Scientific Journal of Impact Factor (SJIF): 4.14

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 3, Issue 5, May -2016

USE OF POLYPROPYLENE FIBER IN RIGID PAVEMENT

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Abstract: *India has a road system of more than 4.87kilometers according to MORTH, TechierResearch July 2015 and the second biggest road system on the planet. Development of Road and Highways are the foundation of infrastructure improvement upgrading the vital main thrust to accomplish quick and supported economic growth in the changing technological innovation. It is undoubtedly the lifeline of the nation which is a never ending process activity in India. Because of rising oil costs and a more tightly monetary environment, cement is turning into a more alluring choice for base venture comprehensively contrasted with conventional bituminous asphalts. The Ministry of Road Transport and Highways in India noticed that advanced society can't work adequately without concrete roads. Cement has a few deficiencies as low tensile strength, limited fatigue life and is characterized by brittle failure resulting in nearly complete loss of loading capacity, once failure is initiated. This paper manages exploratory examination on mechanical properties of M30grade concrete by adding polypropylene fibers in the blend at measurements of 0.5%, 1%, 1.5%, 2%, 2.5% by weight of cement added to the mix. A comparative analysis has been carried out for conventional concrete to that of the fiber reinforced in relation to compressive, tensile and flexural strengths.*

Keywords:*PolypropyleneFibre, Concrete Mix Design, Compressive Strength, Tensile Strength, Flexural Strength.*

INTRODUCTION

In a developing country such as India, road networks form the arteries of the nation. A pavement is the layered structure on which vehicles travel. It serves two purposes, namely, to provide a comfortable and durable surface for vehicles, and to reduce stresses on underlying soils. In India, the traditional system of bituminous pavements is widely used. Locally available cement concrete is a better substitute to bitumen which is the by product in distillation of imported petroleum crude. It is a known fact that petroleum and its byproducts are dooming day by day. Whenever we think of aroad construction in India it is taken for granted that it would be a bituminous pavement and there are very rare chances for thinking of an alternative like concrete pavements. Within two to three decades bituminous pavement would be a history and thus the need for an alternative is very essential. The perfect solution would be POLYMER FIBER REINFORCED CONCRETE PAVEMENTS, as it satisfies two of the much demanded requirements of pavement material in India, economy and reduced pollution. It also has several other advantages like longer life, low maintenance cost, fuel efficiency, good riding quality, increased load carrying capacity and impermeability to water over flexible pavements. Configuration of concrete pavement begin with the research center tests initiate by finding physical properties of cement, aggregate, sand which must fulfill the necessity according to important is codes. After that conventional concrete mix design test containing admixtures has been completed to focus the compressivestrength, tensile strength and flexural strength of bond concrete shape with typical blend at 7 days and 28 days. Correlation between concrete mix with and without polypropylene added in dosages of 0.5 %, 1%, 1.5%, 2% and 2.5% content in place of cement is worked out to focus the compressive strength, tensile strength and flexural strength.

OBJECTIVES OF STUDY

- To increase the strength of rigid pavement.
- To reduce the proportion of cement in rigid pavement.

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BASIC OF POLYPROPYLENE FIBER.

OVERVIEW

Polypropylene fibers are new generation chemical fibers. They are manufactured in large scale and have fourth largest volume in production after polyesters, polyamides and acrylics. About 4 million tons of polypropylene fibers are produced in the world in a year. Polypropylene fibers were first suggested for use in 1965 as an admixture in concrete for construction of blast resistant buildings meant for the US Corps of Engineers. Melting process of polypropylene can be achieved via extrusion and molding

TERMINOLOGY AND KEY DEFINITIONS

- **Workability**:- It is that property of the concrete which determines the amount of useful internal work necessary to produce full compaction.
- **Compression Strength**:- Capacity of a material or structure to withstand loads tending to reduce size.
- **Tensile Strength**:- It is the maximum stress that a material can withstand while being stretched or pulled before failing or breaking.
- **Flexural strength**:-It is a parameter to estimate the load at which the concrete member may crack.

