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Strength properties of extruded polyester fibrereinforced concrete with partial replacement of fine aggregate by foundry sand

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ABSTRACT

Fibre reinforced concrete is very useful in modern construction process. The present work deals with the results of experimental investigations on extruded polyester fiber reinforced concrete. Effect of these fibers on various strengths of concrete are studied. Here we have done the investigations to check the concrete strength parameter like compressive, flexural strengths of fibre reinforced concrete of M30 grade by replacement of 10%, 20%, and 30% of foundry sand and 0.5%, 1%,1.5% of polyester fibre by fine aggregate with water binder ratio of 0.3. The workability was measured with the slump cone test. The mechanical properties like Compressive strength, Split-tensile strength characteristics of fibre reinforced concrete were calculated. The results demonstrates the strength parameters offibre reinforced concrete with foundry sand and polyester fibre. A comparison of results of extruded polyester fiber reinforced concrete with that of normal concrete showed the improvements in various strengths. The Poisson's ratio is found to vary within the specified limits.

Keywords: Durability, Fibre reinforced concrete, Foundry sand, Fly ash, Polyesterfibre.

INTRODUCTION

Fiber Reinforced Concrete which is a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Fiber reinforced concrete are of different types and properties with many advantages. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers.Fiber is a small piece of reinforcing material possessing certain characteristics properties. They can be circular or flat. The fiber is often described by a convenient parameter called "aspect ratio". The aspect ratio of the fiber is the ratio of its length to its diameter. Typical aspect ratio ranges from 30 to 150.Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers. Within these different fibers that character of fiber reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation and densities.

Fibre-reinforcement is mainly used in shotcrete, but can also be used in normal concrete. Fibre-reinforced normal concrete are mostly used for on-ground floors and pavements, but can be considered for a wide range of construction parts (beams, pliers, foundations etc) either alone or with hand-tied rebars.

REVIEW OF LITERATURE

Several researches have been carried out for analysis the properties of foundry sand and also

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the strength of concrete by in cooperating foundry sand in partial as a fine aggregate. Some of them were discussed below**.**

Dushyant RameshbhaiBhimaniet al. (2006), They carried out an experimental investigation on the topic 'Strength Behavior of Foundry Sand on Modified High Strength Concrete'. Fine aggregate was replaced with 0, 15, 25 & 35% of WFS by weight in concrete. Compressive strength, split tensile strength and flexural strength tests were carried out to evaluate the strength properties of concrete. Based on their result values they stated that, 25% replacement give higher strength. They also stated that using of foundry sand for construction work will be more effective and efficient than land filling

Dr. B. Kameshwari et al., They investigated on the topic 'Strength of concrete incorporating waste foundry sand'. They had done their experiment in Grade M20. They replaced the fine aggregate by foundry sand in 10, 20, 30 & 40% by weight in concrete. From their test they concluded that Maximum compressive strength is obtained at 30% replacement and then decreases.

OBJECTIVES OF THIS PROJECT

The main purpose of the project is experimentally investigating the result by replacing 10%, 20%, 30% of fine aggregate by foundry sand and analyzing the major strength performance characteristics such as compressive, flexural strengths.

MATERIALS USED

Cement

Fig 1 Cement

Portland-Pozzolana cement of grade 53 was used to conduct the test on all types of specimens and they should be confirming to IS1489 (Part 1): 1991. The chemical composition of cement was included in table no: 1 shown:

Table 1: Chemical properties of cement

Chemical properties	Compounds (%)
SiO_2	23.5
Al_2O_3	12.9
Fe_2O_3	2.04
CaO	47.0
MgO	1.74
Chloride Content	0.01

Fine aggregate

Fig 2 Fine aggregate

The river sand available locally was cleaned and used. Fine aggregate which were passing through sieve size IS 4.75 mm was used to caste every specimen. The Specific gravity and the fineness modulus values are 2.64 and 2.79 respectively.

Coarseaggregate

Fig 3 Coarse aggregate

As per the IS 383 – 1970 coarse aggregates which were passing through IS sieve 12.5 mm was used. And also the cement paste- aggregate ratio, the aggregate type influences greater on concrete stability. Finally calculate Specific gravity is 2.77 and fineness modulus is 5.90 respectively

Foundry sand

Foundry sand which is high quality uniform silica sand that is used in the preparation of moulds and cores for ferrous and non-ferrous metal castings. Foundry sand which is used is a by-product of casting industries which comprises of uniform sized sands with different additives and metals which are associated with the particular casting process. Foundry sand is as used by Foundries is desired for its thermal resistance and availability. The Specific gravity and fineness modulus of foundry sand is 2.75 and 2.74. The chemical composition of foundry sand were included in table no: 2

Fig 4 Foundary sand

Table 2: Chemical properties of foundry sand

Chemical parameter	Foundry sand%
SiO_2	87.91
Al_2O_3	4.70
Fe_2O_3	0.94
CaO	0.14
MgO	0.30
SO_3	0.09
Na_2O	0.19
K_2O	0.25
TiO_2	0.15
P_2O_5	0.00
Mn_2O_3	0.02
SrO	0.03
LOI	5.15
TOTAL	99.87

Polyester fibre

A manufactured fiber in which the fiber forming substance is any long-chain synthetic polymer composed of at least 85% by weight of an ester of a substituted aromatic carboxylic acid.

