Non Destructive Analysis on Fiber Reinforced Concrete using Waste Plastic Fiber

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Abstract— For quite fifty years, world production of plastic has continued to rise. Some 299 million plenty of plastics were created in 2013, representing a forty five increase over 2012. Recovery and employment, however, stay meager, and countless plenty of plastics find yourself in landfills and oceans annually. in step with the world organization Environmental Program, between twenty two a requirement forty third of the plastic used worldwide is disposed of in landfills, wherever its resources area unit wasted, the fabric takes up valuable area, and it blights communities. sick plastic from the waste stream for employment or for combustion for energy generation has the potential to attenuate these issues. However, abundant of the plastic collected for employment is shipped to countries with lower environmental regulation. And burning plastic for energy needs air emissions controls and produces dangerous ash, all whereas being comparatively inefficient. Plastic is flexible, light-weight, flexible, wet resistant, strong, and comparatively cheap. Those area unit the engaging qualities that lead United States, round the world, to such a voracious appetency and over-consumption of plastic merchandise. what is more solely restricted studies are meted out in Asian nation on the utilization of waste plastic(PET) for the event of high strength concrete with addition of polypropene fibers.Polyethylene Terephthalate (PET) is sometimes used for effervescent nutrient and water bottles. the development business is in need of finding price effective materials for increasing the strength of concrete structures. during this paper deals with the chance of exploitation the waste PET bottles and polypropene fiber size of fibre supplementary in to the concrete with one hundred and twenty fifth, and 1.5% PET bottle fibers. Cube specimens of three numbers every were forged cured and tested twenty eight days strength. Experimental investigation was done exploitation M25 combine and tests were meted out as per counseled procedures by relevant codes. The non harmful tests(Rebound Hammer And unhearable Pulse Velocity) of concrete has been studied during this analysis were done and also the results were compared with management specimens.

Key words: Nondestructive testing, Natural Fibre, Polyethylene Terephthalate, polypropylene fiber, pulse velocity, waste plastic, rebound hammer

I. Introduction

Concrete reinforcement technology is not new and fibers have been used for reinforcement since ancient times. Popular fibers are made up of steel and glass, while plastic and nylons have a limited use. Quantities, concentration, and dispersal influence the properties of fiber reinforced concrete.

Fiber reinforced concrete is a type of concrete that includes fibrous substances that increase its structural strength and cohesion. Fiber reinforced concrete has small distinct fibers that are homogeneously dispersed and oriented haphazardly. Fibers used are steel fibers, synthetic fibers, glass fibers, and natural fibers. The characteristics of fiber reinforced concrete are changed by the alteration of certain factors: type and quantity of fibers, geometric configuration, dispersal, direction, and concentration.

Portland cement concrete is believed to be a comparatively brittle substance. When un-reinforced concrete is exposed to tensile stresses, it is likely to fracture and fail. Since the beginning of the nineteenth century, studies were conducted to reinforce concrete by using steel. After the reinforcement of concrete by steel, it becomes a composite group in which the steel endures the tensile stresses. When concrete is reinforced by using fiber in the mixture, it further increases the tensile strength of the composite system. Research has revealed that the strength of concrete may be improved tremendously by the addition of fiber reinforcing. Since the stretching ability under load of reinforcing fiber is greater than concrete, initially the composite system will function as un-reinforced concrete. However, with additional loading the fiber reinforcing will be activated, to hold the concrete mix together.

The characteristics of concrete depend upon the:

1) type of fiber utilized.
2) volume proportion of the fiber
3) ratio of length of the fiber
4) diameter of the fiber dispersal, direction and concentration of fibers

These conditions will improve the mechanical properties, including toughness, ductility, tensile strength, shear resistance and loading limit of the fiber reinforced concrete.

A. *Materials Used for Fiber Reinforcement*

Materials used for fiber reinforcement include steel, glass, polyester, rayon, cotton, and polythene. Most commonly used materials are: steel (Steel Fiber Reinforced Concrete) and glass fibers (Glass Fiber Reinforced Concrete or GFRC) that are acid resisting.

Natural fibers being vulnerable to alkali attack are not much popular. Similarly, plastic fibers have recently been introduced in the field of reinforcement and are still in the development phase. It is considered that the contribution of plastic fibers in increasing the static strength of concrete is limited.

B. *Methodology*

There are sevral method of calculating the amount of different ingradient of the concrete. In this experiment we adopt the indian standard method according to IS-10262-2009 and mix of M-30 grade of concrete with the different percentage of fibers. we use the waste plastic fibers.

