COMPARITIVE STUDY OF POLYMER FIBRE REINFORCED CONCRETE WITH CONVENTIONAL CONCRETE

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ABSTRACT

The aim of our project is to experimentally investigate the properties of the polymer fibre reinforced concrete and compare it with the conventional concrete. Here we have used two types of polymers such as nylon and polypropylene fibres of different dosages to modify the cement concrete. This project explains on polymer fibre reinforced concrete, which is a recent advancement in the field of reinforced concrete design. The usefulness of fibre reinforced concrete in various civil engineering applications is indisputable. Fibre reinforced concrete has so far been successfully used in slabs on grade, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications.

KEYWORDS: Polymer fibre reinforced concrete – Polypropylene fibre – Nylon fibre – Compressive strength – Split tensile strength.

I.INTRODUCTION

GENERAL

Concrete has better resistance in compression while steel has more resistance in tension. Conventional concrete has limited ductility, low impact and abrasion resistance and little resistance to cracking. Fibre Reinforced Concrete is gaining attention as an effective way to improve the performance of concrete. Fibres are currently being specified in tunnelling, bridge decks, pavements, loading docks, thin unbonded overlays, concrete pads, and concrete slabs. These applications of fibre reinforced concrete are becoming increasingly popular and are exhibiting excellent performance.

In this project polypropylene fibers (6mm) and nylon fibres (6mm) is used. The project deals with the effects of addition of various proportions of polypropylene and nylon fibre (2%, 4%, and 6%) on the properties of concrete in fresh and hardened state. An experimental program was carried out to explore its effects on workability, compressive, flexural, split tensile strength and modulus of elasticity of concrete. Polypropylene and nylon fibre Reinforced Concrete is an embryonic construction material which can be described as a concrete having high mechanical strength, and durability. By utilizations of polypropylene fibre in concrete not only optimum utilization of materials is achieved but also the cost reduction is achieved. Nylon absorbs moisture depends on temperature, crystalline and humidity. It inhibits plastic shrinkage.

II. LITERATURE REVIEW

Kolli, Ramujee (2013) conducted the experimental studies on the strength properties of polypropylene fibre reinforced concrete. A combination of high strength, stiffness and thermal resistance polypropylene fibers are preferred for the fibre reinforced concrete. In this study, the results of the Strength properties of Polypropylene fiber reinforced concrete have been studied. The compressive strength, splitting tensile strength of concrete samples made with different fibers amounts of percentage 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 other fibre percentage

Amit Rai, Dr. Y.P.Joshi (2014) conducted the experimental studies and application of fibers reinforced concrete. They studied different types of fibers and their application. The improvement in concrete properties by polypropylene fibers, they analysed that compressive strength which is increased about 16%. The flexural strength of polypropylene fibers is improved about 30%.They studies the different types of fibres and the concrete properties. Fiber addition improves ductility of concrete Slump test were examined to find out the workability and consistency of fresh concrete. The

efficiency of all fibre reinforcement is dependent upon achievement of a uniform distribution of the fibers in the concrete, their interaction with the cement matrix, and the ability of the concrete to be successfully cast or sprayed.

Milind V. Mohod (2015) presented an experimental study on performance of polypropylene fibre reinforced concrete. In that studied with the effects of addition of various proportions of polypropylene fibers on the properties of High strength concrete (M30and M40 mixes). An experimental program was carried out to explore its effects on compressive, tensile, flexural strength under different curing condition. The main aim of the investigation program is to study the effect of Polypropylene fiber mix by varying content such as 0%, 0.5%, 1%, 1.5% & 2% and finding the optimum Polypropylene fiber content. A notable increase in the compressive, tensile and flexural strength was observed. However, further investigations were highly recommended and should be carried out to understand more mechanical properties of fibre reinforced concrete.

Aadil Qureshi Experimentally analysed to get optimum strength of
Polymer fibre reinforced concrete by adding different percentage of the Recron-3s Fibre and Nylon Fibre by volume of concrete and comparison between conventional concrete and Fibre concrete.

III. EXPERIMENTAL PROGRAMME

MATERIALS USED

CEMENT

Coromondal cement can be used in the present study. Results of various tests should be conducted are summarized below.

S.NO	TEST	RESULTS
1.	Normal Consistency	26%
2.	Initial Setting time	30 min
3.	Final Setting time	600min
4.	Specific gravity	3.05
5.	Fineness of cement	8%

Table 1: Properties of cement

SAND

The sand used for this experimental investigation is locally available river sand and it confirms to Indian Standard Specifications IS: 383-1970 and their by confirms zone II. The sand was primarily sieved through 4.75 mm sieve to separate any particles greater than 4.75 mm.

