Experimental Investigation on mechanical Properties of High Strength Concrete by Adding Synthetic Fiber

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Abstract: *Synthetic fiber is not an absolutely new material, it is successfully applied in such fields as mostly found in garment interlinings, tooth brush, Fishing lines, Nets and building structures. At the present time very prospective directions of using nylon fiber is fiber-concrete and fiber-cement, reinforced with nylon fibers, using nylon fiber as post-tension or pretension reinforcing bars in reinforced concrete structures, applying polymeric and metal composites for structures. The main reason that nylon fiber is considered as construction material so rarely in India is non-availability and its high price on shipping, but the general trend of increasing product of nylon fiber and reducing its cost can said might change this situation in the construction industry. The effects of adding nylon fiber into the concrete matrix on compressive strength of cubes and split tensile strength of cylinders were evaluated in this work. Four test groups were constituted with the Nylon fiber percentages of 0.00%, 1%, 3% and 5%. The results showed the effect of Nylon fiber on concrete has a considerable amount of increase in compressive and split tensile characteristics; make a comparison of materials and about reasonability of applying nylon fiber in terms of operating conditions and economics.*

keywords: *compressive strength, split tensile strength, nylon.*

1. Introduction

Concrete is a composite material composed of coarse aggregate bonded together with fluid cement that hardens over time. Most concretes used are lime-based concretes such as Portland cement concrete or concrete made with other hydraulic cements; However, asphalt concrete, which is frequently used for road surfaces, is also a type of concrete, where the cement material is bitumen and polymer concretes are sometimes used where the cementing material is a polymer.

High-Strength Concrete is typically recognized as concrete with a 28day cylinder compressive strength greater than 6000 psi or 42 Mpa. More generally, Concrete with a uniaxial compressive strength greater than that typically obtained in a given geographical region is considered high strength, although the proceeding values are widely recognized. Strength of up to 20,000 psi (140 Mpa) has been used in different applications. Laboratories have produced strengths approaching 60,000 psi (480 Mpa).High strength concrete can resist loads that normal –strength concrete cannot.

Fiber or fibre is natural or synthetic substances that are significantly longer than it is wide. Fibers are often used in the manufacture of other materials. The Strongest engineering materials often incorporate fibers, for example carbon fiber and ultra -high-molecular-weight polyethylene.

Synthetic fibers can often be produced very cheaply and in large amounts compared to natural fibers, but for clothing natural fibers can give some benefits, such as comfort, over their synthetic counterparts.

2. Objectives

1. To Study the effect of the addition of fibers with High Strength Concrete.
2. To ensure the mechanical properties of High Strength Concrete incorporating with nylon fiber will be experimentally compared with that of conventional concrete.

3. Literature survey

1. **Vinay Kumar Singh "Effect of polypropylene fiber on properties of concrete"in research scholar, department of civil engineering, M.M.M.U.T.Gorakhpur,india,(2014)**
   In this study, in order to improve these properties of plain concrete, an attempt has been made to study the effect of addition polypropylene fiber in ordinary Portland cement concrete. In this experimental investigation fibers in different percentage 0 to 0.7% has been studied for the effect on strength properties of concrete by carrying compressive strength test and flexural strength test at 28 days for M25 grade of concrete. Test results show that the addition of polypropylene fiber to concrete exhibit better performance than the plain concrete. The results have shown improvement in compressive strength and flexural strength with the addition of polypropylene fiber in ordinary Portland cement concrete. The fiber content is vary from 0.1%,0.3%,0.5% and 0.7% by weight of concrete.
2. **Asiwarya Sukumar and Elson John "Fiber addition and its effect on concrete strength" in MG University,Kerala(2014)**
   In this project, carry out test on steel fiber reinforced concrete to check the influence of fibers on strength of concrete. An experimental investigation on the behavior of concrete specimens reinforced with steel fibers and subjected to compressive and flexural loading is presented. Tests were conducted on specimens with three different fiber volume fractions. It was observed that SFRC specimens showed enhanced properties compared to that of normal specimens. The results indicate that the addition of steel fibers to concrete improve not only the strength characteristics but also the ductility. The technology that is available today has made is possible to consider fiber reinforcement without the use of conventional steel bars in load carrying structures.
3. **Amit Rai and Dr.Y.P.Joshi "Application and properties of fiber reinforced concrete" in department of civil engineering SATI Govt. Engineering college , Vidisha(2014)**
   In this project, the conventional concrete micro-cracks develop before structure is loaded because of drying shrinkage and other cause of volume change. When the structure is loaded, the microcracks open up and propagate because of development of such micro-cracks,results in elastic deformation in concrete. Fiber reinforced concrete (FRC)is cementing concrete reinforced mixture with more or less randomly distributed small fibers. In the FRC, a numbers of small fibers are dispersed and distributed randomly in the concrete at the time of mixing, and thus improve concrete properties in all directions. The fibers help to transfer load to the internal micro-cracks. FRC is cement based composite material that has been developed in recent years. These fibers have many benefits. Steel fibers can improve the structural strength to reduce in the heavy steel reinforcement requirement. Freeze thaw resistance of the concrete is improved. Durability of the concrete is improved to reduce in the crack widths. Polypropylene and Nylon fibers are used to improve the impact resistance. Many developments have been made in the fiber reinforced concrete.
4. **M.Nohitha and V.Mounika "Experimental study of strength and durability properties of hybrid fiber reinforced concrete for M25 grade" in department of civil engineering, Tirupati (2016)**
   This paper presents a novel design method of asynchronous domino logic pipeline, which focuses on improving the circuit efficiency and making asynchronous domino logic pipeline design more practical for a wide range of applications. The data paths are composed of a mixture of single-rail and dual-rail domino gates. Dual-rail domino gates are limited to construct a stable critical data path. Based on this critical data path, the handshake circuits are greatly simplified, which offers the pipeline high throughput as well as low power consumption. Moreover, the stable critical data path enables the adoption of single-rail domino gates in the noncritical data paths. This further saves a lot of power by reducing the overhead of

