

## Addition of Discrete Fibers in Concrete Road Pavements

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**Abstract** -Road networks form the arteries of any nation and specifically in Kashmir, road network is the major form of transportation due to the unavailability of other means like railways. The road surface or pavement is a surface made from durable material laid down on an area to sustain the load of vehicles and footfall. Pavements are mainly of three types: flexible pavements, rigid pavements and composite pavements. Traditionally, pavements are constructed by using bituminous materials and therefore, whenever we think of a road construction it is assumed to be a bituminous pavement because very rarely, we opt for an alternative like concrete pavements. There are several advantages of cement concrete pavements over bituminous pavement such as greater life span and low maintenance but at the same time concrete roads may also undergo cracking, warping and they are less resilient, less ductile and weak in tension. Since, road transportation is witnessing an exponential growth, there is a need for rigorous research for the improvement of properties of concrete road pavements. To overcome these problems, addition of discrete fibers can prove to be a boon in the construction of concrete road pavements.

This paper reviews the effects of polypropylene and polyester fibers on concrete and proposes their use in concrete road pavements. Several research papers have been assessed to analyze the properties of concrete and the effect of the polypropylene and polyester fibers on these properties are discussed in this paper.

**Key Words:** Concrete, Fibers, Polypropylene, Polyester, Strength, Durability, Fiber Reinforced Concrete.

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### 1. INTRODUCTION

A road may be defined as a passage, route, or way on land between two places that has been paved or otherwise improved to permit safe pass by foot or by another means of conveyance. For the long service of the road, it is important to keep a check over its maintenance. The road pavement should be durable enough to ensure safe movement of traffic. The purpose of the road pavement is to transfer the vehicular loads or footfall to its sub-base. Usually, rigid pavement is preferred due its sturdiness and capability to tolerate hard environmental conditions. Due to its high flexural stiffness and mechanical resistance, it allows the transfer of vehicular loads homogenously to the underlying layers, preventing load and stress concentrations within the sub grade which in turn provides a structured,

convenient, and economical design for the roadways and highways. These rigid pavements can be constructed using cement concrete or RCC slab. RCC slabs are used when traffic flow is very high. This pavement can resist different types of loads and adverse weathering effects more easily. But, as one can easily predict RCC slab-based pavement proves to be quite uneconomical and that gives a certain edge to cement concrete pavement. But concrete pavements suffer failures due to formation of cracks and fissures which lead to the loss of serviceability. This condition arises chiefly due to the stiff behavior of cement concrete together with its little resistance to fatigue phenomena and its small resilience which finally results in unsafe driving situation and makes the pavement aesthetically unacceptable. These cracks also change concrete structures into permeable elements and consequently give rise to corrosion. Therefore, it is important to reduce the crack width because if these cracks don't exceed a particular width, they're neither harmful to a structure nor to its serviceability. This can be achieved by adding synthetic fibers (polypropylene or polyester) to concrete because addition of fibers in cement concrete matrix bridges these cracks and arrest their development which enhances the mechanical behavior of concrete pavement. The fiber is added during the blending of the concrete blend. Therefore, Fiber Reinforced Concrete (FRC) contains fibrous materials that increase the structural integrity of concrete.

## 2. LITERATURE REVIEW

Various experimentations have already been performed by various scholars regarding the addition of fibers to concrete resulting in different observations. Some of the best literature reviews are as under:

