

The Study of Pervious Concrete Road Pavement With And Without Using Fiber Reinforcement And Reuse of Absorb Water,

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Abstract—This project explores the use of polypropylene fiber-reinforced pervious concrete (PFRC) as a sustainable solution to environmental challenges. Pervious concrete helps manage storm water by allowing infiltration, thereby recharging groundwater, reducing runoff. Pervious concrete is a relatively new concept for rural road pavement, with increase into the problems in rural areas related to the low ground water level, agricultural problem. Pervious concrete has introduced in rural road as a road pavement material. A literature review and laboratory study were conducted to evaluate the effects of polypropylene fibers on pervious concrete properties, impact resistance, and permeability. The lab study confirmed that 0.40% fiber content enhances the strength of pervious concrete, making it suitable for limited structural applications. Additionally, this study highlights the potential for collecting and reusing the filtered water that passes through the pervious concrete pavement for secondary purposes such as irrigation, cleaning, or other non-potable uses, further enhancing the environmental benefits of the system .

Index Terms— (Pervious Concrete, Polypropylene fiber ,Ground Water recharge)

I. INTRODUCTION

Pervious concrete, also known as porous or no-fines concrete, is designed with interconnected voids that allow water to pass through, reducing storm water runoff and recharging groundwater. This makes it a sustainable solution for urban drainage challenges caused by increasing impermeable surfaces.. The mix typically excludes fine aggregates, using single-sized coarse aggregates bound by a cement paste. While the chemical composition is similar to conventional concrete, its strength depends on the paste quality and the bond between the paste and aggregate This project explores the incorporation of polypropylene fibers into the pervious concrete mix to enhance its mechanical properties and durability. A comprehensive literature review and laboratory investigations were carried out to assess the impact of polypropylene fiber content on key performance parameters such as compressive strength, impact resistance, and permeability. The experimental results indicated that a fiber dosage of 0.40% significantly improves the structural strength of pervious concrete, making it more suitable for use in low-load-bearing pavement applications. In addition to improving mechanical performance, this study also highlights the potential for utilizing the filtered water that passes through the pervious concrete pavement. This water can be collected and reused for secondary purposes such as irrigation, cleaning, and other non-potable applications, further enhancing the environmental value of the system. The outcomes of this research contribute to the broader understanding of PFRC as a viable material for sustainable rural infrastructure.

II. POLYPROPYLENE FIBER-REINFORCED PERVIOUS CONCRETE (PFRC)

- Polypropylene Fiber-Reinforced Pervious Concrete (PFRC) is a type of pervious (or porous) concrete that is enhanced by incorporating polypropylene fibers into the concrete mix to improve its mechanical properties while retaining its permeability.
- **Benefits –**
 - Permeability: Allows rainwater to pass through, reducing runoff and recharging groundwater.
 - Improved strength: Fibers enhance compressive, flexural, and impact resistance.
 - Crack control: Reduces shrinkage cracks and increases durability.
 - Eco-friendly: Supports sustainable drainage and water reuse (e.g., for irrigation or cleaning).
- **Applications:**
 - Rural road pavements
 - Parking lots and sidewalks
 - Low-traffic roads
 - Green infrastructure and stormwater management systems

III. OBJECTIVES

- i. To compare the performance of pervious concrete pavement with and without fiber reinforcement in terms of strength, durability, and permeability.
- ii. To investigate the effect of fiber reinforcement (e.g., polypropylene fibers) on compressive strength, flexural strength, porosity, and resistance to clogging.
- iii. To assess the potential for collecting and reusing water absorbed through pervious concrete for sustainable applications such as irrigation or groundwater recharge.
- iv. To evaluate the efficiency of pervious concrete in reducing storm water runoff and enhancing water infiltration.
- v. To perform laboratory tests—including compressive strength, infiltration rate, permeability, and water quality analysis of reused water.
- vi. To recommend an optimized pervious concrete mix suitable for road pavement applications that supports sustainable water management.

