JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Analyze the properties of porous concrete.

Prof. Subhashini Ramteke[1]*,Bhushan Adhalkar*[2]*,Shubham Patil*[3]*,Vishal Patil*[4]*,Sanket Shinde*[5]

[1]Assistant Professor, Department of Civil Engineering, D. Y. Patil College of Engineering, Akurdi Pune, India

[2345]Student, Department of Civil Engineering, D. Y. Patil College of Engineering, Akurdi, Pune, India

Abstract:
Cities exemplify a remarkable transformation of the natural landscape into a human-made environment. Among the most consequential alterations associated with urbanization is the increase in impervious cover. Impervious cover refers to surfaces that hinder rainwater from infiltrating into the subsurface, including buildings, sidewalks, driveways, and notably, streets and parking lots. The proliferation of impervious cover poses a significant challenge. When natural land is replaced with paved areas, vital natural processes within a watershed are severely disrupted. However, it is important to note that not all surfaces within urban areas need to be impervious.
Urbanization augments a large amount of impervious ground surfaces. However, over use of impervious ground surfaces would induce many problems, such as the urban waterlogging, heat island effect, blockage of underground water cycle. Pervious concrete, which has pores to allow permeation of water and air, is being used as one of the solutions for combating the problems induced by urbanization.
The aim of this research is to determine various parameters for the mix design of porous concrete. These parameters include finding the optimal aggregate size that will yield satisfactory results, determining the appropriate range of water-to-cement (w/c) ratio that effectively coats the aggregate without filling the gaps and reducing the infiltration rate. Additionally, the research aims to identify a mix design method that consistently produces satisfactory results and explore various approaches to enhancing the compressive strength of porous concrete.

Keywords: **pervious concrete, compression strength, infiltration rate**

Introduction

Porous concrete, also known as o-fines, porous, gap-graded, or permeable concrete, has been recognized as a reliable stormwater management tool. It is composed of a mixture of gravel, stone, cement, water, and a little to medium amount of sand (fine aggregate). When used for paving, the open cell structures of porous concrete allow stormwater to filter through the pavement and into the underlying soils. This feature helps protect the surface of the pavement and the surrounding environment.

Porous concrete offers a unique and effective solution to address important environmental issues and promote sustainable growth. It serves as a drainage system by allowing rainwater to naturally infiltrate the ground. The rough texture and honeycombed surface of porous concrete, along with moderate surface raveling on heavily traveled roadways, contribute to its permeability. The carefully controlled proportions of water and cementitious materials create a paste that coats the aggregate particles, preventing the paste from flowing off during mixing and placing. Sufficient paste is used to coat the particles and maintain a system of interconnected voids that enable water and air to pass through.

Although porous concrete has many advantages, such as its ability to eliminate surface runoff of stormwater and facilitate groundwater recharge, its usage is limited due to its lower compressive strength compared to conventional concrete. Research work is being conducted to improve the compressive and flexural strengths of porous concrete, as enhancing these properties would allow for a wider range of applications. Currently, porous concrete is primarily used for light traffic roads. However, if its properties are improved, it could be utilized more extensively, leading to effective land usage and further environmental benefits.

Objectives:

- To review the literature on analyzing the properties of porous concrete.
- To decide significant parameters required for mix design of porous concrete.
- To identify a mix design method that consistently produces satisfactory results and explore various approaches to enhancing the compressive strength of porous concrete.).

Problem statement:

- One of the key characteristics of pervious paving, is its ability to contain voids that facilitate water percolation into the underlying base materials. This permeability plays a crucial role in reducing peak stormwater flow and minimizing water pollution, while also promoting groundwater recharge. Therefore, there is a significant interest and need to analyze the properties of porous concrete to ensure its effective usage.
- The usage of porous concrete is currently limited due to its lower compressive strength compared to conventional concrete, resulting from its inherent porosity and voids. This limitation restricts the potential applications of porous concrete

Literature review:

1- Experimental Investigation of Compressive Strength and Infiltration Rate of Pervious Concrete by Fully Reduction of Sand

Aneel Manan a, Mushtaq Ahmad b*, Fawad Ahmad c, Abdul Basit a, Muhammad Nasir Ayaz Khan d.2018

Study has investigated 7 and 28 days compressive strength of pervious concrete by reduction of fine aggregate from zero percentage to 100% in the design mix. It is concluded that by reduction of fine aggregate compressive strength of the pervious concrete decrease. Maximum 49.82% compressive strength of 7 days and 46.25% compressive strength decreased on 28 days by the reduction of 100% sand. Study found that compressive strength decrease by reducing fine aggregate from the previous concrete. Study concluded that infiltration increase by reducing the fine aggregate in pervious concrete. The findings indicated that 0-40% reduction of fine aggregate does not permit water runoff or zero percentage infiltration rate. The highest infiltration of 273.11% increase by the reduction of 100% fine aggregate from the previous concrete mix. The 90% reduction of sand from concrete give considerable compressive strength of 2150 psi and infiltration rate of 165.79 inch/hour, which can be recommended for pavements of parking and walking area. Lower compressive strength may limit the applications of the pervious concrete but since high permeability is core purpose in the development of pervious concrete. It may applicable in the area where lower compressive strength required like pathways or sidewalks etc.

