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Experimental Study of Permeable Paver Block for Road Side Drainage System

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Abstract *–This project studies a roadside drainage system using permeable zig-zag paver blocks and compares it with normal solid paver blocks. The aim is to check water infiltration, surface runoff, and strength of the blocks. In the experiment, permeable paver blocks were placed on a base layer and water was poured to observe how fast water passes through them. The same test was done on normal paver blocks for comparison. The results show that permeable zig-zag paver blocks allow water to pass quickly through joints, which reduces water stagnation and surface runoff. They also help in groundwater recharge and reduce flooding. The blocks also have sufficient strength for low to medium traffic roads. Although permeable pavers cost slightly more at first, they reduce drainage cost, maintenance, and improve environmental sustainability, making them a good solution for roadside drainage systems.*

Keywords-*Permeable Paver Block, Roadside Drainage System, Stormwater Management, Permeable Concrete, Surface Runoff Reduction.*

INTRODUCTION

Urbanization and rapid infrastructure development have significantly increased the construction of impervious surfaces such as concrete roads, pavements, and parking areas. These conventional pavements do not allow rainwater to infiltrate into the ground, resulting in excessive surface runoff. During heavy rainfall, this runoff leads to roadside water logging, traffic disruption, soil erosion, and damage to pavement structures. In many areas, traditional drainage systems are either insufficient or poorly maintained, which further aggravates the problem of urban flooding.

Conventional roadside drainage systems generally depend on concrete side drains and storm water pipes to carry rainwater away from the pavement surface. However, these systems require proper slope, frequent maintenance, and high construction cost. Blockage due to debris, silt, and waste materials often reduces their efficiency. Moreover, continuous runoff reduces groundwater recharge, leading to depletion of underground water levels.

To address these challenges, permeable pavement systems have been introduced as a sustainable alternative. Permeable paver blocks are specially designed concrete units that contain interconnected voids, allowing rainwater to pass through the surface and percolate into the underlying soil. Unlike traditional concrete, permeable concrete is prepared without fine aggregate (sand), which creates a porous structure capable of effective water infiltration. This system acts both as a pavement and as a drainage medium.

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The concept of using permeable paver blocks for roadside drainage provides multiple advantages. It reduces surface runoff, minimizes water stagnation, improves groundwater recharge, and decreases dependency on conventional drainage structures. Additionally, it helps in reducing soil erosion and enhances environmental sustainability in urban road infrastructure.

The present experimental investigation focuses on studying the performance of permeable paver blocks when used in roadside drainage applications. The study includes selection of suitable materials, preparation of permeable concrete mix, casting of paver blocks, curing, and evaluation of properties such as workability, compressive strength, water absorption, and permeability. A cost analysis is also conducted to examine the economic feasibility of the system.

The primary objective of this investigation is to evaluate whether permeable paver blocks can effectively function as an integrated pavement and drainage system while maintaining adequate structural strength and durability. The findings of this study aim to contribute toward the development of sustainable, economical, and environmentally friendly roadside drainage solutions.

METHOLOGY

The methodology adopted for the experimental investigation on roadside drainage system using permeable paver blocks consists of material selection, mix preparation, casting of paver blocks, curing, and performance evaluation through laboratory testing.

Table. 1.1-Material Selection

Sr.No	Material
1	Cement: Portland pozzolana cement (PPC) 43 Grade
2	Coarse Aggregate: Crushed stone aggregate, 6–10 mm size
3	Water: Clean potable water (as per IS 456)
4	Paver Block Mould: Zig-zag shape, standard size

Fig. 1.1- Permeable Concrete Block (Circular)

Fig. 1.2-Permeable Paver Block

DESIGN

The design of the permeable paver block for roadside drainage application was carried out considering structural strength, permeability, and durability requirements. The system was designed to function both as a pavement surface and as a drainage medium.

1. Block Dimensions

The standard size adopted for the permeable paver block is:

Length = 250 mm
Breadth = 110 mm
Depth = 60 mm
Volume of one block = 0.25 x 0.11 x 0.06
= 0.00165 m^3
2. Mix Design
The permeable concrete mix proportion adopted:
Cement: Coarse Aggregate = 1: 5
Water–cement ratio:w/c = 0.35
Fine aggregate (sand) was not used in order to create interconnected voids for water infiltration.

3. Structural Design Consideration

The design was based on:

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Required compressive strength for light traffic conditions

Adequate void ratio (15–25%) for proper permeability

Sufficient thickness (60 mm) for load resistance

Uniform compaction to maintain strength and pore structure

4. Drainage Function Design

The permeable paver block system allows rainwater to:

Pass through surface voids

Percolate into the sub-base layer

Recharge groundwater naturally

The underlying layer consists of coarse aggregate which acts as a temporary water storage and filtration layer.

