Performance Comparison and Analysis af A Designed Experimental Investigation an Concrete by Using Polypropylene Fiber

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Abstract- *This research studies thecomparison of conventional concrete of grade M25 with that of the micro synthetic polypropylene fiber reinforced concrete. Destructive and non-destructive compressive strength tests and destructive flexural strength tests were carried out on the samples built with 0.5%, 1% 1.5% contents of polypropylene fibers with the addition of 10% and 30% silica fume alongside a control samples after 7, 14, 28 days of curing.The relationship between cube compressive strength and cylinder split tensile strength for conventional and polypropylene fibre reinforced concrete were established and compared with standards.The study suggested the significant improvement in compressive and tensile strength for concrete mixes reinforced with polypropylene fibers. The samples with added polypropylene fibersof 0.5% showed better results in comparison with the others.*

Keywords- Concrete, Polypropylene Fiber, Destructive Test, Non Destructive Tests, Compressive Strength,Flexural Strength

I. INTRODUCTION

Concrete is the most widely used building material. It has the distinction of being formed into desired shape most conveniently. It is an artificial material consisting of ingredients such as cement, fine aggregates, coarse aggregates and water. Aggregates are the major ingredients of concrete.
Concrete can be formulated with high compressive strength, but always has lower tensile strength hence it is usually reinforced with materials strong in tension.Concrete develops micro cracks during curing which lowers the tensile strength of concrete. Production of Portland concrete is currently exceeding 2.6 billion tonnes per year worldwide and growing at 5% annually.

This paper deals with the effects of addition of variousproportions of polypropylene fibers on the properties of concrete. The main aim of the investigation is to compare the cube compressive strength and cylinder split tensile strength of conventional concrete and polypropylene fiber reinforced concrete. The mix design is done based on IS 10262-2009.

The polypropylene fibers of 12mm critical length at the ratio of 0.5%,1%,1.5% of the volume of concrete is added and the results are charted.Silica fume is added as a admixture replacing with cement at 10% and 30%.

Super plasticizer is added to enhance the workability.Curing is done for 7 days,14 days and 28 days and the respected strength is determined.The study suggests the significant improvement in compressive and tensile strength.

1.1. Fiber Reinforced Concrete

Concrete is very brittle in nature with the consequent low crack resistance which have limited its use only to absorbing compressive stresses. The idea of adding additives to concrete to improve its strength have been employed for many centuries.. In the most recent times, many methods have been adopted to improve concrete properties, and one of such methods is the addition of fibers to concrete. Research into the types of fibers to be used in concrete applications have been intensified since the 1950s alongside researches on the improvement of the composite materials technologies. For over half a century, extensive researches were undertaken to determine the appropriate qualities of fibers needed for various applications. The qualities of fibers needed for fiber reinforced concrete has been one of the major topics of interest because of the importance of concrete to the construction industries. Various types of fiber materials such as steel, carbon, glass, plastic, polypropylene, nylon, and cotton were tested. From the results of these research, American Concrete Institute's Committee 544 [3] classified fiber reinforced concrete into four groups based on the fiber materials: steel fiber reinforced Concrete (SFRC), glass fiber reinforced concrete (GFRC), synthetic fiber reinforced

concrete (SNFRC), and natural fiber reinforced concrete (NFRC). Synthetic fibers such as polyester, acrylic, polyethylene and polypropylene are further subdivided into micro-synthetic fibers (for diameter less than 0.30 mm) and macro-synthetic fibers (for diameter greater than 0.30 mm).

II. LITERATURE REVIEW

First of all various books and journals were collected for reference and study before starting the project work for having ideas about how the project should be.