- **Ahmed, et al., (2006)** It deals with the effect of addition of various proportions of polypropylene fiber on the properties of concrete. This literature concluded that by the addition of polypropylene fibers in the range of 0.35% to 0.50%, the shrinkage cracking was reduced by 83% to 85%
- **Ramujee, et al., (2013)** In this study 0%, 0.5%, 1%, 1.5%, 2% Polypropylene fibers were used in concrete and resulting compressive strength and splitting tensile strength of the samples were analyzed. It concluded that the samples with 1.5% Polypropylene fiber performed better than the rest.
- **Ali, and Mohod, et al., (2015)** Various tests were performed on concrete and it was concluded that addition of polypropylene fibers helped overcome the problem of low tensile strength of concrete and also reduce its permeability.
- **Mathda, and Khaire, et al., (2016)** It concluded that on addition of 0.2% Recron 3S polyester fiber by weight of cement, the workability of concrete was highest and then on further addition, it started to reduce. Also, the maximum compressive strength was attained on addition of 0.2% of Recron 3S polyester fiber by weight of cement.
- **Ramana, et al., (2016)** It studied the effect of polypropylene and polyester fibers on the properties of concrete. Fibers were used in fractions of 0%, 0.1%, 0.2%, 0.3% and 0.4% by weight of cement and micro silica was also used as cement replacement material. It concluded that the best results were attained on addition of 0.1% of fiber content to a mixture that contained 10% of micro silica.
- **Patil, and Shivananda, et al., (2017)** It used M-30 grade concrete and the percentage of polypropylene fibers used was 0.5, 1.0, 1.5, 2. It was concluded that the best results were obtained while using 1.5% of polypropylene fibers and crack width reduced in casted beams. Therefore, it proposed the use of polypropylene fibers as reinforcement in concrete pavements.

Since, majority of the literature reviewed encourage the use of polypropylene and polyester fibers in concrete. The research work to be conducted will therefore be in accordance with the above-mentioned literatures while also treading some new unattained paths.

### **3. FIBERS OF INTEREST**

There are many types of fibers being used in concrete to alter different properties of concrete that either enhance or degrade it. Each fiber possesses a set of unique characteristics properties and limitations. Thus, selection of a particular fiber attains an important role.

Some of the fibers that are fit for use in concrete are Steel, nylon, glass, coir, carbon, polyester and polypropylene. Among these, the fibers of our interest are:

#### **3.1 polypropylene fiber:**

It is one of the most economical and readily available fibers and is chemically inert. It has high melting point that gives it an edge over other fibers. It enhances the flexural strength of concrete and prevents the cracks from widening further.

#### **I. Specifications of Polypropylene Fiber**

Melting Point	164° C
Specific Gravity	0.91
Thermal Conductivity	Low
Alkali Resistance	Alkali proof
Electric Conductivity	Low
Water Absorption	Negligible
Acid and Chemical Resistance	Very High

Obtained from <https://www.joganireinforcement.in/>



#### **II. Properties of Polypropylene Fibers**

- Its water adsorption is negligible.
- It is chemically inert and thus, on contact with more aggressive chemicals, the concrete will always degrade first.
- Balling was a matter of concern in steel fibers which caused fibers to pullout of the concrete matrix resulting in deterioration of its properties. On contrary to that, the

hydrophobic surface of polypropylene not being wet by concrete mixture helps to overcome this problem.

### **III. Advantages of Polypropylene Fiber**

- Reduces Shrinkage and Cracking
- Improves Ductility of Concrete
- Increases Abrasion and Impact Resistance
- Reduces Water Permeability
- Increases Flexural Toughness
- Reduces Bleeding and Segregation
- Increases Thermal Stress Resistance

### **3.2 Polyester Fiber**

It is a very cost-effective synthetic fiber that prevents micro cracking and also helps increase flexural strength as well as compressive strength of concrete pavements. Its alkali resistant nature prevents it from corroding or decaying.

#### **I. Specifications of Polyester Fiber**

Melting Point	>250° C
Specific Gravity	1.34 – 1.40
Tensile Strength	6000 kg/cm <sup>2</sup>
Alkali Resistance	Good
Dispersion	Excellent
Moisture	<1%
Acid and Chemical Resistance	Excellent
<i>Obtained from web</i>	

#### **II. Properties of Polyester Fibers**



- Its water adsorption is fairly low.
- It is inert to most of the chemicals
- It retains its shape as it is resistant to stretching, shrinking and wrinkling.
- It is hydrophobic in nature and has a property of quick drying.

- These lightweight fibers with high tensile strength bridge the cracks even after opening up by being present through the crack plane.