logic circuits. Synchronization logic gates, which have no data dependency problem, are used in the design to construct the reliable data path. Three phase dual-rail precharge (TDPL) logic is used for evaluating the proposed pipeline method. A high-throughput and ultralow-power asynchronous domino logic pipeline design method, targeting to latch-free and extremely fine-grain or gate-level design.

4.Material used in work

Cement

The ordinary Portland cement confirming to IS 4031 was used for the preparation of specimens.OPC 43 grade was used.

Fine aggregate

The fine aggregate used in the experimental investigation was sand confirming to zone II of IS 383-1970. Sand used in the work which has the particle size was less than 4.75mm.The specific gravity of fine aggregate is 2.65

Coarse aggregate

The coarse aggregate particles passing through 20mm and retained on 16mm IS sieve used as the natural aggregate which met the grating requirement of IS 383-1970. The specific gravity of coarse aggregate is 2.64

Water

The tap water at P.S.R. Engineering College, Sivakasi was used

Super plastizers

Conplast SP300 was used.

Nylon fiber

Concrete Mix Design (M60)

Design stipulation

Target strength =60Mpa
Maximum size of aggregate used =20mm
Specific gravity of cement = 3.15
Specific gravity of fine aggregate =2.65
Specific gravity of coarse aggregate =2.64

Mix proportion

Cement	Fine aggregate	Coarse aggregate	w/c ratio
1	1.24	2.04	0.29

5. Details of cast specimen

Concrete cube of size 150mm x 150mm, cylinder of size 150mm diameter and 300mm height were casted and demodulated after 24 hours, by adding the nylon fiber 1%, 3% & 5%. Cubes were tested to find compressive strength at the age of 7 days, 28 days and cylinder were tested to find out the split tensile strength at the age of 7 days and 28 days

Table 5.1 specimen details

Percentages of concrete mixes	No of cubes (7 days)	No of cubes (28 days)	No of cylinder (7 days)	No of cylinder (28 days)
CC	3	3	3	3
NF 1%	3	3	3	3
NF 3%	3	3	3	3
NF 5%	3	3	3	3

CC-Conventional Concrete
NF-Nylon Fiber

6. TEST RESULT

TABLE 6.1 COMPARES THE COMPRESSIVE STRENGTH RESULT

CURING OF CONCRETE (DAYS)	TYPES OF CONCRETE	TARGET STRENGTH	ATTAINED STRENGTH	% OF STRENGTH INCREASED
7	CC	38.2		
	NF 1%	38.2	39.1	2.62
	NF 3%	38.2	37.5	-1.83
	NF 5%	38.2	36.8	-3.66
28	CC	59.1		
	NF 1%	59.1	59.5	0.6
	NF 3%	59.1	57.7	-2.36
	NF 5%	59.1	54.6	-7.61

CC-Conventional Concrete
NF-Nylon Fiber

TABLE 6.2 COMPARE THE SPLIT TENSILE STRENGTH RESULT

CURING OF CONCRETE (DAYS)	TYPES OF CONCRETE	TARGET STRENGTH	ATTAINED STRENGTH	% OF STRENGTH INCREASED
7	CC	3.96		
	NF 1%	3.96	4.1	3.53
	NF 3%	3.96	3.53	-10.85
	NF 5%	3.96	3.11	-21.46
	CC	59.1		

28	NF 1%	59.1	7.07	4.12
	NF 3%	59.1	6.64	-2.20
	NF 5%	59.1	5.94	-12.51

CC-Conventional Concrete
NF-Nylon Fiber

7. CONCLUSION

The comparison of conventional concrete and high strength concrete with nylon fiber adding in various percentages such as 1%, 3%, and 5%.
Based on the experimental investigations carried out, the following conclusions are made.

1. Nylon Fibre Reinforced Concrete has far better strength than conventional concrete. Four mix designs of high strength concrete including Nylon Fibre Reinforced of 1%, 3%, 5% and Conventional Concrete.
2. Increased the compressive strength and split tensile strength are found that the adding 1% Nylon of total volume of concrete achieves more strength than that of conventional concrete.

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