FIG 5 POLYESTER FIBRE

Table 3

PHYSICAL PROPERTIES OF EXTRUDED POLYESTER FIBER	
Property	Value
Length	40 mm
Width	1.20 mm
Thickness	0.50 mm
Colour	Gray
Density	1.36 g/m^3
Tensile strength	400-800 MPa
Melting point	253^{0}C
Young's elastic modulus	11.3 kN/mm^2
Water absorption	0.04%
Minimum elongation	8%
Resistance to alkali in concrete	Excellent
Effective Diameter	0.874 mm

Method of Experiment

It should be very significant that the all the materials of concrete should be uniformly distributed in the concrete mass and also the characteristics of concrete should not be affected and should be in compliance with relevant codes of practice. As per the IS Standardsvarious tests like strength as well as durability properties were carried out. For all the aggregates specific gravity and particle distribution tests was also tested workability test like the slump cone test was carried out for fresh concrete. Then the concrete was casted in moulds for further investigations.

The size of cube 0.150m x 0.150mx 0.150m casted for compressive strength test the beam size of 0.100 m x 0.100 m x 0.500 m 72 cube specimens for flexural strength studies and cylinder specimens of size0. 3m height and 0.150 m diameter 72 prism specimens for split tensile strength studies were prepared. To determine the durability parameter specimens were casted and cured for twenty eight days as per standard curing methods

RESULTS AND DISCUSSION

Workability studies

Slump cone test

The slump value is one of the major factor in FRC. With the value of slump we can found out the effectiveness of FRC. Due the low water/binder ration in FRC the value of slump should be minimum. Because of low slump the segregation,bleeding controlled in the mix. For a fresh FRC the minimum value of slump shouldbe40mm and maximum of 80mm. The value of slump for different mixes are shown in Table 4.

TABLE 4: Slump flow

Mix proportio (%)	**Slump (mm)**
M1	35
M2	31
M3	29
M4	27

Strength studies

Compressive strength test

For various Fibre reinforced concrete mixes the compressive test results of at the period of seven ,twenty eight days are shown in Table 5,6,7 .The influence of different ratios of different mixes foundry sand on concrete specimens are shown.

Table 5: 10% Replacement of Foundry Sand

Mix	Fibre content %	Compressive strength in MPa	
		7 days	28 days
M0	0	28.22	39.33
M1	0.5	30.33	40.42
M2	1	32.23	42.33
M3	1.5	22.64	28.23

Table 6: 20% Replacement of Foundry Sand

Mix	Fibre content %	Compressive strength in MPa	
		7 days	28 days
M0	0	29.32	40.33
M1	0.5	31.33	41.22
M2	1	32.93	43.13
M3	1.5	27.64	29.13

Table 7: 30% Replacement of Foundry Sand

Mix	Fibre content %	Compressive strength in MPa	
		7 days	28 days
M0	0	27.12	38.33
M1	0.5	29.33	37.22
M2	1	30.13	38.13
M3	1.5	25.34	27.13

Flexural strength test

The standard beam specimen of size were casted and cured for 7, 28 days and they were tested for maximum load. The results of the flexural strength of different concrete mixes at the age of 7, 28 days are shown in the Table 8,9,10. The flexural strength is high for 20 % replacement of fine aggregate by foundry sand.

Table 8: 10% Replacement of Foundry Sand

Mix	Fibre content %	Flexural strength in MPa	
		Seven days	twenty eight days
M0	0	1.08	1.20
M1	0.5	1.12	1.30
M2	1	1.20	1.27
M3	1.5	0.56	0.82

Table 9: 20% Replacement of Foundry Sand

Mix	Fibre content %	Flexural strength in MPa	
		Seven days	twenty eight days
M0	0	1.01	1.10
M1	0.5	1.05	1.15
M2	1	1.16	1.19
M3	1.5	0.52	0.78

Table 10: 30% Replacement of foundry sand

Mix	Fibre content %	Flexural strength in MPa	
		Seven days	twenty eight days
M0	0	1.01	1.10
M1	0.5	1.05	1.15
M2	1	1.16	1.19
M3	1.5	0.52	0.78

CONCLUSION

- When compared to ordinary concrete FRC concrete attain good strength by using lower water/binder ratio. Hence segregation and bleeding in the concrete can be reduced.
- Foundry sand replacement generally results in favorable outcomes and is highly recommended for all FRC mixes. The strength of concrete structures using foundry sand is always similar to conventional concrete.
- There was high compressive strength at 28 days by 20% replacement of fine aggregate by foundry sand compared to other specimens.
- There was high flexural strength at 28 days with 20% replacement of fine aggregate by foundry sand compared to other specimens.
- Therefore the utilization of foundry in an effective manner in concrete is more useful instead of dumping it as an industrial waste.

REFERENCES

[1]. Bentur, A. and Mindess, S., Fiber Reinforced Cementitious Composites, Elsevier Applied Science, London, 1990.
[2]. Mullick, A.K., Walia, P. and Sharma, S.N., "Applications of polypropylene fiber reinforced concrete with vacuum processing," Adv. Bridge Eng., 8(2), 2006, 123–129.
[3]. Balaguru, P. and Talukdar, S., "A comparative study of compressive, Flexural, Tensile, and Shear strength of concrete with fibres of different origins.", The Indian Conc. Jl., 81(7), 2007, 17–24.
[4]. Balaguru, P.N. and Slattum, K., "Test Methods for Durability of Polymeric Fibers in Concrete and UV Light Exposure". ACI Mat. Jl., 148(1), 1995, 115–136.
[5]. Abichou, Benson C, Edil T. Database on beneficial reuse of foundry by-products. Recycled materials in geotechnical applications. In: Vipulanandan C, Elton D, editors. Geotechnical Special Publication 79, 1998, 210–23.
[6]. IS: 10262-1982. Recommended guidelines for concrete mix design. New Delhi, India: Bureau of Indian standards