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Strength Enhancement of Thirsty (Pervious) Concrete by Using GI Wire Mesh

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Abstract: Pervious concrete is an environmentally sustainable construction material that promotes groundwater recharge and reduces surface runoff through its interconnected void structure. However, its relatively lower compressive strength limits its application in pavement systems subjected to higher loading conditions. This study investigates the effect of Galvanized Iron (GI) wire mesh reinforcement on the compressive strength characteristics of pervious concrete. Pervious concrete specimens with and without GI wire mesh reinforcement were prepared and tested for compressive strength at 7, 14, and 28 days under standard curing conditions. The experimental findings indicated that the incorporation of GI wire mesh enhanced the compressive strength performance of pervious concrete compared to plain pervious concrete specimens. The study demonstrates that GI wire mesh reinforcement can be an effective approach for improving the compressive strength performance of pervious concrete, thereby enhancing its suitability for sustainable pavement applications.

Keywords: Pervious Concrete, Thirsty Concrete, GI Wire Mesh Reinforcement, Compressive Strength, Sustainable Concrete, Pavement Materials.

INTRODUCTION

Rapid urbanization and the expansion of impervious surfaces have significantly altered the natural hydrological cycle, resulting in increased surface runoff, urban flooding, groundwater depletion, and deterioration of water quality. Sustainable stormwater management has therefore become a major concern in modern infrastructure development. Pervious concrete, also known as porous or permeable concrete, has emerged as an environmentally friendly construction material capable of mitigating these challenges. Unlike conventional concrete, pervious concrete is produced with little or no fine aggregate, creating a network of interconnected voids that allows rainwater to infiltrate through the pavement surface and recharge groundwater reserves. Due to its high permeability, pervious concrete has been widely utilized in parking lots, sidewalks, pedestrian pathways, low-volume roads, and other sustainable pavement applications.

Despite its environmental advantages, the widespread application of pervious concrete is restricted by its relatively low mechanical strength. The high void content necessary for water permeability reduces the load-carrying capacity and compressive strength of the material when compared to conventional concrete. Consequently, pervious concrete is generally limited to light-traffic and non-structural applications. Enhancing its strength characteristics while maintaining adequate permeability remains a significant challenge for researchers and engineers.

Various methods have been investigated to improve the mechanical performance of pervious concrete, including the incorporation of supplementary cementitious materials, fibers, recycled aggregates, and reinforcement systems. Among these approaches, wire mesh reinforcement has demonstrated considerable potential in improving crack resistance, load distribution, ductility, and overall structural performance of cement-based materials. Previous studies have reported that steel wire mesh reinforcement effectively enhances the flexural behavior and energy absorption capacity of concrete elements. The confinement effect provided by wire mesh can also contribute to improved compressive strength by restricting crack propagation and delaying failure under loading conditions.

Galvanized Iron (GI) wire mesh is an attractive reinforcement material because of its high tensile

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strength, corrosion resistance, availability, and cost-effectiveness. While GI wire mesh has been successfully employed in ferrocement and composite concrete applications, limited research has been conducted on its utilization in pervious concrete. The influence of GI wire mesh reinforcement on the compressive strength characteristics of pervious concrete therefore requires detailed investigation.

The present study aims to evaluate the effectiveness of GI wire mesh reinforcement in enhancing the compressive strength of pervious concrete. Concrete specimens were prepared with and without GI wire mesh reinforcement and tested under compression after curing periods of 7, 14, and 28 days. Furthermore, the effect of mesh positioning on strength development was examined. The findings of this research are expected to contribute to the development of stronger and more durable pervious concrete systems suitable for sustainable pavement applications while preserving the environmental benefits associated with permeability and groundwater recharge.

Objectives of the Study

- To prepare pervious concrete using cement, coarse aggregates, and water without fine aggregates.
- To incorporate GI wire mesh reinforcement in pervious concrete specimens.
- To evaluate the compressive strength characteristics of plain and GI wire mesh reinforced pervious concrete at 7, 14, and 28 days curing periods.
- To compare the performance of plain pervious concrete and with GI Mesh pervious concrete.
- To study the effect of GI mesh position on strength.
- To determine percentage increase in compressive strength.

LITERATURE REVIEW

Kunpeng Li et al., 2024[1]

To enhance the mechanical properties of pervious concrete made with 100% recycled coarse aggregate (RCA), this study utilized fly ash (FA) to partially replace cement and added basalt fiber (BF). The effects of FA replacement ratio and BF content on properties such as porosity, water permeability, wear resistance, and compressive strength were examined. Findings indicated that with 6% FA and 4 kg/m³ BF, the compressive strength reached 24.3 MPa and mass loss was 6.66%. Optimal porosity and permeability were also achieved, meeting specification standards. Analyzing the microstructure revealed the mechanisms by which BF enhances RCA pervious concrete, providing insights for engineering applications.

