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RESEARCH ARTICLE

AN EXPERIMENTAL INVESTIGATION ON LIGHT WEIGHT REINFORCED CONCRETE ELEMENTS BY USING POLYPROPYLENE MATERIAL

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Abstract
A polypropylene ball may be a formwork made from recycled polypropylene, designed to make lightened intermediate slabs and raft foundations in ferroconcrete . The use of Polypropylene balls formworks permits to build specific slabs: Polypropylene balls remains dip into the concrete casting. Thus, a grid of orthogonal beams, superiorly and inferiorly closed by plane slabs of various heights, is obtained without executing two distinct concrete castings, all that suggests an interesting saving of concrete and reinforcement.The present experimental investigation is carried out to study the mechanical properties of concrete by using of Polypropylene. Which would make it, light weight structure? The strength of the polypropylene concrete also increased compared to the conventional concrete. The experiments were carried out to evaluate the effect of polypropylene on the compressive strength, Tensile strength test and Flexural test for 7, 14, 28 day.

1. INTRODUCTION

Objectives of Project

In this project our main objective is to study the influence of Additional material of Polypropylene balls and to decrease the self weight of structure, and to compare it with the compressive strength of ordinary M25 concrete.

•To find the percentage of polypropylene material to be added in concrete that makes the strength of the concrete maximum.

1.1 General Introduction

Concrete may be a widely used material within the world. Based on global usage it's placed at second position after water. At present housing industry is growing exponentially thanks to several other factor besides increasing developmental activities. This results in huge demand of construction materials. Due to the auspicious attribute of concrete such as durability, availability, versatility, good compressive strength, it has been used as a major construction material ever since its inception. No construction can be dreamed without use of concrete.

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1.1.1 Definition of Concrete

Concrete is made up of three basic components: Water, Aggregates (rock, sand, or gravel) and Portland cement. Concrete is a mixture of cement, fine aggregates, coarse aggregates and water. Cement, usually in powder form, acts as a binding agent when mixed with water and aggregates.

1. METHODOLOGY

2.1 Materials Used in The Present Investigation

2.1.1 Cement In this study, 53 Grade Ordinary Portland Cement (OPC53) was used conforming to IS-12269-1987 specification as shown in the below Figure 2.1

Figure 2.1 Ordinary Portland Cement (53 Grade)

2.1.2 Fine Aggregate

Sand grains passing through a 4.75 mm sieve are called fine aggregates. Natural sand is used as fine aggregate.Sand occurs naturally and consists of fine rock material and mineral particles. Its composition is variable depending on the source. The sand we obtained is as shown in the Figure 2.2

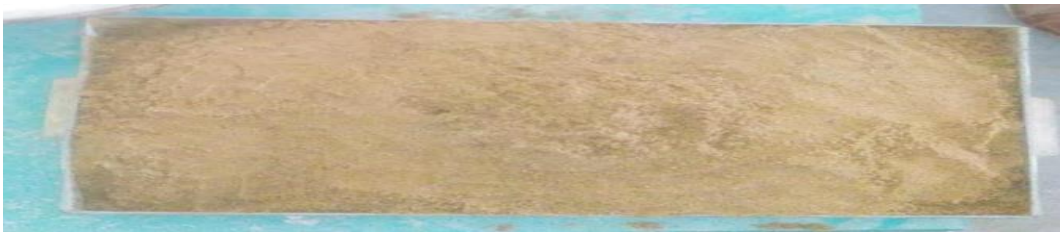

Figure 2.2 Fine aggregate (Sand)

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1.1.3. Coarse Aggregate Commonly sized, locally available well-graded aggregates larger than 4.75 mm and smaller than 12.5 mm are used as coarse aggregate. Maximum Nominal Aggregate Size taken is 20 mm. The coarse aggregate we obtained is as shown in the Figure 2.3

Figure 2.3 By using IS Sieve 20mm the Coarse aggregate is sieving by hand

2.1.4. Water

Water used in the mixing should be fresh and free from organic and harmful solutions which will lead to deterioration in the properties of the mortar. Salt water should not to be used. Potable water is used for mixing as well as for curing of cubes and cylinders. Potable tap water available in the laboratory was used for mixing and curing of concrete in this experiment as shown in the Figure 2.4.