AGGREGATES

Crushed granite was used as coarse aggregate and it conforms to Indian Standard Specification IS: 383-1970 was used. Maximum size of coarse aggregate in the present study was 20 mm. The properties of fine aggregate and coarse aggregate are shown in table 2.

S.NO	TEST	RESULTS FOR COARSE AGGREGATE	RESULTS FOR FINE AGGREGATE
1.	Fineness modulus	3.1	6.24
2.	Specific Gravity	2.60	2.68

Table 2 properties of fine aggregate and coarse aggregate

POLYMER FIBRES USED

1. POLYPROPYLENE

Polypropylene fibres are new generation chemical fibres. They are manufactured in large scale and have fourth largest volume in production after polyesters, polyamides and acrylics. About 4 million tonnes of polypropylene fibres are produced in the world in a year. 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 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

PROPERTIES OF POLYPROPYLENE

Material : Polypropylene
Type: Syntheic polymer
IUPAC name: poly (propene)
Chemical formula : (C3H6)
Density : 0.855g/cm3
Amorphous : 0.946g/cm3

C

NYLON FIBER

Nylon is generic name that identifies a family of polymers. Nylon fibers are imparted by the base polymer type, addition of different levels of additive, manufacturing condition and fiber dimensions. Currently only two types of nylon fiber are marketed for concrete. Nylon is heat stable, hydrophilic, relatively inert and resistance to a wide variety of materials. Nylon is particularly effective imparting impact resistance and flexural toughness and sustaining and increasing the load carrying capacity of concrete following first crack

Fig 2 Nylon

PROPERTIES OF NYLON

Material: NYLON
Type: Synthetic polymer
Density: 1.15 g/cm3
Electrical conductivity: 10- 12s/m
Thermal conductivity: 0.25 W / (m.k)

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PREPARATION AND CASTING OF SPECIMEN

The standard size of specimens such as cubes (150 mm × 150 mm × 150 mm) to determine compressive strength and cylinders (150 mm diameter and 300 mm length) to determine split tensile strength were cast. All the inner surfaces and base plates of moulds were coated with oil for easy removal of form and smooth finish. At-most care was taken while batching, mixing and casting operations were done. The specimens are shown in fig 3.

Fig 3 Cast Specimens

EXPERIMENTAL PROCEDURE

Experimental investigation was carried out with reference to the M20 grade concrete mix. Polypropylene and nylon polymer fibre were used in this study. Different specimens were cast using fibres at different percentages 2%, 4%, 6%. Mix proportions of reference mix M20 grade concrete.

MIX	CEMENT	FINE AGGREGATE	COARSE AGGREGATE	WATER(L)
M20	411	654	872	240

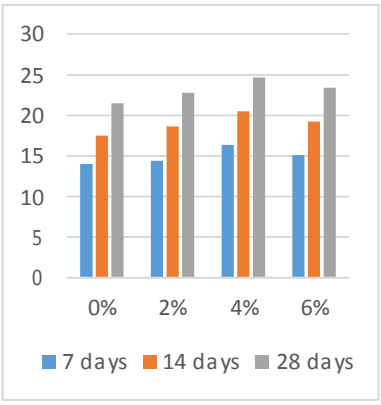
Table 3 Mix proportions of M20 grade concrete kg/m^3

COMPRESSION STRENGTH TEST

Cube specimens were tested for compression and the ultimate compressive strength was determined from failure load measured using the compression testing machine as shown in Fig. 4. The average values of compressive strength of 3 specimens for each category at the age of 7, 14 and 28 days . From these values it was observed that the increase in strength of M20 grade concrete with the addition of fibres upto 4% and beyond 4% it decreased. The compressive strength of M20 grade concrete with the addition of 2%, 4%, 6% of polypropylene and nylon was found out.

PROPORTION	2%	4%	6%
POLYPROPYLENE AND NYLON	22.8	24.68	23.4

Fig 4 compressive strength test



Days Percentage	7Days	14Days	28Days
0%	14	17.5	21.5
2%	14.38	18.66	22.8
4%	16.38	20.5	24.68
6%	15.1	19.22	23.4