Hui Song et al., 2025[2]

The study investigates the influence of inter-aggregate pore structure on the mechanical and permeability properties of pervious concrete. By replacing larger aggregates (4.75–9 mm) with smaller ones (2.35–4.75 mm) and adjusting compaction density, it was found that lower densities (<2250 kg/m3) enhance both permeability and compressive strength. The use of Image-J software allowed for effective analysis of pore size distribution, while grey relational analysis quantified relationships between pore characteristics and material properties. Key findings include a linear relationship between flat-surface pore area and porosity ratio, and an exponential relationship of permeability with pore area.

Weizhong Liu et al., 2025[3]

The study compares load-deflection, crack progression, ductility, and energy absorption in slabs reinforced with 3D-HSWM through four-point bending tests, revealing that 3D-HSWM enhances ductility and crack control by 1.2–1.8 times versus traditional methods. Best results occur with type b 3D-HSWM aligned with the long axis, combined with high-performance concrete. A model for calculating the flexural strength of these slabs was also developed, accounting for the unique structure of 3D-HSWM.

Research Gap

Most studies on pervious concrete have focused on improving its strength through fibers, supplementary cementitious materials, recycled aggregates, and conventional reinforcement techniques. However, limited research has investigated the use of Galvanized Iron (GI) wire mesh as reinforcement in pervious concrete. The effect of GI wire mesh on the compressive strength of pervious concrete remains largely unexplored. Therefore, this study aims to evaluate the effectiveness of GI wire mesh reinforcement in enhancing the compressive strength of pervious concrete and compare its performance with conventional pervious concrete.

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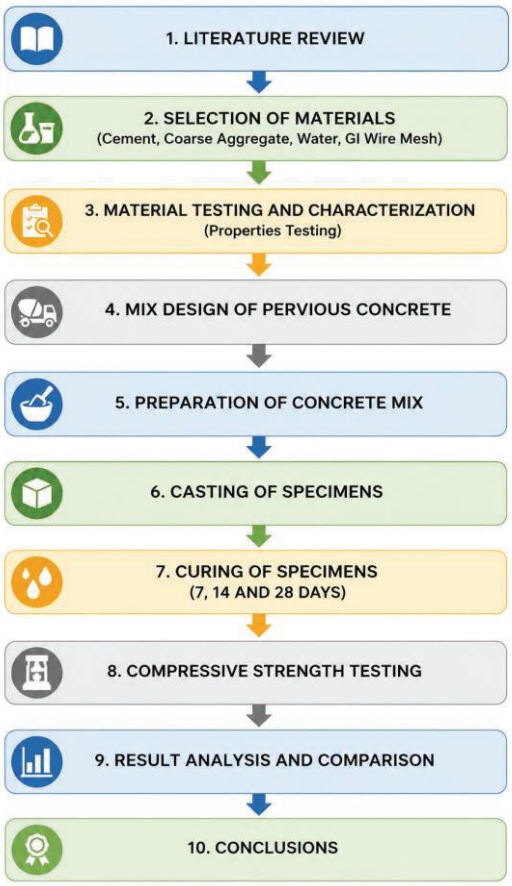
METHODOLOGY



Materials Used

Cement

Ordinary Portland Cement (OPC) 53 Grade conforming to relevant IS specifications was used as the binding material. Cement plays a vital role in providing cohesion between aggregate particles and contributes significantly to the strength development of pervious concrete.

Coarse Aggregate

Single-sized coarse aggregates of nominal size 20 mm were used in the preparation of pervious concrete. The coarse aggregates form the skeletal framework of the concrete and create interconnected voids responsible for water permeability.

Water

Clean potable water free from harmful impurities was used for mixing and curing purposes. Water initiates the hydration process of cement and influences the workability and strength of concrete.

GI Wire Mesh

Galvanized Iron (GI) wire mesh was used as reinforcement to improve the compressive strength characteristics of pervious concrete. The zinc coating on the mesh provides corrosion resistance and durability. The mesh also helps in controlling crack propagation and improving load distribution within the concrete matrix.

Properties of Materials

The physical properties of cement, coarse aggregates, and GI wire mesh were evaluated before mix preparation.

Cement Properties

- Specific Gravity
- Standard Consistency
- Initial Setting Time
- Final Setting Time

Aggregate Properties

- Specific Gravity
- Water Absorption
- Aggregate Size Distribution
- Shape and Surface Texture

GI Wire Mesh Properties

- Wire Diameter
- Mesh Spacing
- Tensile Strength
- Corrosion Resistance

Mix Design of Pervious Concrete

The mix design was prepared in accordance with IS 10262:2019 and relevant provisions of IS 456:2000. Pervious concrete was produced without fine aggregates to maintain interconnected voids required for water infiltration.