IV. ADVANTAGES

- i. **Improved Stormwater Management:**
Pervious concrete allows rainwater to infiltrate through the pavement, reducing surface runoff, preventing flooding, and recharging groundwater.
- ii. **Environmental Sustainability:**
Helps in meeting environmental regulations (e.g., EPA guidelines) by reducing the strain on drainage systems and supporting eco-friendly construction practices.
- iii. **Reuse of Absorbed Water:**
Captured stormwater can be reused for non-potable applications like landscape irrigation, reducing water demand and promoting resource conservation.
- iv. **Reduced Urban Heat Island Effect:**
The open structure of pervious concrete reflects less heat and allows for better cooling, lowering surrounding temperatures.
- v. **Enhanced Pavement Durability (with Fibers):**
Adding fiber reinforcement (e.g., polypropylene fibers) can improve crack resistance, flexural strength, and fatigue life of the concrete.
- vi. **Clogging Resistance and Low Maintenance:**
When properly designed, pervious concrete resists clogging and requires minimal maintenance, lowering long-term upkeep costs.
- vii. **Noise Reduction:**
The porous structure of pervious concrete absorbs sound, leading to quieter roadways.
- viii. **Sustainable Material Use:**
The use of M-sand and recycled water contributes to sustainable construction and reduces reliance on natural resources.
- ix. **Versatility in Application:**
Suitable for low-traffic roads, parking lots, sidewalks, and pathways while offering environmental benefits.
- x. **Improved Safety:**
Reduces water pooling on roads, lowering the risk of hydroplaning and improving driving safety during rains.

V. MATERIAL,ITS PROPERTIES AND MIX DESIGN

Materials and Their Properties

1. Cement

After reviewing all requirements ,Ordinary Portland Cement (OPC) of 53 grade cement is used for this experiment investigation throughout



SR.NO	DESCRIPTION OF TEST	RESULT
1	Fineness of cement	2.73%
2	Standard consistency of cement	32%
3	Setting Time Cement :(IS 12269-1987)	
	a) Initial setting Time	67 min
	b) Final setting Time	410 min
4	Soundness Test Of Cement (with Le-Chatelier's mould)	2 mm
5	Compressive Strength Of Cement	
	3 days	21 N/mm ²
	7 days	37 N/mm ²

2. Coarse Aggregate

- **Type:** Crushed angular aggregates
- **Size:** 10 mm (single-sized)
- **Properties:**
 - Specific Gravity: 2.6–2.8
 - Water Absorption: 0.5%–2%
 - Clean, dust-free, and strong



3. Water

- **Type:** Potable water for mixing and curing
- **pH:** 6.5–8.5
- ****Free from oils, acids, and salts**



4. Fiber Reinforcement

- **Type:** Polypropylene Fibers
- **Dosage:** 0.30%, 0.35%, 0.40% by volume of Aggregate.
- **Properties:**
 - Length: 8 mm
 - Tensile Strength: ≥ 400 MPa
 - Improves toughness, crack resistance, and durability

Mix Design for Pervious Concrete

General Considerations:

- **Water–Cement Ratio (W/C):** 0.28- 0.40
- **No Fine Mix:** Traditional pervious concrete omits fine aggregates completely
- **Modified Mix:** Includes 15% M-sand to improve strength while retaining permeability
- **Target Porosity:** 15% – 25%
- **Target Compressive Strength:** 15MPa – 25 MPa (depends on application)



Sample Mix Proportion (by weight):

MATERIAL	CONTROL MIX	FIBER-REINFORCED MIX
CEMENT	1 PART	1 PART
COARSE AGGREGATE	3 PART	3 PART
WATER	0.40 (W.C)	0.40 (W.C)
POLYPROPYLENE FIBER	-	0.30%,0.35%,0.40% (BY AGGREGATE)

VI. EXPERIMENTAL INVESTIGATION AND RESULT

1) SLUMP TEST

Slump Test Result

Mix Type	Slump Value (mm)	Workability Observation
Pervious Concrete (with Fiber)	25 mm	Poor Workability

Interpretation:

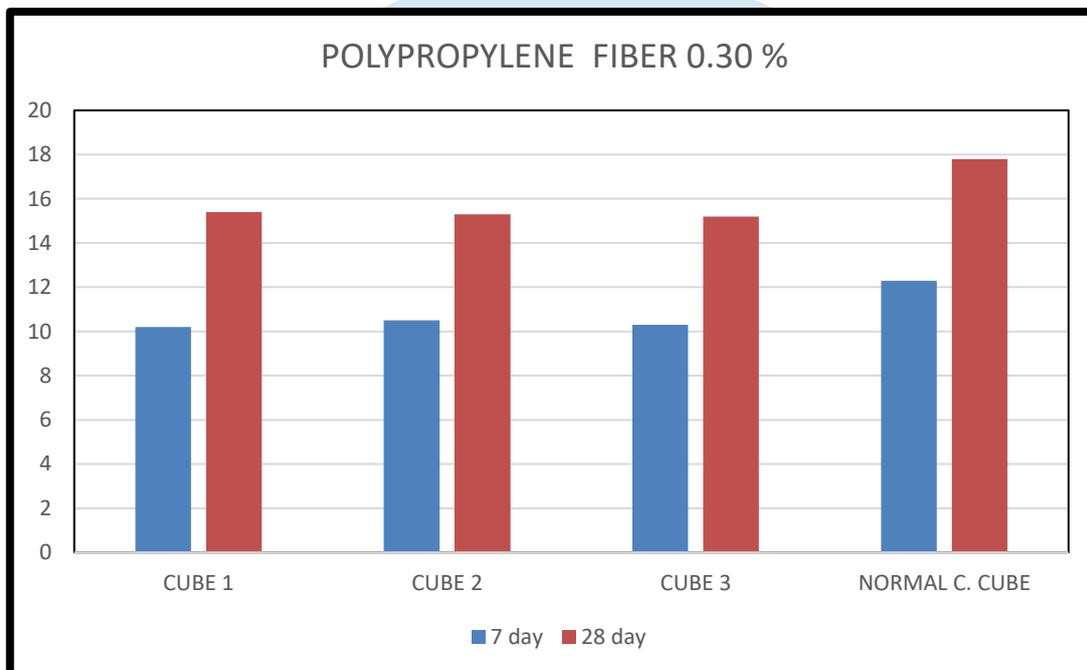
- A **slump of 25 mm** indicates **Poor workability**.
- This is likely due to:
 - **Polypropylene fibers**, which slightly enhance cohesion.
 - Adequate **water-cement ratio** (possibly near 0.35–0.40)

2) COMPRESSIVE STRENGTH

Compressive Strength Test Results (Average of 3 Cubes)

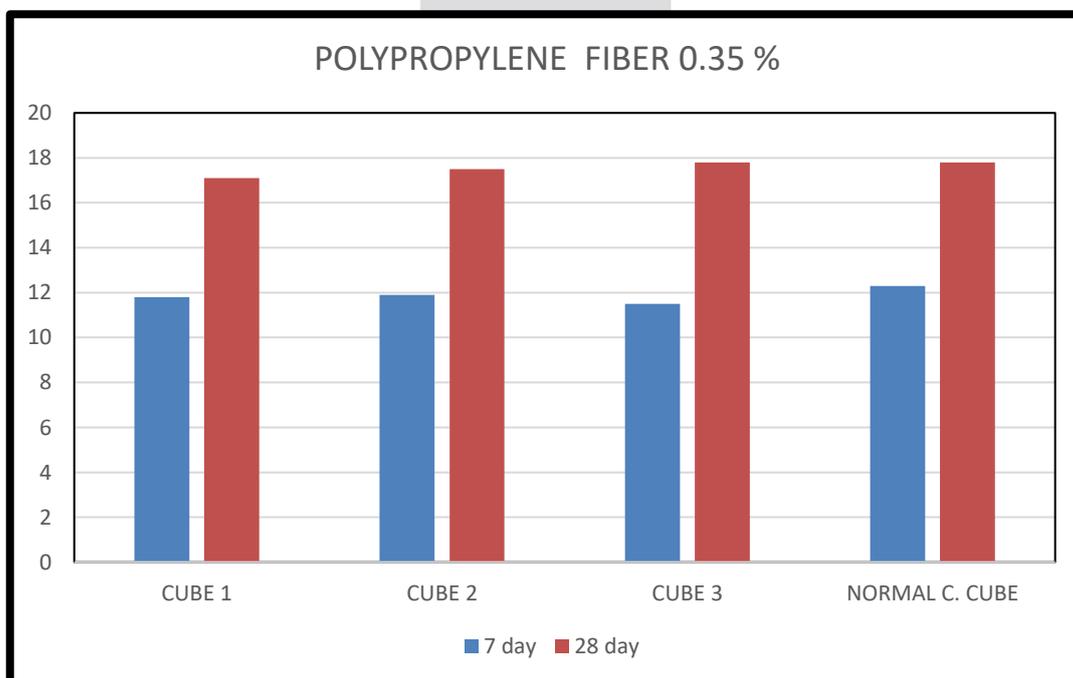
Polypropylene Fibers 0.30% Of Aggregates:-

Days	Cube1 (MPa)	Cube2 (MPa)	Cube3 (MPa)	NCC (MPa)	Remarks
7 Days	10.2	10.5	10.3	12.3	Slight improvement
28 Days	15.4	15.3	15.2	17.8	Slight improvement