LITURATURE REVIEW

Peng Zhang and QingfuLi(2013)"Fracture Properties of Polypropylene Fiber Reinforced Concrete"

The goal of this paper is to Used 0.04%, 0.06%, 0.08%, 0.1% and 0.12% of polypropylene fibers in concrete containing 15% fly ash and 6% silica fume. They reported by testing beam specimens under three point loading, that addition of fibers greatly improved the fracture parameters of concrete composite such as fracture toughness, fracture energy, effective crack length, maximum mid-span deflection, critical crack opening displacement etc. With increase in fiber volume fraction from 0 to 0.12%, there is increase in fracture parameters. The fibers embedded in concrete affect the stress and strain, enhancing the stress redistribution and reducing strain localization. The addition of polypropylene fibers to plain concrete reduces the crack width to an extent of 21% to 74%.

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KomalBedi (2014) "Experimental study for flexure strength on polypropylene fiber Reinforced concrete"

Considered the impacts of polypropylene fiber on the flexure strength of cement. The trial customized was under taken to test standard concrete beam (150 X 150) mm with a span 700 mm for examining strength in flexure. The specimens were contrasted with no fiber and polypropylenes fiber of force 0.89 kg for each cum of cement. To give a premise to flexure, reference examples were thrown without polypropylene fiber. The test outcomes demonstrated that the mechanical properties of flexural strength coming about because of included of polypropylene fiber was generally high.

P. Sathe, A. V. Patil(2013) "Experimental Investigation on Polypropylene Fiber Reinforced Concrete with Artificial"

Exploration work of trial examination on polypropylene fiber strengthened cement by supplanting river sand to manufactured sand with and without admixture. Utilization of fiber strengthen polymer in structural designing increment quickly. Different kind of fiber is utilized, for example, glass, and carbon, steel, asbestos, polyester and polypropylene. The different trial examinations for determination of properties of polypropylene fiber are talked about in paper work. This paper introduces the impact of polypropylene (PP) fibers on different properties of cement, for example, compressive strength, elasticity, workability, and fracture properties with different substance of fiber (0%, 0.5%, 1.0%, and 1.5%). The consequence of this present examination demonstrates that by including of 0.5% of polypropylene fiber indicates greatest compressive and rigidity strength

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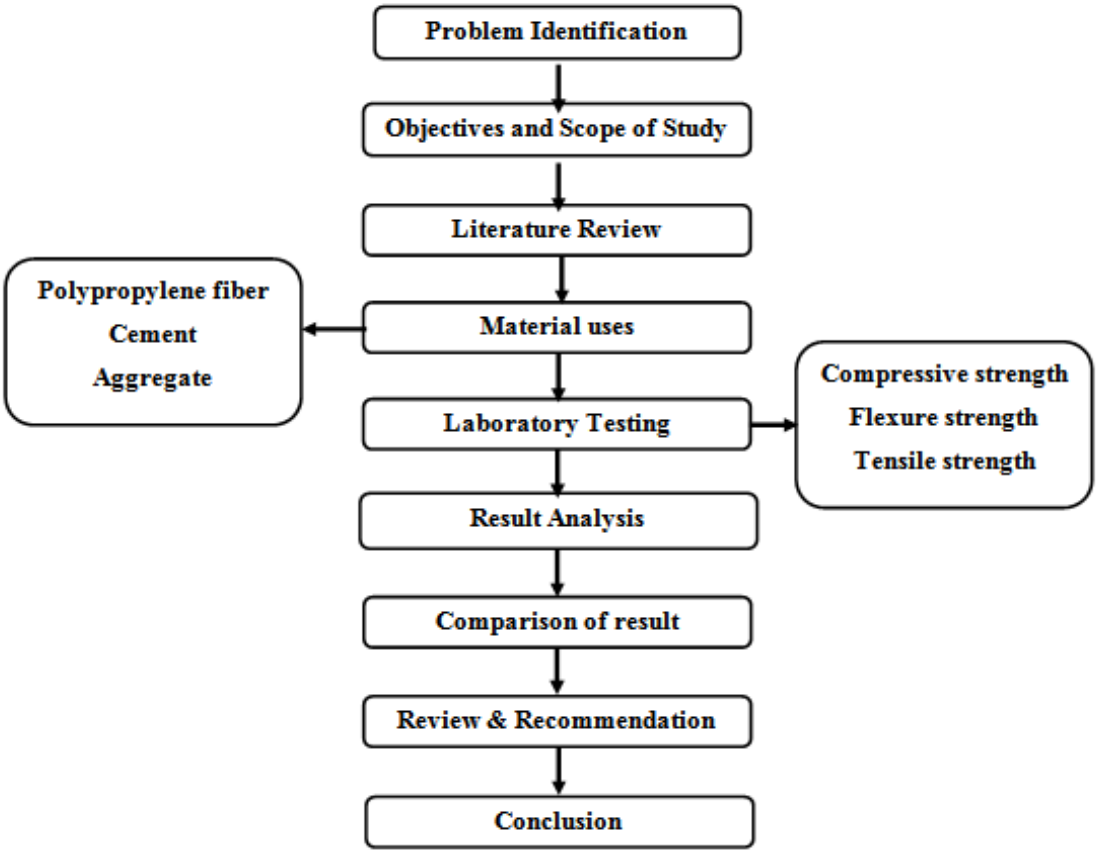
METHODOLOGY AND EXPERIMENTS