Mix Proportion

Material	Quantity (kg/m³)
Cement	360
Coarse Aggregate	1800
Water	110

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Water-Cement Ratio = 0.30

Mix Proportion = 1 : 4 (Cement : Coarse Aggregate)

The selected mix proportion was found suitable for achieving the desired balance between permeability and compressive strength.

Specimen Preparation

Preparation of Moulds

Standard cube moulds of size 150 mm × 150 mm × 150 mm were used. The moulds were cleaned thoroughly and coated with a thin layer of oil to facilitate easy removal of specimens after casting.

Mixing Procedure

The required quantity of coarse aggregate and cement was dry mixed until a uniform blend was obtained. Water was then added gradually while mixing continuously to ensure proper coating of aggregates with cement paste. Care was taken to avoid excessive mixing that could affect the porous structure of the concrete.

Casting of Specimens

The concrete mixture was placed into the moulds in layers. Light compaction was carried out using a tamping rod to ensure adequate bonding between aggregates while maintaining the interconnected void structure necessary for pervious concrete. Excessive compaction was avoided to preserve permeability.

Placement of GI Wire Mesh

For reinforced specimens, the GI wire mesh was positioned at the mid-depth of the cube specimen. The mesh dimensions were kept smaller than the mould dimensions to provide adequate concrete cover on all sides.

The specifications of GI wire mesh used were:

- Mesh Size: 120 mm × 120 mm
- Wire Diameter: 2 mm
- Grid Spacing: 10 mm × 10 mm
- Position: Mid-depth of specimen

The mesh was carefully aligned to ensure uniform reinforcement and proper embedding within the concrete matrix.

Demoulding and Curing

After 24 hours of casting, the specimens were removed carefully from the moulds. The specimens were then immersed in a curing tank containing clean water and cured under laboratory conditions.

The curing periods adopted were:

- 7 Days
- 14 Days
- 28 Days

Proper curing ensured adequate hydration of cement and development of the desired strength characteristics.

Experimental Program

The experimental program consisted of two categories of specimens:

A. Plain Pervious Concrete Specimens

These specimens were prepared without reinforcement and served as control specimens for evaluating the effect of GI wire mesh reinforcement.

B. GI Wire Mesh Reinforced Pervious Concrete Specimens

These specimens were prepared by embedding GI wire mesh at the specified location within the concrete cube. The reinforced specimens were tested to determine the improvement in compressive strength resulting from the inclusion of GI wire mesh.

Compressive Strength Test

The compressive strength test was conducted using a Compression Testing Machine (CTM) in accordance with IS 516 provisions. The cured cube specimens were removed from water, cleaned, and tested at the ages of 7, 14, and 28 days.

The specimen was placed centrally on the testing machine and load was applied gradually until failure occurred. The maximum load at failure was recorded and the compressive strength was calculated using:

Compressive Strength (MPa) = Maximum Load (N) / Loaded Area (mm^2)

The obtained results were analyzed and compared to evaluate the effectiveness of GI wire mesh reinforcement in enhancing the compressive strength characteristics of pervious concrete.

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RESULTS AND DISCUSSION

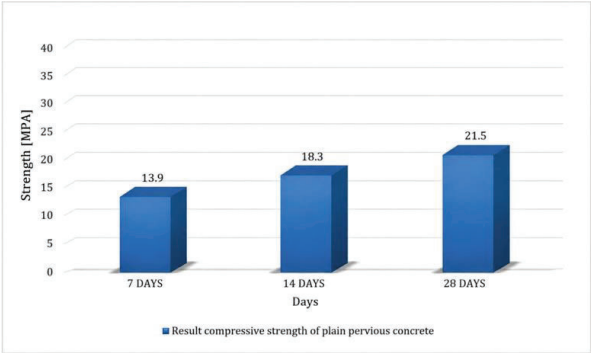
Introduction

This chapter presents the results of the compressive strength tests conducted on plain pervious concrete specimens and GI wire mesh reinforced pervious concrete specimens. The tests were carried out at curing periods of 7, 14, and 28 days. The obtained results are presented in tabular form and compared to evaluate the effect of GI wire mesh reinforcement on the compressive strength characteristics of pervious concrete.