Figure 3.4 Potable water

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2.1.5 Polypropylene $(C_3H_6)N$

Polypropylene may be a recycled material which is obtained by a recycled plastic industrial waste. It is a by-product of plastic industry. It is discovered in the middle 1950's by Italian scientists. Since then, it's getting used as a flexible material throughout the planet . It contains three carbon molecules and six hydrogen molecules. Due to its chemically inert nature it doesn't react with any of the materials like water, cement, admixtures etc when it's placed in concrete. It has high melting point and hence, it can be used in construction industry. As it may be a flexible material, it's immune to cracks and stress. Thanks to its durable nature, it can withstand daily wear and tear. The polypropylene has very low density and it is the reason for the light weight of the slab constructed using Polypropylene slab.(we adopted polypropylene material in the shape of balls of 50mm dia)

Figure 2.5 Polypropylene balls of 50mm

2.2. Grades of Concrete

Grade of concrete is defined because the minimum strength the concrete must possess after 28 days of construction with proper internal control. Concrete is understood by its grade which is designated as M15, M20 etc. in which letter M refers to concrete mix and number 15, 20 denotes the required compressive strength (fck) of 150mm cube at 28 days, expressed in N/mm2.Thus, concrete is known by its compressive strength. M20 and M25 are the foremost common grades of concrete, and better grades of concrete should be used for severe, very severe and extreme environments. Design mix concrete are those that mix proportions are obtained from various lab tests. The mix proportions of those concretes are supported mix design. In this project we considered M25

2.3 .Characteristic Strength of Concrete

It is defined as the value of the strength below which not more than 5% of the test results are expected to fall (i.e. there is 95% probability of achieving this value only 5% of not achieving the same)

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The characteristic strength of concrete in flexural member is taken as 0.67 times the strength of concrete cube. The strength to be taken for the aim of design is understood is understood as design strength and is given intentionally strength (fd) = characteristic strength/ partial safety factor for material strength. The value of partial factor of safety depends upon the sort of fabric and upon the sort of limit state. According to IS code, partial factor of safety is taken as 1.5 for concrete and 1.15 for steel. Design strength of concrete in member = 0.45fck

In this project we replaced by polypropylene balls of 50mm, as three cases and we conducted of compression test on cubes of 150*150*150 mm

Case No	Replacement
Case-I	One polypropylene ball of 50mm in 150mm concrete cube
Case-II	Two polypropylene ball of 50mm in 150mm concrete cube
Case-III	Three polypropylene ball of 50mm in 150mm concrete cube

And we concluded that case-II is the best by compression test .so we imparted case-II and followed further

2. Experimental Procedure

3.1 Mixing of Concrete

- Mix the concrete either by hand or in a laboratory batch mixer Hand Mixing.
- Mix the cement and fine aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform colour.
- Add the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch
- Add water and mix it until the concrete appears to be homogeneous and of the desired consistency. Mixing of concrete is shown in figure 3.1

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Figure 3.1 Machine Mixing of concrete

Figure3.2 Hand Tamping by using 50mm diameter of Tamping rod to compact the concrete.

3.2. Compression Testing of Concrete Cubes

All the cubes were tested under dry condition. For each mix proportion three cubes were tested at 7 days, 14 days and 28 days. Compression testing machine of 2000 kN capacity as per IS: 516-1959 code was used. As shown in Figure 3.3

Figure. 3.3 Load Application

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Figure 3.4 .Specimen deformation

3.3. **Split Tensile Test**

It is the quality test, to work out the lastingness of concrete in an indirect way. This test could be performed in accordance with IS : 5816-1970. A standard test cylinder of concrete specimen (300 mm X 150mm diameter) is placed horizontally between the loading surfaces of Compression Testing Machine.

3.5 mixing and preparation of cylinder

Calculation:

Calculate the splitting tensile strength of the specimen as follows: T= 2P/ pi LD

Where:

T = splitting tensile strength, MPa

P: maximum applied load indicated by the testing machine

D: diameter of the specimen, mm

L: length of the specimen, mm

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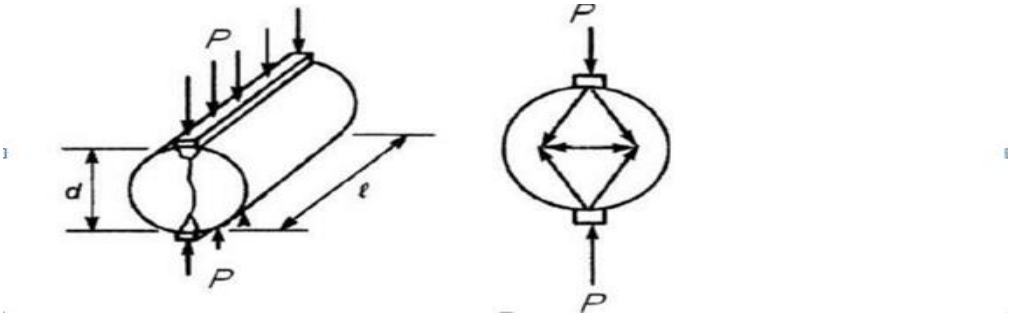

3.4flexural Strength Test Of Concrete (Is:516-1959)

Determining the flexural strength of concrete, which comes into play when a road slab with inadequate sub-grade support is subjected to wheel loads and / or there are volume changes due to temperature / shrinking.

Equipment and Apparatus

▪ Beam mould of size 15 x 15x 70 cm (when size of aggregate is less than 38 mm) or of size 10 x 10 x 50 cm (when size of aggregate is less than 19 mm)

▪ Tamping bar (40 cm long, weighing 2 kg and tamping section having size of 25 mm x 25 mm)

▪ Flexural test machine– The bed of the testing machine shall be provided with two steel rollers, 38 mm in diameter, on which the specimen is to be supported, and these rollers shall be so mounted that the space from centre to centre is 60 cm for 15.0 cm specimens or 40 cm for 10.0 cm specimens. The load shall be applied through two similar rollers mounted at the third points of the supporting span that's , spaced at 20 or 13.3 cm centre to centre. The load shall be divided equally between the 2 loading rollers, and every one rollers shall be mounted in such a fashion that the load is applied axially and without subjecting the specimen to any torsion stresses or restraints.

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3.6 preparation of beam

Calculations:

The Flexural Strength or modulus of rupture (fb) is given by

$fb = pl/bd^2$ (when a > 20.0cm for 15.0cm specimen or > 13.0cm for 10cm specimen)

$fb = 3pa/bd^2$ (when a < 20.0cm but > 17.0 for 15.0cm specimen or < 13.3 cm but > 11.0cm for 10.0cm specimen.)

Where,

a = the distance between the line of fracture and the nearer support, measured on the center line of the tensile side of the specimen

b = width of specimen (cm)

d = failure point depth (cm)

l = supported length (cm)

p = max. Load (kg)

Figure 3.7 Placing of polypropylene balls in the centre of reinforcement & laying the concrete

Fig.3.8.Polypropylene reinforced concrete slab

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3. Results & Discussion

4.1 Compression Strength Test Results

Concrete cubes of size 150mm x 150mm x 150mm are casted for nominal mix of M25 grade concrete to determine the compressive strength. Cubes were casted and tested for 7days, 14days and 28days after curing. From the results it was observed that the compressive strength of concrete increases by Polypropylene Material and up to 20% of dead load decreases. So, Using of Polypropylene balls in R.C elements and concrete structures is safe and economic. Test results are shown in the table 4.1

Table 4.1. Test Results

No. of Polypropylene balls placed	Compression strength of M25		
	7 days	14 days	28 days
0 Balls in concrete cube	17	22	28.2
1 Ball in concrete cube	17.4	21.2	26
2 Ball in concrete cube	18.2	24.2	34.4
3 Ball in concrete cube	16.2	20.8	24.6

Specific gravity :

Coarse aggregate 2.72

Fine aggregate 2.66

Normal consistency :

Vicat plunger to penetrate to a depth of 6.2mm from the bottom of the vicat mould

Spilt Tensile test:

$T= 2p/\pi ld$

$= 2*350/\pi 300*150 = 4.95mpa$

Conclusions

- The following are the major conclusions drawn from this experimental investigation using polypropylene fibre balls are additionally installed in slab.
- For the experimental studies, we can conclude that the polypropylene reinforced concrete structure is lighter than conventional reinforced concrete structure.
- For the experimental studies, we can conclude that the compressive strength of polypropylene reinforced concrete of 28 days is optimum and the value is 34.2 N/mm^2.

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- The addition of polypropylene balls in concrete gives Lighter the weight and higher the compressive strength.
- By the addition of polypropylene balls in the concrete structures and R.C.C structures are Economical.
- Finally we concluded that 25 percentage of polypropylene material is used in RCC slab

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