METHODOLOGY

As in the literature review I have chosen the polypropylene fibre for making the concrete mix and I have select the different proportions of polypropylene fibre for obtaining the strength variation at 0.5%, 1%, 1.5%, 2% and2.5% for making the polypropylene concrete, we required different materials which are described below



EXPERIMENTAL PROGRAM

The essential properties of material are assessed out for blend outline and are thought seriously about in this paper. The trial modified was under taken to the standard concrete cube of size (150 × 150 × 150) mm for compressive strength of concrete and standard concrete beam of size (150 × 150 × 700) mm for flexural strength of concrete and standard concrete cylinder of size (150dia×300) mm an expect to think about the flexural strength, compressive strength and tensile strength of hardened concrete. Compare about the flexural strength, compressive strength and tensile strength of concrete with and without polypropylene fiber. Concrete mix for M – 30 evaluations was outlined according to IS: 10262-2009.

MATERIALS USED.

Cement

Ultratech OPC 53 grade cement is used for study purpose as studies revealed that for ordinary Portland cement when water is added to it; the paste is formed, which hardens into rock like mass over a period of time. Compounds like C3S and C2S present in cement react in presence of moisture and fully hydrated reaction can be expressed as

$$2C3S + 6H \rightarrow C3S2H3 + 3Ca(OH)2$$

$$2C2S + 4H \rightarrow C3S2H3 + Ca(OH)2$$

Concrete cubes and beams are casted using it. The basic properties of cement are evaluated in the laboratory to ascertain the strength of cement satisfying relevant codal practice.

Table 1: Properties of Cement

Sr.no	Characteristics	Results	Limitations	IS Codes
1.	Fineness	3.21	< 10 gm	IS:4031(Part-1) - 1996
2.	Normal Consistency	30%	-	IS:4031(Part-4) - 1988
3.	Initial Setting Time	80min	30 min minimum	IS:4031(Part-5) - 1988
4.	Final Setting Time	190min	600min maximum	IS:4031(Part-5) - 1988
5.	Specific Gravity	3.15	-	
6.	Compressive Strength at 28days	54.84 N/mm^2	$53N/mm^2$	IS:4031(Part-6) - 1988

Fine aggregate

Part of fine total is to help with creating workability and consistency in blend. It additionally helps the cement paste to hold the coarse aggregate in suspension. The fine aggregate utilized for the exploratory customized was privately obtained and confirmed to Indian standard detail IS: 383 – 1970. The fineness of sand found by sieve investigation represents the extent of sand in concrete and for which zone reviewing of sand is suitable (Refer table-2). The general fineness of sand is given by variable called fineness modulus. Fineness Modulus is given by division of the summation of total retained fractions for standard sieves up to 150-micronsieve size by 100. The fineness modulus of sand varies from 2.0 to 4.0; higher the FM coarser is the sand (Table-3). As the grading zone falls in 2nd, the sand is of coarser category.

Table 2: Properties of Fine Aggregate

Sr no.	Characteristics	Results	Limitation as per codes
1.	Type	Natural	-
2.	Specific gravity	2.635	-
3.	Water absorption	1.45%	2%
4.	Fineness modulus	3.03	-
5.	Grading Zone	Zone-II	-

Coarse Aggregate

Aggregates are for the most part considered as inactive filler inside of a concrete blend. Be that as it may, a more critical look uncovers the real part and impact total plays in the properties of both new and hardened concrete. Changes in gradation, greatest size, unit weight, and dampness substance can all modify the character and execution of your concrete mix. Economy is another purpose behind keen aggregate determination. One can regularly spare cash by selecting the most extreme reasonable aggregate size. As in field if perfect gradation does not exist, combined gradation is desirable to be done to better control workability, pump ability, shrinkage and different properties of concrete.