Compressive Strength of Plain Pervious Concrete

Table 1 Compressive Strength Results of Plain Pervious Concrete

Curing Period	Specimen 1 (N/mm²)	Specimen 2 (N/mm²)	Specimen 3 (N/mm²)
7 Days	13.2	13.8	14.7
14 Days	17.8	18.2	18.9
28 Days	21.1	21.5	22.0

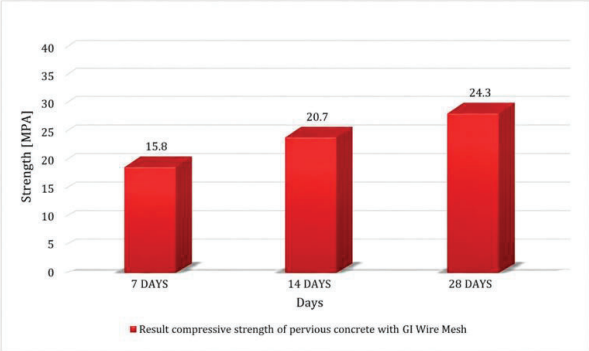


The compressive strength of plain pervious concrete increased with the increase in curing period. The average compressive strength at 7 days was found to be 13.9 N/mm². At 14 days, the average strength increased to 18.3 N/mm². The maximum average compressive strength of 21.55 N/mm² was obtained at 28 days. The gradual increase in strength is due to the continued hydration of cement and improved bonding between cement paste and aggregates.

Compressive Strength of GI Wire Mesh Reinforced Pervious Concrete

Table 2 Compressive Strength Results of GI Wire Mesh Reinforced Pervious Concrete

Curing Period	Specimen 1 (N/mm²)	Specimen 2 (N/mm²)	Specimen (N/mm²)
7 Days	14.9	15.7	16.8
14 Days	20.5	20.6	21.0
28 Days	23.7	24.5	24.7



The compressive strength of GI wire mesh reinforced pervious concrete also increased with curing age. The average compressive strength at 7 days was 15.8 N/mm², which increased to 20.7 N/mm² at 14 days and 24.3 N/mm² at 28 days. The results indicate that the inclusion of GI wire mesh improved the strength characteristics of pervious concrete. The reinforcement provided additional resistance against cracking and helped in distributing the applied load more effectively within the concrete matrix.

Comparison of Compressive Strength Results

Table 3 Comparison of Average Compressive Strength

Curing Period	Plain Pervious Concrete (N/mm²)	GI Wire Mesh Reinforced Concrete (N/mm²)
7 Days	13.9	15.8
14 Days	18.3	20.7
28 Days	21.55	24.3

The comparison of results shows that the GI wire mesh reinforced pervious concrete achieved higher compressive strength than plain pervious concrete at all

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curing periods. At 7 days, the average strength increased from 13.9 N/mm² to 15.8 N/mm². Similarly, at 14 days and 28 days, the reinforced specimens recorded higher strengths of 20.7 N/mm² and 24.3 N/mm² respectively, compared to 18.3 N/mm² and 21.55 N/mm² for plain pervious concrete. The improvement in strength demonstrates the effectiveness of GI wire mesh reinforcement in enhancing the compressive strength performance of pervious concrete.

CONCLUSION

The present study was carried out to investigate the effect of GI (Galvanized Iron) wire mesh reinforcement on the compressive strength characteristics of pervious concrete. Compressive strength tests were conducted on plain pervious concrete specimens and GI wire mesh reinforced pervious concrete specimens after curing periods of 7, 14, and 28 days.

Based on the experimental investigation, the following conclusions are drawn:

Plain Pervious Concrete

• Plain pervious concrete exhibited comparatively lower compressive strength values at all curing periods due to the presence of interconnected voids required for permeability.

• The average compressive strength of plain pervious concrete was found to be 13.9 MPa, 18.3 MPa, and 21.55 MPa at 7, 14, and 28 days respectively.

• The compressive strength increased with curing age, indicating continuous hydration of cement and improved bonding between aggregate particles.

GI Wire Mesh Reinforced Pervious Concrete

• The incorporation of GI wire mesh improved the compressive strength characteristics of pervious concrete at all curing ages.

• The average compressive strength of GI wire mesh reinforced pervious concrete was found to be 15.8 MPa, 20.7 MPa, and 24.3 MPa at 7, 14, and 28 days respectively.

• The GI wire mesh acted as a reinforcing element that enhanced load distribution within the concrete matrix and helped in controlling crack propagation.

• The reinforced specimens exhibited better structural performance and higher load-carrying capacity compared to plain pervious concrete specimens.

Percentage Increase in Strength

• The 28-day compressive strength increased from 21.55 MPa for plain pervious concrete to 24.3 MPa for GI wire mesh reinforced pervious concrete.

• The use of GI wire mesh resulted in an approximate increase of 13.02% in compressive strength at 28 days.

• The results demonstrate that GI wire mesh reinforcement is an effective method for improving the compressive strength performance of pervious concrete without affecting its basic porous characteristics.

Overall Conclusion

The study confirms that GI wire mesh can be successfully used as a reinforcement material in pervious concrete to enhance its compressive strength characteristics. Therefore, GI wire mesh reinforced pervious concrete can be considered a suitable and sustainable alternative for pavement applications where both permeability and improved strength are required.

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