IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ჯ Impact Factor 8.102 ჯ Peer-reviewed / Refereed journal ჯ Vol. 12, Issue 8, August 2023

DOI: 10.17148/IJARCCE.2023.12818

Water Absorption Road

Prof. Shaikh S. Fatima[1], Khan Faizan Yaqub[2], Khan Yusuf Feroz[3], Shaikh Mohd. Faizan[4], Shaikh Mohd. Ilyas[5], Shaikh Shabaaz Zahed[6]

Assistant Professor, Department of Civil Engineering, PES College of Engineering, Aurangabad, (MS), India[1]

Student, Department of Civil Engineering, PES College of Engineering, Aurangabad, Maharashtra, India[2-6]

Abstract: Pervious concrete is a unique and eco-friendly alternative to traditional concrete, known for its high porosity and permeability. Different mix designs, with and without fines, were tested to determine their mechanical properties. The study found an inverse relationship between compressive strength and permeability. Various mixtures were evaluated using aggregate sizes ranging from 12 mm to 4.75 mm, with consistent water content and varying fines content. Pervious concrete typically exhibits compressive strength between 9.18 MPa and 14.06 MPa, and permeability ranging from 5.9% to 12.7%. The desired void ratio falls between 15% and 20%.

The study emphasizes the influence of factors like shape, angularity, paste content, size, and water-to-cement ratio on the strength and permeability of pervious concrete. The goal is to implement pervious concrete in different applications to replenish groundwater resources

Keywords: Pervious concrete, Permeable concrete Compressive strength, Void ratio, Ground water Recharge

I. INTRODUCTION

In a natural, undeveloped forest site, the processes of infiltration, evaporation, and transpiration significantly reduce storm water runoff. Less than 1% of the storm water leaves the site as runoff. However, as a site is developed and impervious surfaces such as roads, rooftops, sidewalks, and parking areas are introduced, the site's ability to handle storm water changes dramatically. More water, approximately 20-30%, runs off the site, and less water is able to infiltrate, evaporate, or be transpired. Apart from the increased volume of runoff, the speed at which it travels also becomes a concern.

To address this problem, pervious concrete has been introduced. Pervious concrete is a special type of concrete intentionally designed with continuous pores. It differs entirely from conventional concrete. Pervious concrete finds numerous applications such as sidewalks, shoulders, and parking lots due to its environmental benefits

Pervious concrete serves a dual purpose by providing a solid structural surface while allowing water from rain or other sources to percolate through it and replenish the groundwater table. It is an effective method for reducing runoff from impervious surfaces and aids in the recharge of the groundwater table. By utilizing pervious concrete, storm water management goals can be achieved while promoting sustainable development.

1.1 Materials: Following materials are to be in consideration

1. Cement:

Ordinary Portland cement, 53 grade conforming to Confirm IS requirement as per IS 12269-2013.OPC was used for casting all the specimens. The type of cement used is important to ensure compatibility of chemical and mineral admixtures.

Table -1: Basic test values of cement

Tests	Value
Normal consistency	32 %
Initial setting time	45 min
Final setting time	600 min
Soundness	3.50 mm
Specific gravity	3.15
Fineness	6.5%

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁑ Impact Factor 8.102 ⁑ Peer-reviewed / Refereed journal ⁑ Vol. 12, Issue 8, August 2023

DOI: 10.17148/IJARCCE.2023.12818

2. Coarse aggregates

Locally available crushed granite stones that conform to the IS: 2386 (Part III) – 1963 standards were utilized. The aggregate size used ranged from 19 mm to 4.75 mm, as prescribed by the ACI -211, Appendix -6, A6.2. The maximum size of the aggregates did not exceed 20 mm. It should be noted that the choice of aggregate type also significantly impacts the dimensional stability of the concrete.

In addition to the coarse aggregates, manufactured sand was incorporated in the mixture. The percentage of manufactured sand used varied at 5%, 10%, 15%, and 20% of the total aggregate weight. This addition of manufactured sand as a partial replacement of natural sand influences the properties of the concrete mixture.

Table -2: Basic test values of course aggregates

Tests	Value
Specific gravity	2.70
Water Absorption	1%
Dry rodded density	1524 kg/m³
Angular number	12.36
Impact test	5.96

Table -3: Basic test values of fine aggregates

Tests	Value
Specific gravity	2.52
Water Absorption	1.5%

II. LITERATURE REVIEW

Park, S., and M. Tia. (2004). An experimental study on the water-purification properties of porous concrete, Cement and Concrete Research

In this study, silica fume and fly ash, both industrial by-products, were added to the manufacture of environmental load reducing porous concrete, a bio-responsive eco-concrete, to which terrestrial as well as aquatic microbes can attach themselves. The porous concretes were then submerged under river water in order for bio-film to develop over the broad specific surface and internal continuous pores. Subsequently, the strength property of the porous concrete was evaluated according to the particle size of the aggregate and the paste–aggregate ratio (P/G). In addition, its water purifying capacity was also evaluated with the use of the natural contact oxidation method. Recently, various artificial structures and an increasing amount of pollutants brought about by industrial development have severely degraded the global environment, which in turn reminds us of the importance of material circulation, the food chain and water supply. Currently, concrete is heavily used as one of the major construction materials in modern industrial society

III. SYSTEM DEVELOPMENT

3.1 Mix design:

Porous concrete can be made by adjusting the mixture of traditional concrete to allow for the formation of voids or within the material. Here are the basic steps involved in making porous concrete.