5. Performance Criteria

The design was evaluated based on:

Compressive strength (IS 516)

Water absorption

Permeability observation

Cost effectiveness

The final design ensures that the permeable paver block provides adequate structural capacity while effectively reducing roadside water stagnation and improving groundwater recharge.

RESULTS AND ADVANTAGES

1. Workability (Slump Test Results)

- The workability of permeable concrete was assessed using the slump cone test.
- Due to the absence of fine aggregate and the use of single-sized coarse aggregate, the concrete exhibited low workability.
- The low slump is desirable for permeable paver blocks, as it helps in maintaining interconnected voids required for water infiltration.
- The mix was found to be stable and suitable for mould filling without segregation.

Table. 1.2- Slump Test Results

Mix Type	Slump (mm)
Permeable concrete mix (No sand)	20–30 mm (approx.)

Table. 1.3- *Compressive Strength (28 Days)*

Sr. No.	Type of Paver Block	Load at Failure (kN)	Area (mm^2)	Compressive Strength (MPa)
1	Normal Paver Block	560	27500	16.73
2	Normal Paver Block	480	27500	13.82
3	Normal Paver Block	520	27500	18.91
4	Permeable Paver Block	460	27500	15.27
5	Permeable Paver Block	440	27500	16
6	Permeable Paver Block	450	27500	16.36

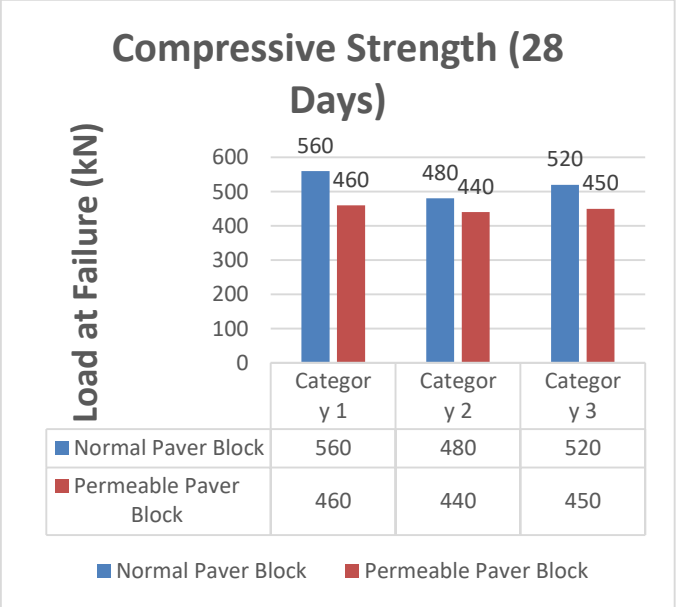

Fig.1.3-*Compressive Strength (28 Days)*

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COST ANALYSIS

- A comparative cost analysis was carried out between conventional solid concrete paver blocks and permeable paver blocks used for roadside drainage.
- Although permeable paver blocks use slightly higher cement content, they reduce the need for separate roadside drains, resulting in overall cost efficiency.
- Savings are also achieved due to reduced excavation, drainage pipes, and maintenance cost.

Table. 1.4- COST ANALYSIS

Type of pavement	Approx. Cost per paver block (₹)
Normal concrete paver block	₹15 - ₹20
Permeable paver block	₹10 - ₹15

CONCLUSION

The experimental investigation on the roadside drainage system using permeable paver blocks demonstrates that permeable pavement technology is an effective and sustainable alternative to conventional drainage systems. The permeable concrete mix prepared without fine aggregate successfully created interconnected voids, allowing rainwater to infiltrate through the pavement surface.

The compressive strength results indicate that the permeable paver blocks possess adequate structural capacity for light traffic and pedestrian applications. The water absorption and permeability observations confirm that the blocks effectively reduce surface runoff and minimize roadside water stagnation. Proper curing significantly improved strength and durability characteristics.

The study also shows that permeable paver blocks can function both as a pavement surface and as a drainage medium, thereby reducing the dependency on traditional roadside drains. From an environmental perspective, the system promotes groundwater recharge, reduces urban flooding, and supports sustainable infrastructure development.

Based on the experimental results, it can be concluded that permeable paver blocks are technically feasible, economically reasonable, and environmentally beneficial for roadside drainage applications.

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