Table 3.Properties of Coarse Aggregate

Sr no.	Characteristics	Results	Limitation as per codes
1.	Maximum size	20 mm	-
2.	Specific Gravity(20 mm)	2.881	-
3.	Water Absorption (20 mm)	1.33%	-

Polypropylene Fibre

The raw material of polypropylene is gotten from monomeric C3H6 which is simply hydrocarbon. The specific gravity is 0.91, external appearance of fibers is white, C , diameter of fibers is 30 – 35 microns, tensile strength is 0.67 KN/mm2, young modulus is 4.0 KN/mm2, absorbency is <0.1 % and fiber cut length is 12mm.

Water

It is a prevalent view and a measuring yardstick that if water is fit for drinking, it is fit for making concrete. Suitability of water for concrete comparing so as to make is checked after seven days and 28 days strength with cubes 3D shapes made with distilled water. Water containing expansive amounts of chlorides may bring about efflorescence and dampness. We utilize the water having pH esteem value 7.0 and free from salts.

MIX DESIGN

Concrete Mix Design M-30 grade (IS: 10262-2009)

Table 6: PQC Mix Proportion (dry weight in kg) for Normal Mix

Material	Quantity 1 m3 (kg)	Quantity 0.1215 m3 (kg) cube	Quantity 0.1907 m3 (kg) cylinder	Quantity 0.567 m3 (kg) beam
Cement	401.76	48.81	76.61	227.79
Coarse Aggregate (20 mm)	1156.1	140.46	220.46	655.50
Fine aggregate	682.27	82.89	130.10	386.84
Water	213.69	25.96	40.75	121.16

RESULTS.

Table 7: Compressive Strength of Concrete

Sr. No.	Description	7 days Avg. (N/mm2)	28days Avg. (N/mm2)
1	Normal Concrete Mix Design	21.70	35.40
2	Concrete mix design with 0.5% polypropylene fibre	22.07	35.60
3	Concrete mix design with 1% polypropylene Fibre	22.24	36.20
4	Concrete mix design with 1.5% polypropylene Fibre	23.04	37.37
5	Concrete mix design with 2%polypropylene Fibre	22.90	36.90
6	Concrete mix design with 2.5%polypropylene Fibre	22.33	35.50

Table 8: Split – Tensile strength of Concrete

Sr. No.	Description	7 days Avg. (N/mm2)	28days Avg. (N/mm2)
1	Normal Concrete Mix Design	2.56	3.9
2	Concrete mix design with 0.5% polypropylene fibre	2.63	4.06
3	Concrete mix design with 1% polypropylene Fibre	2.66	4.10
4	Concrete mix design with 1.5% polypropylene Fibre	2.75	4.13
5	Concrete mix design with 2% polypropylene Fibre	2.70	4.11
6	Concrete mix design with 2.5% polypropylene Fibre	2.60	4.0

Table 9: Flexural strength of Concrete

Sr. No.	Description	7 days Avg. (N/mm2)	28days Avg. (N/mm2)
1	Normal Concrete Mix Design	3.86	5.20
2	Concrete mix design with 0.5% polypropylene fibre	3.78	5.60
3	Concrete mix design with 1% polypropylene Fibre	3.90	5.90
4	Concrete mix design with 1.5% polypropylene Fibre	4.30	6.30
5	Concrete mix design with 2% polypropylene Fibre	4.04	6.10
6	Concrete mix design with 2.5% polypropylene Fibre	3.9	5.90

CONCLUSION

- The compressive strength of normal concrete is less than the polypropylene fiber concrete but the increasing the % ofPolypropylene in concrete mixes, it decreased the value of strength up to 1.5% of replacing cement with fiber in concrete mix.
- The Flexural strength of normal concrete is less than the polypropylene fiber concrete but the increasing the % ofPolypropylene in concrete mixes, it decreased the value of strength up to 1.5% of replacing cement with fiber in concrete mix.
- The split tensile strength of normal concrete is less than the polypropylene fiber concrete but the increasing the % ofPolypropylene in concrete mixes, it decreased the value of strength up to 1.5% of replacing cement with fiber in concrete mix.
- The compressive strength, split tensile strength, flexural strength and modulus of elasticity increase with the addition of fiber content as compared with conventional concrete.By replacing cement with polypropylene dosage it help to saving the cement content in concrete.

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