In the laboratory, pervious concrete mixtures were designed and proportioned. These mixtures were then cast into cubes with dimensions of 150 x 150 x 150 mm for the purpose of determining the compressive strength. Compression testing machines were employed to measure the cube compressive strength, which provides an indication of the concrete's ability to withstand compressive forces. For assessing the hydraulic conductivity (permeability) of the pervious concrete, circular specimens with a diameter of 100 mm and a length of 200 mm were used. The permeability of the pervious concrete was determined by conducting tests on these specimens. The hydraulic conductivity test helps evaluate the concrete's ability to allow water to pass through it.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 8, August 2023

DOI: 10.17148/IJARCCE.2023.12818

Cube or cylindrical specimens were also used to determine the total void percentage of the pervious concrete. These specimens are analyzed to calculate the voids present in the concrete, which is an important parameter in assessing the porosity and permeability of the material.

3.2 Construction Methods:

Pervious concrete can be placed and finished using standard concrete construction methods.
However, there are a few important considerations:

- The concrete must be placed in a uniform layer.
- The concrete must be compacted to ensure that there are no voids.
- The concrete must be sealed to prevent clogging.
- Maintenance
- Pervious concrete pavements require little maintenance. However, it is important to clean Pavement regularly to remove debris and prevent clogging.

3.3 Test we performed

3.3.1 Hydraulic conductivity (permeability):

In order to evaluate the hydraulic conductivity of pervious concrete, a specialized method was employed due to its unique properties. The conventional method used for normal concrete is not applicable to pervious concrete, as it possesses a large interconnected pore network.

To estimate the hydraulic conductivity of pervious concrete, a falling head permeability test apparatus was fabricated at the R&D Centre of Karnataka Ready Con Mix, a unit of KRC Group in Bengaluru. The apparatus is designed specifically for conducting the falling head permeability test on pervious concrete.

During the test, water is poured from the top of the pervious concrete specimen, and its percolation through the concrete is observed. The apparatus allows for precise measurement of the falling head, which refers to the vertical distance the water level drops over a specific time period. This data is then used to calculate the hydraulic conductivity of the pervious concrete specimen.
This specialized test apparatus enables accurate assessment of the hydraulic conductivity of pervious concrete and provides valuable insights into its permeability characteristics.

3.3.2 Compressive strength:

Compressive strength tests for the pervious concrete followed IS 516 (1959) guidelines. Cubes of 150 mm x 150 mm x 150 mm were prepared for each mix and cured for 24 hours before demoulding. The demoulded specimens were then submerged in water at 24ºC until testing. Compressive strength was measured at 7 days and 28 days, with three samples tested at each interval. The average strength value was reported, providing a reliable representation of the pervious concrete's compressive strength.

Compressive strength N/mm2 =
Load Applied (N)/Area of Specimen (mm2)

IV. PERFORMANCE ANALYSIS

Performance analysis is done with different parameters and observed the values in percentage. Following table shows the comparative analysis of strength etc parameters.

4.1 Comparison of void ratio with respect to the different percentage of fines given by table

Percentage of Fines	Percentage of Void Ratio
0	23
6	20
12	18
18	15
24	12

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁓ Impact Factor 8.102 ⁓ Peer-reviewed / Refereed journal ⁓ Vol. 12, Issue 8, August 2023
DOI: 10.17148/IJARCCE.2023.12818

4.2 Comparison of compressive strength of pervious with respect to the different percentage of fines given by table

Percentage of Fines	Compressive Strength 7 Days mpa	Compressive Strength 28 Days mpa
0	5.51	9.18
6	5.80	9.83
12	6.20	9.54
18	7.05	10.76
24	8.89	14.06

3.3 Comparison of compressive strength of normal with respect to the different percentage of fines given by table

Percentage of Fines	Compressive Strength 7 Days mpa	Compressive Strength 28 Days mpa
0	7.22	11.13
6	8.63	11.81
12	9.39	12.32
18	10.28	15.23
24	11.31	17.21

4.2.3 Comparison of permeability with respect to the different percentage of fines given by table

Percentage of Fines	Permeability mm/sec
0	12.5
6	11.60
12	10.00
18	8.90
24	6.10

V. CONCLUSION

Pervious concrete: 50-75% lower compressive strength than conventional concrete. Pervious concrete: 4% higher void ratio, resulting in high permeability. Pervious concrete: 30% reduced density compared to conventional concrete. Coarser aggregates in pervious concrete: Larger void ratio. Cube compressive strength decreases with increasing aggregate size in pervious concrete. Adding sand improves mechanical strength but decreases permeability in pervious concrete. Permeability increases with aggregate size in pervious concrete

REFERENCES

[1]. Park, S., and M. Tia. (2004). An experimental study on the water-purification properties of porousconcrete, Cement and Concrete Research 34 (2004)pg.177-184.
[2]. Guide for Selecting Proportion for No-Slump Concrete, Reported by ACI Committee 211, ACI 211.3R-02 (Reapproved 2009).
[3]. Joshi, T.; Dave, U (2016). Evaluation of Strength, Permeability and Void Ratio of Pervious Concrete with
[4]. Changing w/c Ratio and Aggregate Size. Int. J. Civ. Eng. Technol., 7, pg. 276–284.
[5]. Yang J, Jiang G (2003). Experimental study on properties of pervious concrete pavement materials. Cem Concr Res; 33(3):381–6.
[6]. Kajio, S., Tanaka, S., Tomita, R., Noda, E., and Hashimoto, S. (1998). Properties of Porous Concrete with High Strength, Proceedings 8th International Symposium on Concrete Roads, Lisbon, pg. 171-177.
[7]. [Neamitha, M.; Supraja, T.M (2017). Influence of Water Cement Ratio and the Size of Aggregate on the Properties Of Pervious Concrete. Int. Ref. J. Eng. Sci., 6, pg. 9–16.