IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

"Green Porous Concrete For Rain Water Harvesting And Urban Pavement"

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Abstract: In rapidly urbanizing areas, impervious pavements contribute significantly to surface runoff, urban flooding, and groundwater depletion. This study explores the development of Green Porous Concrete (GPC) as a sustainable alternative for urban pavements and rainwater harvesting systems. Using a no-fines approach with 10 mm and 20 mm aggregates, OPC 53-grade cement, and superplasticizers, several mix designs were developed and tested. The optimal mix achieved a 28-day compressive strength of 35.71 N/mm² with excellent permeability. On-site implementation validated lab results by eliminating water stagnation and enabling effective infiltration. The findings confirm GPC's dual role in enhancing urban resilience and environmental sustainability.

Keywords: porous concrete, rainwater harvesting, urban pavement, permeability, sustainable construction, green infrastructure.

I. Introduction:

Pervious concrete (also called porous concrete, permeable concrete, no fines concrete and porous pavement) is a special type of concrete with a high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. Urban infrastructure, dominated by conventional concrete, often exacerbates issues like waterlogging, decreased groundwater levels, and urban heat islands. Porous concrete presents a viable alternative, offering high void ratios that facilitate direct infiltration of rainwater into subsoil layers. This study introduces Green Porous Concrete (GPC) as a multipurpose material for both stormwater management and low-traffic pavement applications.

II. Literature Review:

Multiple studies highlight the effectiveness of porous concrete. Bhutta et al. demonstrated the role of admixtures in enhancing the strength and reducing void ratio. Aoki et al. confirmed that replacing cement with fly ash maintained strength while improving permeability. Chandrappa and Biligiri outlined its hydrological and environmental benefits, and Dong et al. compared abrasion resistance test methods for pervious concrete. These works collectively underscore the importance of optimized mix design for structural and hydrological performance.

III. Materials and Methods

The study used OPC 53 Grade cement, 10 mm and 20 mm coarse aggregates from Warora, Maharashtra, and superplasticizer. Four concrete mixes were prepared (Type 1: 40% 10 mm aggregate + 60% 20 mm aggregate ; Type 2: 100% 10 mm aggregate; Type 3: 100% 20 mm aggregate; Type 4: no admixture). The mix was designed as per IS 10262:2019 and IS 456:2000. And found that Type 1 have more porosity as compare to other Types. Tests included specific gravity, water absorption, sieve analysis, compressive strength, and permeability.

MIX DESIGN CALCULATION

CEMENT	SAND	AGGREGATE	WATER
430	682	1059	197
1	1.38	2.97	0.4

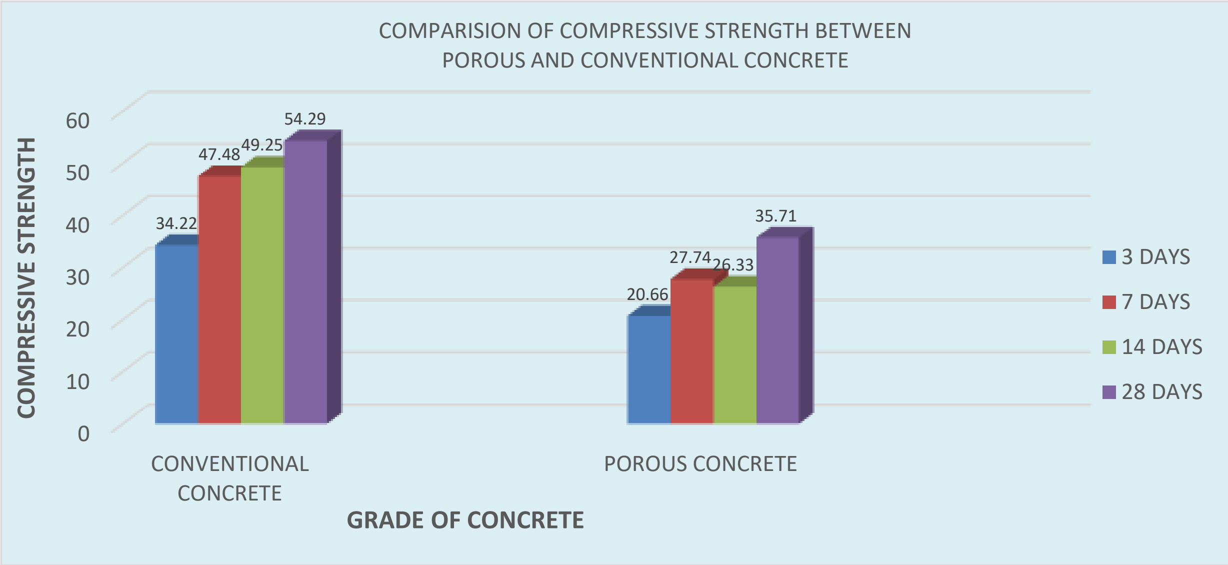
IV. Results and Discussion

The optimized porous mix (Type 1) achieved a 28-day compressive strength of 35.71 N/mm², which is adequate for low-load urban pavements. Permeability was qualitatively high. Compared to conventional concrete, porous concrete showed reduced strength but improved infiltration. The results validate its utility in sustainable urban drainage and stormwater management.

COMPRESSIVE STRENGTH TEST

Curing Days	Conventional Concrete (N/mm²)	Porous Concrete (N/mm²)	As per Is Code (N/mm²)
3 Days	34.22	20.66	7.5-10
7 Days	47.48	27.74	15-17.5
14 Days	49.25	26.33	21.22.5
28 Days	54.29	35.71	25

COMPARISION OF COMPRESSIVE STRENGTH BETWEEN POROUS AND CONVENTIONAL CONCRETE



V. OVERALL ANALYSIS

Parameter	Result	Remark
Specific Gravity	2.73–3.10	Acceptable
Water Absorption	< 1.1%	Good-quality aggregates
Compressive Strength	35.71 N/mm² at 28 days	Suitable for urban pavement
Permeability	High (assumed from structure)	Excellent for rainwater harvesting
Environmental Benefit	Present	Use of green and recycled materials confirmed
Feasibility for Implementation	Positive	Practical for low-load applications

VI. On-Site Implementation

The porous concrete was implemented at RCERT Chandrapur campus under a palm tree (1.5m x 1.5m). The mix demonstrated excellent infiltration and stability under pedestrian traffic. No water stagnation was observed during rainfall. The test site confirmed the field feasibility of the developed mix.

VII. Conclusion:

Green porous concrete successfully meets requirements for light-load pavements and water management. It supports the dual goals of sustainability and engineering performance. The mix offers an eco-friendly alternative for footpaths, walkways, and parking areas with added environmental benefits like urban flood control and groundwater recharge.

VIII. References:

1 Bhutta, M.A.R., et al. 'Evaluation of high-performance porous concrete properties.'
2 Aoki, Y., et al. 'Properties of pervious concrete containing fly ash.'
3 Chandrappa, A.K., & Biligiri, K.P. 'Pervious concrete as a sustainable pavement material.'
4 Dong, Q., et al. 'Investigation into abrasion test methods for pervious concrete.'
5 IS 10262:2019, IS 456:2000, IS 2386:1963.