40% with addition of 0.5% hooked end steel fibers and 2% coir fibers by the volume of concrete The test results shown that the 10% replacement of cement by silica fume and 20% replacement of sand by quarry dust show the good and optimized results.

METHODOLOGY



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Results and Discussions

PHYSICAL PROPERTIES OF MATERIAL

Cement

Ordinary Portland cement of 53grade confirming to IS12269-1989 is used for this present study. The specific gravity of cement is, and the other properties of cement are given in Table-1.

Table-1: Physical properties of cement.

Property	Value
Specific gravity	3.16
Initial setting time	34 min.
Final setting time	410 min.
Fineness modulus	1.60%
Soundness	6.10

Aggregates

Good quality river sand and M sand was used as a fine aggregate. The material whose particles are of size as are retained on I.S Sieve 4.75mm is termed as coarse aggregate. The size of coarse aggregate depends upon the nature of work. The coarse aggregate used in this experimental investigation are of 20mm size crushed angular in shape. The aggregates are free from dust before used in the concrete.

table 2: Physical properties of coarse aggregate and fine aggregates.

Property	Coarse aggregate	Fine aggregate	
		River sand	M sand
Specific gravity	2.70	2.60	2.45
Bulk density(kg/m3)	1510	1460	1556
Water absorption (%)	0.45	1.00	0.85
Moisture content (%)	0.65	1.55	1.10
Aggregate impact value (%)	12.50	-	-
Fineness modules	6.67	3.44	3.54
Fineness particles Less than 150mm (%)	-	4.14	7.60

Polypropylene Fibers

Polypropylene is available in two forms, monofilament fibers and film fibers. Monofilament fibers are produced by an extrusion process through the orifices in a spinneret and then cut to the desired length. The newer film process is similar except that the polypropylene is extruded through a die-that produces a tubular or flat film. This film is then slit into tapes and uniaxially stretched. These tapes are then stretched over carefully designed roller pin systems which generate longitudinal splits and these can be cut or twisted to form various types of fibrillated fibers.

Fig 1. Polypropylene Fibers

Table 3: Properties of polypropylene fibers

Properties	Test Report
Diameter(D) ,mm	0.0445
Length (l),mm	6.20
Aspect Ratio (l/D)	139.33
Tensile strength Mpa	438
Specific gravity	1.23

Water

Fresh potable water having p^H value 7 is used for making concrete and for curing the concrete cubes.

Mix Design

The main objective of current experimental investigation is to find out the M40 grade of concrete design ratio of conventional concrete test report on this project. Concrete mix was designed as per IS 10262-2009. M40 grade concrete having mix proportions of cement: River Sand: Coarse aggregate proposal ratio of 1:2.6:3.66 used by weight and the w/c ratio was fixed as 0.40 as per the designed curve and M50 grade concrete having mix proportions of 1:1.47:2.9 used by weight and the w/c ratio was fixed as 0.35 as per the designed curve.

Fig 2. Mixing of Concrete with Polypropylene Fibers

RESULTS AND DISCUSSIONS

The main objective of current experimental investigation is to find out the M40 grade design ratio of conventional concrete test and different percentage of polypropylene fibers mixing report on this phase 2 project. Concrete mix was designed as per IS 10262-2009.

Fig 3. Compression strength Test

Table 4: Conventional Concrete Compression strength Results for M40 grade of concrete

S.No	conventional concrete	7 Days N/mm²	28Days N/mm²	Average Result
1	1:2.6:3.66	25.9	42.5	44.23
2		26.5	44.9	
3		26.8	45.3	

Table 5. Compression strength Results for M40 grade of concrete with different percentage of polypropylene fibers

S.No	P P fibers	7 Days N/mm²	28 Days N/mm²	28 Days N/mm² Average Result
1	0.25 %	22.56	39.28	39.22
		22.78	38.58	
		21.80	39.80	
2	0.50 %	24.78	42.90	42.59
		24.22	42.28	
		25.36	42.60	
3	0.75 %	27.26	44.70	44.71
		27.80	44.55	
		27.58	44.88	
4	1.00 %	28.44	46.20	46.53
		28.65	46.54	
		29.10	46.86	
5	1.25 %	25.33	42.10	42.43
		25.54	42.48	
		25.40	42.73	

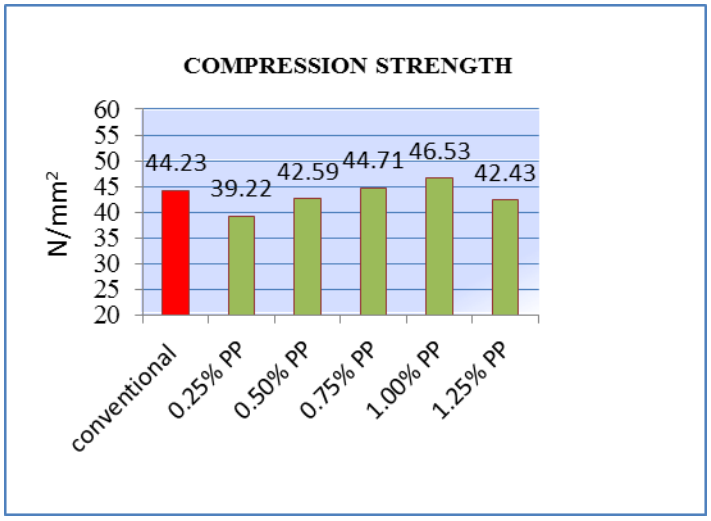

Fig 3. Flow Chart for Conventional Concrete Compression strength Results for M50 grade of concrete

CONCLUSIONS

Based on the experiment conducted the following observation were made hence some conclusion. The use of polypropylene fibers has increased in recent years due to the property of the fibers to eliminate some defects in concrete. The high tensile strength as a result of fibers can improve the capacity of the concrete and can control the volume changes with time.

a) Compressive strength properties of polypropylene fiber reinforced concrete increase as the percentage of polypropylene fiber increase up to 1% increasing strength

b) Tensile strength properties of polypropylene fiber reinforced concrete increase as the percentage of polypropylene fiber increase up to 1% increasing strength and therefore at 1.2% shows decreasing strength.

c) Flexural strength properties of polypropylene fiber reinforced concrete increase as the percentage of polypropylene fiber increase up to 1% increasing strength and therefore at 1.2% shows decreasing strength.

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