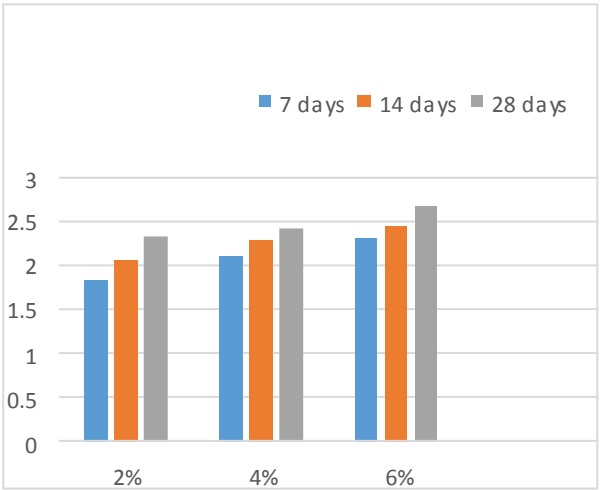
COMPRESSIVE STRENGTH TEST VALUE

SPLIT TENSILE STRENGTH TEST

It is a common test used to determine the tensile strength of concrete indirectly when the cylindrical specimen is kept horizontally and loaded in compression, the specimen is subjected to tensile stress along the plane perpendicular to the line of loading the cylinder. The average values of specimens for each category at the age of 7, 14 and 28 days. The experimental setup was carried out in fig 5. From these values it was observed that the increase in strength of M20 grade concrete with the addition of 2% and 4% of polymer fibre and the remaining mix strengths were decreased (6%). The split tensile strength of M20 grade concrete with the addition of 2%, 4%, 6% of polypropylene and nylon was found out.

PROPORTION	2%	4%	6%
POLYPROPYLENE AND NYLON	2.32	2.42	2.67

Fig 5 Split tensile strength test



Days percentage	7Days	14Days	28Days
0%	1.71	1.94	2.13
2%	1.82	2.05	2.32
4%	2.1	2.28	2.42
6%	2.3	2.45	2.67

SPLIT TENSILE STRENGTH TEST VALUE

V. CONCLUSION

- From the experimental work, it can be concluded that the concrete with polymer fibre attained greater strength over normal conventional concrete.
- Compressive strength increases upto 2 % and 4 % for 7 days, 14days and 28 days of maturity period respectively for M20 grade of concrete with the addition of polypropylene and nylon fibre. After that further increase of polypropylene fibre cause decrease in compressive strength.
- Split tensile strength increases with the increase in addition of polypropylene and nylon polymer fiber upto 6%
- The optimum dosage of polymer fibre for maximum strength properties was found to be 4% by the weight of cement for M20 grade of concrete.
- Strength of (polypropylene and nylon) polymer fibre reinforced concrete is relatively high when compared with conventional concrete.
- However polymerized concrete is the viable to many problems faced due to lack of proper compaction and curing and the workability decreases with increase in fibre.

REFERENCES

1 Kolli.Ramujee "Strength properties of polypropylene fibre r f rc d c cr ". International Journal of Innovative Research in Science, Engineering and Technology (ISO 3297: 2007 Certified Organization) Vol. 2, Issue 8, August 2013.

2 Milind V. Mohod "Performance of polypropylene fibre r f rc d c cr " IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 1 Ver. I (Jan- Feb. 2015), PP 28-36 www.iosrjournals.org.

3 Dr.T.Ch.Madhavi1, L.Swamy Raju2, Deepak Mathur

" ypr py f br r f rc d c cr – A R v w" International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Special Issue 4, June 2014) International Conference on Advances in Civil Engineering and Chemistry of Innovative Materials (ACECI')

4 Mr.Ashish Kumar Yadav1, Dr.Brajkishor Prasad2, Dr.Virendra Kumar3 and Meenu Mohan4 "Properties of Polypropylene Fiber Reinforced Concrete and Structural Behaviour of beam"International Journal of Innovative Research in Science,

Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 6, Issue 6, June 2017].

5 Tariq Ahmad Sheikh1, Er. Mohit Bajaj2 "A Review of polymer fibre reinforced concrete with conventional concrete pav m " International Journal of Latest Research In Engineering and Computing (IJLREC) Volume 5, Issue 3 , Page No. 98-100 May-June 2017 www.ijlrec.com

6 1Aadil Qureshi, 2Shubham Goyal, 3Yogendra Choudhary, 4Leevesh Kumar "Comparison of Polymer Fibre Reinforced Concrete with Conventional Concrete" International Journal of Engineering Technology Science and Research, www.ijetsr.com

ISSN 2394 – 3386, Volume 5, Issue 1, January 2018

7 Jaya Saxena1, Prof. Anil Saxena2 "Enhancement the Strength of Conventional Concrete by using Nylon Fibre"

Research Inventy: International Journal of Engineering and Science Vol.5, Issue 2 (February 2015), PP 56-59 ISSN (e): 2278-4721, ISSN (p):2319-6483, www.researchinventy.com

8 Divya S Dharan1, Aswathy Lal2 "STUDY THE EFFECT OF POLYPROPYLENE FIBER IN CONCRETE" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 06 | June-2016 www.irjet.net p-ISSN: 2395-0072