### **III. Advantages of Polyester Fiber**

- Improves Tensile & Compressive Strength
- Reduces Water Permeability.
- Reduces Shrinkage Cracks
- Economical & Effective
- Reduces density and ensures more yield of mix
- Environment friendly, non-hazardous, disperses and separates in the dry ready mix easily

### **4. CONCLUSION**

It is clear, as per the literature review, the addition of the fibers (polypropylene and polyester) improves the strength of the concrete. Many researchers have experimented with different techniques while incorporating the use of these fibers and have concluded that not only the flexural strength but also other properties like compressive strength, fatigue strength, durability, etc. are enhanced positively. The toughness of concrete is increased 10 to 40 times by reinforcement of fibers. The fibers used are eco-friendly, economical and readily available.

Thus, Fiber Reinforced Concrete Pavements are the future of Road Pavements and rigorous research in this field is the need of the hour.

### **REFERENCES**

1. *Aadil Qureshi, Shubham Goyal, Yogendra Choudhary, Leevesh Kumar* “Comparison of Polymer Fiber Reinforced Concrete with Conventional Concrete.” in *International ResJournal of Engineering Technology Science and Research (IJETS)*, Volume: 05, Issue: 01, January 2018.
2. *R. Fanguetro, M. Dearaujo*. 2008. “Application of Polyester and Polyamides in Civil engineering.
3. *Cengiz, O.Turanli, L.* (2004) “Durability of polypropylene fiber in Portland cement based composites” University of Surrey, Guildford. United Kingdom.
4. *Dave U. V. and Desai Y. M.* “Effect of Polypropylene, Polyester and Glass fibres on various strength of ordinary and standard concrete”, *The First International Conference on Recent Advance in Concrete Technology*, September 2007.
5. *Saeed Ahmed, Imran A Bukhari, Javed Iqbal Siddiqui, Shahzad Ali Qureshi* “A STUDY ON PROPERTIES OF POLYPROPYLENE FIBER REINFORCED CONCRETE”, in *31st Conference on OUR WORLD IN CONCRETE & STRUCTURES*: 16 – 17 August 2006, Singapore
6. *KolliRamujee* “Strength properties of polypropylene fiber reinforced concrete” in *International journal of innovative research in science, engineering and technology*: Vol. 2, Issue 8, August 2013

7. *Amreen N. Ali, Milind. V. Mohod* “Effect of fiber reinforced concrete in rigid pavement” in *International Journal of Research in Engineering, Science and technologies (IJRESTs)* Vol.:1, No.:8 December 2015.
8. *Dr. Vagheesha S. Mathda, Ms. Hemali K. Khairi*, “Study of Effects of Polyester Fibers on Compressive Strength of Concrete” *International Journal for Research in Applied 12. Science and Engineering Technology*, Volume 4 Issue I, January 2016, ISSN: 2321-9653.
9. *N.Venkata Ramana, U.Raghu Babu and E.ArunaKanthi (2016)*”Performance of polyester and polypropylene fibers in concrete.” *International Journal of Scientific & Engineering Research*, Volume 7, Issue 4, April-2016.
10. *Patil CC, Shivananda P (2017)*, “Experimental study on the performance of polypropylene fibre reinforced concrete” *International Journal of Application on Innovation in Engineering and Management*, 6, 114-119.
11. *Milind V Mohod* “Performance of Polypropylene Fibre Reinforced Concrete” in *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*: Volume 12, Issue 1 Ver. I (Jan- Feb. 2015)
12. *Craig, R.J.*, “Structural Applications of Reinforced Fibrous Concrete”, *ACI Concrete International*, 6(12):28-323, 1984.
13. *Priti A Patel, Dr. Atul Desai and Dr. Jatin Desai*. “Evaluation of engineering properties for polypropylene fiber reinforced concrete” in *International journal of Advanced Engineering technology*, volume 3, Issue 1, 2012.
14. *K. Vamshi Krishna, J. Venkateswara Rao*. “Experimental Study on Behavior of Fiber Reinforced Concrete for Rigid Pavement” in *(IOSR) Journal of Mechanical and Civil Engineering*, Vol. 11, Issue 4, Version 6, 2014.
15. *Insha Shahzad, Er. Neeraj Kumar*, “STUDY ON RIGID PAVEMENTS WITH ADDITION OF DISCRETE FIBER” in *INTERNATIONAL JOURNAL FOR RESEARCH & DEVELOPMENT IN TECHNOLOGY* Volume-15, Issue-3 (Mar-21)