Some of the literature reviews are

1. **Mustapha Abdulhadi in March 2014,** "**A COMPARATIVE STUDY OF BASALT AND POLYPROPYLENE FIBERS REINFORCED CONCRETE ON COMPRESSIVE AND TENSILE BEHAVIOUR"** The paper presentsAddition of 0.3%,0.6%,and 0.9% volume of polypropylene fibre increases the splitting tensile strength of concrete by 15.1%, 7.8%, 5.6% respectively.The optimum dosage for the splitting tensile strength of polypropylene fiber is in the vicinity of 0.3%

2. **PawanKumar ,Dr . A .K .Mishra,In Apr 2016.** "**COMPARATIVE STUDY OF POLYPROPYLENE FIBER REINFORCED CONCRETE WITH CONVENTIONAL CONCRETE PAVEMENT DESIGN"** The maximum flexural strength has obtained at 2% of polypropylene fiber by volume of concrete.Compressive strength increases with adding the percentage of polypropylene fiber.

3. **AhsanaFathima K M &Shibivarghese "BEHAVIOURAL STUDY OF STEEL FIBER AND POLYPROPYLENE FIBER REINFORCED CONCRETE"**Higher splitting tensile strength with addition of 0.5 % polypropylene fiber and higher flexural strength with addition of 0.75% steel fiber by volume of comcrete .The SFRC yield higher flexural strength with addition of 0.75% steel fiber by volume of concrete. The PFRC yield higher flexural strengthwith the addition of 0.5 % polypropylene fiber by volume of concrete.

4. **SaeedAhmed ,Imarn A Bukhari , JavedIqbalSiddiqui , Shahzad Ali Qureshi. "A STUDY ON PROPERTIES OF POLYPROPYLENE FIBER REINFORCED CONCRETE"** The addition of polypropylene fibers at low values i.e. 0.18% to 0.40 % actually increases the 28 days compressive strength by about 5%.Shrinkage cracking is reduced by 83 to 85 % by addition of fibers in the range of 0.35 to 0 .50 %.

III. MATERIALS USED

A. POLYPROPYLENE FIBRE

- Polypropylene is a synthetic fiber.
- It is also known as polypropene ,is a thermoplastic polymer used in a wide variety of applications .
- It is white, mechanically rugged and resistant to many chemical solvents, bases and acids.
- In 2013 , the global market for polypropylene was about 55million tons.
- The polypropylene is the world's second most widely produced synthetic plastic.
- It is more resistant to creep and fatigue.

B.Cement

Cement used to prepare the specimen was 53 grade Ordinary Portland cement, conforming to IS 12269:2013 with a fineness of 1%, standard consistency of 35% and Initial setting time 28mins.

C. Coarseaggregates

Coarse aggregates of 4.75mm to 12.5mm size aggregates wereused

D. Fineaggregates

Fine aggregates are taken for concrete preparation which passthrough 2.36mm sieve size.

E.Water

Portable water was used for mixing and curing of concrete specimens.

IV. MIXDESIGN

As per IS CODE BOOK 10262-2009 design mix for M25grade of concrete was prepared by replacing cement by10%,30%silica fume with the addition of polypropylene fibers.

V. TEST RESULTS

A. CompressiveStrength

Compressive strength was tested in compressive testingmachine.Cubespecimensofsize150mmx150mmx150mm were adopted for the test. Compressive strength was tested after7,14and 28 days of curing. The results of the tests are tabulated below.

VI. MATERIALS TESTRESULT

Table-1 Physical properties of cement

Fineness modulus	Normal consistency	Initial setting time	Final setting time
4.03%	35%	28mins	10hrs

Table-2 Physical properties of fineaggregates

Specific gravity	Water absorption	Fineness modulus
2.72	1%	2.85

Table-3 Physical properties of Coarseaggregates

Specific gravity	Water absorption	Fineness modulus
2.72	1%	7.73

Table 6.1 Properties of cement

TEST	RESULT
SPECIFIC GRAVITY	3.15
FINENESS	4.03%
INITIAL SETTING TIME	28mins
FINAL SETTING TIME	10hrs
CONSISTENCY TEST	35%