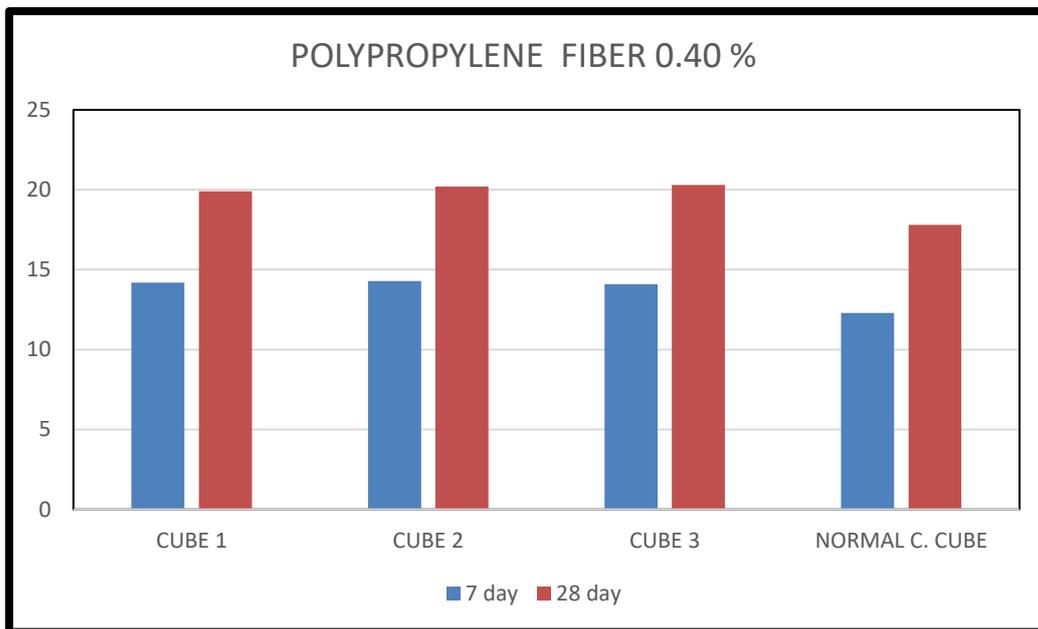
Polypropylene Fibers 0.35% Of Aggregates:-

Days	Cube1 (MPa)	Cube2 (MPa)	Cube3 (MPa)	NCC (MPa)	Remarks
7 Days	11.8	11.9	11.5	12.3	Noticeable improvement
28 Days	17.1	17.5	17.8	17.8	Good performance



Polypropylene Fibers 0.40% Of Aggregates:-

Days	Cube1 (MPa)	Cube2 (MPa)	Cube3 (MPa)	NCC (MPa)	Remarks
7 Days	14.2	14.3	14.1	12.3	Best early strength
28 Days	19.9	20.2	20.3	17.8	Highest strength

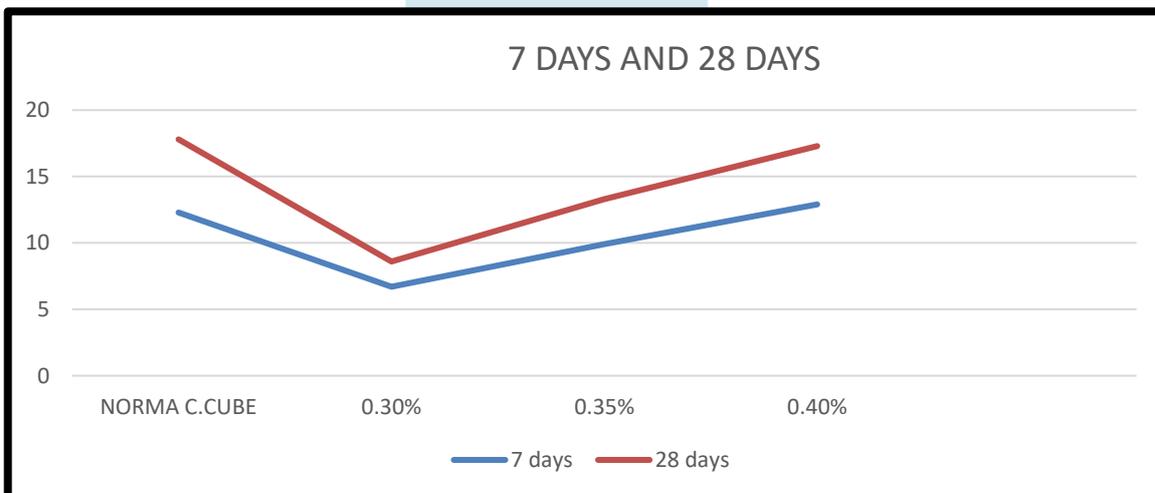


Calculation of Compressive Strength

The **compressive strength** of each concrete cube was calculated using the following standard formula as per **IS 516:1959**:

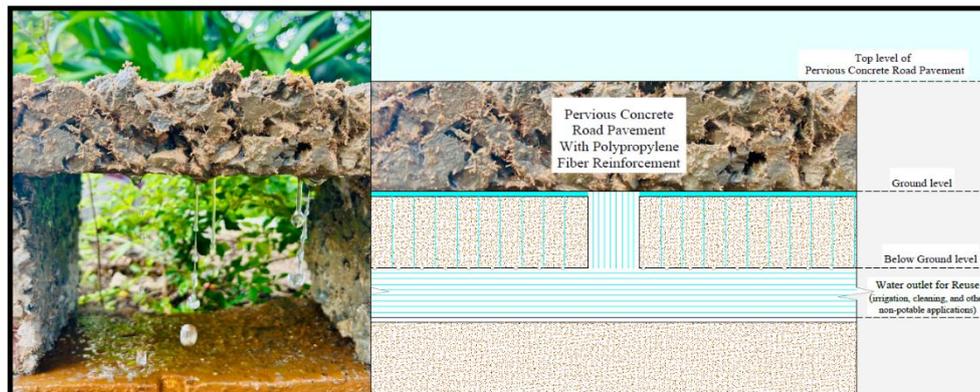
$$\text{Compressive Strength (MPa)} = \frac{\text{Loaded (N)}}{\text{Area (mm}^2\text{)}}$$

COMPARATIVELY COMPRESSIVE STRENGTH STUDY BETWEEN 7 DAYS AND 28 DAYS



APPLICATION OF WORK

This study also highlights the potential for utilizing the filtered water that passes through the pervious concrete pavement. This water can be collected and reused for secondary purposes such as irrigation, cleaning, and other non-potable applications, further enhancing the environmental value of the system. The outcomes of this research contribute to the broader understanding of PFRC as a viable material for sustainable rural infrastructure. irrigation, cleaning, and other non-potable applications



Pervious Concrete Road Pavement

VII. CONCLUSION

- Pervious concrete proves to be a sustainable and effective solution for pavement construction, allowing stormwater infiltration, reducing runoff, and contributing to groundwater recharge.
- The experimental study evaluated the effect of **polypropylene fiber concrete** at 0.30%, 0.35%, and 0.40% (by weight of coarse aggregate) on the performance of pervious concrete.
- The mix with **0.40% fiber** showed the **highest compressive strength**, indicating that this dosage provides the best balance between strength and permeability.
- Although the **0.35% fiber** mix had higher strength than the control, a slight reduction compared to the 0.35% mix was observed, likely due to **polypropylene fiber or medium workability**.
- The **7-day and 28-day compressive strength tests** confirmed that the addition of fiber significantly improves the mechanical strength of pervious concrete without affecting its open structure, **Greater than 17 Mpa is for low traffic pavement And greater than 14 Mpa we use as parking area.**
- Water absorbed and later reused from pervious concrete was found to be of good clarity, supporting the idea of **water recycling** for secondary uses like irrigation or construction cleaning.

Note:

The results support the use of **fiber-reinforced pervious concrete** in low to moderate traffic road pavements. It enhances **structural durability**, maintains **permeability**, and supports **sustainable water management** practices.

VIII. SUMMARY

This project focuses on the development and evaluation of **pervious concrete road pavement** with and without the inclusion of **polypropylene fiber reinforcement**. Pervious concrete, known for its high porosity, allows rainwater to infiltrate through the pavement, helping to reduce surface runoff and support groundwater recharge — making it a sustainable alternative for urban infrastructure.

In this study, pervious concrete mixes were prepared with fiber additions of **0.30%, 0.35%, and 0.40%** by weight of aggregate. Standard cube specimens were tested at **7 and 28 days** for **compressive strength**, and water reuse from concrete infiltration was also examined.

Results showed that the addition of fibers enhanced the compressive strength of pervious concrete. The mix with **0.35% fiber** achieved the **maximum strength**, indicating it as the optimum dosage. Beyond this point, at 0.40%, a slight decline was observed due to workability issues.

The project confirms that **fiber-reinforced pervious concrete** is a promising material for **eco-friendly, durable, and water-efficient pavements**, suitable for low to medium traffic conditions

IX. REFERENCES

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