C. Materials

Portland Pozzolana Cement (Fly Ash based) was used in this experimentation conforming to IS: 1489-1991 (Part I) . The essential properties of cement required for the experiment are as given in Table I.

Fineness	Normal consistency	Initial setting time	Final setting time	Soundness (Le chart)	28 days compressive strength
2.65 %	34%	215 min	400 min	1.6 mm	51.2 kN/mm^2

Table 1:

Locally obtainable natural sand from watercourse was utilized in this study as fine combination and also the crushed stone aggregates were collected from the native question. the most sizes of aggregates were twenty metric linear unit and ten metric linear unit. The fine and coarse aggregates were tested as per IS: 383-1970 and 2386-1963 (Part I,II and III) specifications. The physical properties of aggregates square measure as shown in Table two and three.

Specific gravity	Water absorption	Bulk density Kg./cu. m	Fineness modulus	Silt content	Grading Zone
2.51	1.4%	1720.53	2.65	0.59 %	II

Table 2: Different properties of fine Aggregates

Aggregate maximum size	Specific Gravity	Bulk density Kg/cum	Fineness modulus	Water absorption
20mm	2.81	160.2	7.52	1.15%

Table 3: Different properties of Coarse Aggregates

D. Experiments on Different Proportional

1) Concrete Mix Design

Based on the trial combinees for various proportion of ingredients the ultimate style mix was chosen for M 30 grade of concrete as per IS 10262:2009 , the concrete mix proportions is as given. The plastic fibers were additional into dry mixture of concrete within the percentages of 1.0 to 1.5% by weight of coarse mixture. These specimens were tested once twenty eight days of set.

Concrete mix proportion is-

Cement - 380 kg
Fine Aggregate - 711 kg
Coarse Aggregate- 1283 kg
Water - 160 kg

Cubes of size 150mm X150mm X150 millimetre were ready exploitation the quality moulds. The samples ar casted exploitation the 2 totally different proportion of plastic fiber. The samples ar demoulded when twenty four hours from casting and unbroken in an exceedingly storage tank for twenty eight days natural action. a complete of twenty four specimens ar casted for testing the properties like compressive strength, and flexural strength. the main points of the specimen and their notations ar given below.

Type of specimen	Code of particular item	No. of specimen
Concrete without fibre	A	3
Concrete with 1% fibre	B	3
Concrete with 1.5% fibre	C	3

II. RESULTS AND DISCUSSIONS

The results of fiber concrete for reference concrete for two aspect ratios 25 are represented in Tables. The behaviour of properties of waste plastic fiber reinforced concrete (PFRC) is shown in the form of tables.

A. Schmidt Rebound Hammer Test

The Schmidt rebound hammer is principally a surface hardness tester. It works on the principle that the rebound of an elastic mass depends on the hardness of the surface against which the mass impinges. There is little apparent theoretical correlation between the strength of concrete and the rebound number of the hammer. However, within limits, empirical correlations have been established between strength properties and the rebound number(EN 12504-2:2002).

Specimen	Points	Hammer type testing angle	Compressive strength N/mm^2
Conventional	1	90	45.51
	2	90	42.35
	3	90	40.68
	4	90	49.65
	5	90	43.55
	6	90	44.25
	7	90	42.75
	8	90	41.25
	9	90	42.25

Table 4: Results of the conventional concrete cube A

Specimen	Points	Hammer type testing angle	Compressive strength N/mm^2
Conventional	1	90	42.25
	2	90	45.51
	3	90	42.35
	4	90	40.68
	5	90	45.51
	6	90	55.35
	7	90	40.68
	8	90	43.55
	9	90	44.25

Table 5: Results of the conventional concrete cube B

Specimen	Points	Hammer type testing angle	Compressive strength N/mm^2
Conventional	1	90	44.25
	2	90	60.75
	3	90	41.25
	4	90	42.25
	5	90	45.51
	6	90	42.35
	7	90	35.68
	8	90	41.65
	9	90	43.55

Table 6: Results of the conventional concrete cube C

Specimen	Points	Hammer type testing angle	Compressive strength N/mm^2
	1	90	32.56
	2	90	35.36
	3	90	40.26
	4	90	37.56

1% of Fiber	5	90	40.26
	6	90	45.25
	7	90	42.42
	8	90	39.65
	9	90	41.25

Table 7: Results of the 1% fiber mixed concrete cube A

Specimen	Points	Hammer type testing angle	Compressive strength N/mm²
1% of Fiber	1	90	40.25
	2	90	42.42
	3	90	39.65
	4	90	45.25
	5	90	32.56
	6	90	35.36
	7	90	40.26
	8	90	37.56
	9	90	38.25