Table 6.2 Properties of polypropylene fiber

S. no	Properties	Values
1	Density	900kg/m^3
2	Length	12mm
3	Youngs modulus	1300-1800N/mm^2
4	diameter	34 microns
5	geometry	Fibrillated

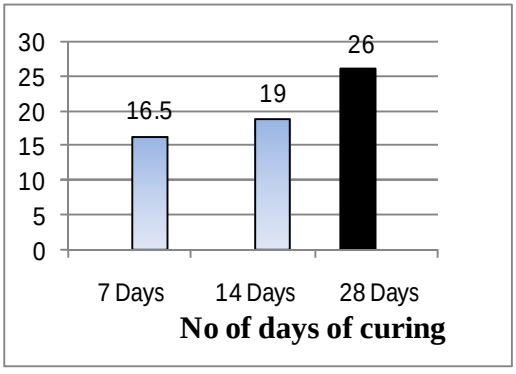
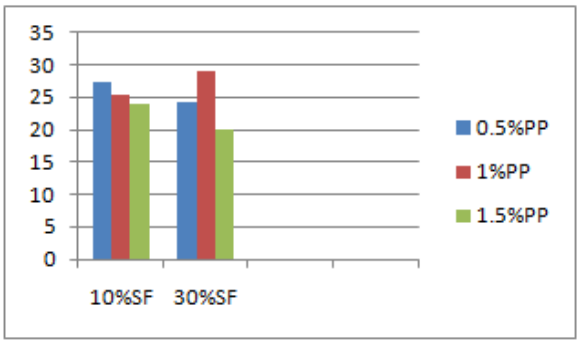


Table 6.3 Compressive strength of normal concrete

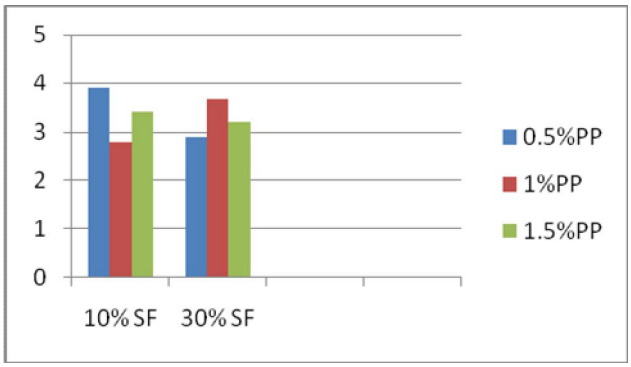
COMPRESSION STRENGTH OF REPLACEMENT OF POLYPROPYLENE FIBER REINFORCED CONCRETE 7, 21, 28 DAYS

POLYPROPYLENE FIBER	Fck for 10% SILICA FUME	Fck for 30%SILICA FUME
0.5%	27.5	24.4
1%	25.5	29
1.5%	24	20



TENSILE STRENGTH OF REPLACEMENT OF POLYPROPYLENE FIBER REINFORCED CONCRETE 7, 21, 28 DAYS

POLYPROPYLENE FIBER	for 10% SILICA FUME	for 30%SILICA FUME
0.5%	3.9	2.9
1%	2.8	3.67
1.5%	3.4	3.2



Based on the limited study carried out on the behavior of polypropylene fiber on concrete, the following conclusions are drawn:

i. At 10% cement replacement levels of silica fume, the addition of 0.5% of polypropylene fiber gives better improvement in compressive strength compared to other proportions.
ii. At 30% cement replacement levels of silica fume, the addition of 1% of polypropylene fiber gives better improvement in compressive strength compared to other proportions.
iii. (Based on the comparison between the two mix, prism is casted for the mix which achieves the higher strength.

VII. CONCLUSION

The maximum increase in compressive strength was 34%and split tensile strength was 40% compare to the mix without fibers**.**Compressive strength decreases with adding the percentage of polypropylene fiber and the tensile strength increases with the adding the percentage of polypropylene fiber.

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