Table 8: Results of the 1% fiber mixed concrete cube B

Specimen	Points	Hammer type testing angle	Compressive strength N/mm²
1% of Fiber	1	90	35.36
	2	90	40.26
	3	90	37.56
	4	90	42.42
	5	90	39.65
	6	90	41.25
	7	90	37.56
	8	90	40.26
	9	90	45.25

Table 9: Results of the 1% fiber mixed concrete cube C

Specimen	Points	Hammer type testing angle	Compressive strength N/mm²
1.5% of Fiber	1	90	29.03
	2	90	38.54
	3	90	40.30
	4	90	42.75
	5	90	35.06
	6	90	39.21
	7	90	45.25
	8	90	33.54
	9	90	37.75

Table 10: Results of the 1.5% fiber mixed concrete cube A

Specimen	Points	Hammer type testing angle	Compressive strength N/mm²
1.5% of Fiber	1	90	39.21
	2	90	45.25
	3	90	33.54
	4	90	37.75
	5	90	39.21
	6	90	40.30
	7	90	42.75
	8	90	35.06
	9	90	39.21

Table 11: Results of the 1.5% fiber mixed concrete cube B

Specimen	Points	Hammer type testing angle	Compressive strength N/mm²
1.5% of Fiber	1	90	33.54
	2	90	37.75
	3	90	39.21
	4	90	40.30
	5	90	38.54
	6	90	40.65
	7	90	42.75
	8	90	35.06
	9	90	41.36

Table 12: Results of the 1.5% fiber mixed concrete cube C

B. Ultra Sonic Pulse Velocity Testing

Non-destructive tests are adopted by the Indian standards. And The ultrasonic pulse velocity method is most reliable method as compare to the Schmidt Rebound hammer test. The ultrasonic pulse velocity method could be used to establish:

a) the homogeneity of the concrete,
b) the presence of cracks, voids and other imperfections,
c) changes in the structure of the concrete which may occur with time,
d) the quality of the concrete in relation to standard requirements,
e) the quality of one element of concrete in relation to another,
f) the values of dynamic elastic modulus of the concrete.

As per the IS -13311-1992 The ultrasonic pulse velocity result as followed-

S. No.	Pulse Velocity by Cross Probing (km/sec)	Concrete Quality Grading
1.	Above 4.5	Excellent
2.	3.5 to 4.5	Medium
3.	3 to 3.5	Good
4.	Below 3.0	Doubtful

Table 13: Velocity Criterion for Concrete Quality Grading

Note - In case of * Doubtful * quality it may be necessary to carry out further tests.

Specimen	Direction	Path Length (mm)	Velocity (KM/sec)	Result as per codal provision
Conventional	Longitudinal	150	5.4	Excellent
	Vertical	150	6.2	Excellent
1% Fiber	Longitudinal	150	4.42	Medium
	Vertical	150	4.36	Medium
1.5% Fiber	Longitudinal	150	3.95	Medium
	Vertical	150	4.15	Medium

Table 14: Velocity Criterion for Concrete Quality Grading for cube set of A

Specimen	Direction	Path Length (mm)	Velocity (KM/sec)	Result as per codal provision

Conventional	Longitudinal	150	5.35	Excellent
	Vertical	150	6.15	Excellent
1% Fiber	Longitudinal	150	4.35	Medium
	Vertical	150	4.49	Medium
1.5% Fiber	Longitudinal	150	3.86	Medium
	Vertical	150	4.15	Medium

Table 15: Velocity Criterion for Concrete Quality Grading for cube set of B

Specimen	Direction	Path Length (mm)	Velocity (KM/sec)	Result as per codal provision
Conventional	Longitudinal	150	5.25	Excellent
	Vertical	150	6.06	Excellent
1% Fiber	Longitudinal	150	4.29	Medium
	Vertical	150	4.41	Medium
1.5% Fiber	Longitudinal	150	4.01	Medium
	Vertical	150	4.32	Medium

Table 16: Velocity Criterion for Concrete Quality Grading for cube set of C

III. CONCLUSION

The results of this investigation can be summarized as follows.

1) The dry density is also reduced in Plastic fiber reinforced concrete but it is beneficial to reduce dead weight of concrete.
2) Its density is also decrease but the material cost also reduce and. Its compressive strength is greater than the conventional concrete specimen.
3) It was shows in the test that the sudden broken phenomenon is ont occurred in this type of work

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