2-A Study on Compressive Strength of Pervious Concrete.

Muhammad Zeeshan, Asim Farooq, 2018

From the previous work done on pervious concrete and advantages integrated concludes that pervious concrete could be used economically as building material, and by doing compression test suitable material for construction can be designed. The size of coarse aggregate, w/c proportion and aggregate to cement ratio has a crucial role in strength of pervious concrete. Using smaller size aggregate (10mm) can enhance the compressive strength of pervious concrete than bigger size aggregate (20mm). As the aggregate size goes up, the voids ratio of the concrete also improves due to which the compressive strength of the concrete decreases. Compressive strength can possibly be improved with the use of proper admixtures also. Single size of coarse aggregates (9.375mm – 12.7mm) must be used for better compressive strength and porosity.

3- Improvement of compressive strength of pervious concrete

1Prem Dutt Sharma 2Sumit Singh 3Shivendra Yadav 4Yogendra Tiwari ,2022

Aggregate size and water-to-cement ratio are crucial factors influencing the compressive strength of porous concrete. To enhance the compressive strength, various strategies can be employed, such as replacing cementitious materials or incorporating fine-sized aggregate. However, it is important to note that an increase in fines content and cementitious replacement may lead to a reduction in the penetration capacity of the flowing concrete.

4-Evaluation of structural performance of pervious concrete in construction
Ajamu Solomon Olalere, johnson rotimi oluremi,2012.

The smaller the size of coarse aggregate should be able to produced a higher compressive strength and at the same time produce a higher permeability rate. The mixture with higher aggregate/cement ratio 8: and 0:1 are considered to be useful for pavement that requires low compressive strength and high permeability rate. Further study should e conducted on pervious concrete pavement produced with this material proportions meet the condition of increased abrasion and compressive stress due to high vehicular loading and traffic volumes.

5-Experimental Study on Permeability of Concrete.
Honglu Yang, Rentai Liu*, Zhuo Zheng, Haojie Liu, Yan Gao, Yankai Liu Research Center of Geotechnical and Structural Engineering, Shandong University, Jinan, Shandong ,250061, China2018
The permeability of pervious concrete depends on the size of the measured porosity. Generally, the larger the porosity is, the greater the permeability coefficient is, and the permeable pore is the communicating pore. Due to the increase of amount of cement, causes between the aggregate number and size of the original connected pores are reduced, and even block the pores, the pore is not connected, which leads the whole skeleton permeable channel is reduced, the permeability coefficient decreases .Comprehensive analysis, aggregate particle size is the most influential factor in the permeability of concrete. Finally, through comprehensive analysis of a variety of factors, the optimal water cement ratio is 0.28.

6-Porous concrete with optimum fine aggregate and fiber for improved strength.
Savitri s.karanth,U.Lohith kumar and Naveen Danigond, 2019.

Workability decreases with the addition of fine aggregate. This is normal as the surface area of aggregate is increased more area needs to get wet for paste to coat around. Maximum increase in compressive strength was observed at 20% replacement of fine aggregate. The strength was in par with M20 concrete. The inclusion of fine aggregate resulted in porosity which reduced to more than 50%. However it was still in the range to be considered as porous concrete. This is an expected outcome and the quantity of fine aggregate should be adjusted to achieve the required strength and porosity.The impact strength increased with inclusion of fibre as well as fine aggregate. As the road pavements are subjected to impact load more often, this is an important observation from the present study. The increase in impact strength was as much as 2.15 times for first crack and 2.85 times for final failure with the inclusion of 1.5% of recron fibres. Hence with the strength equal to M20 concrete, 16.8% porosity and impact strength of 85 joules, the porous concrete is very much suitable for

OBSERVATIONS

1. It is found that the smaller the size of coarse aggregate will produce a higher compressive strength and at the same time produce a higher permeability rate.

2. The recommended range for the water-cement ratio in porous concrete is typically between 0.28 to 0.35. This range provides a good balance between achieving sufficient strength and porosity in the concrete.

3. At a void content lower than 15 %, there is no significant percolation through the concrete due to insufficient interconnectivity between the voids. So concrete mixtures are typically designed for 20% void content in order to attain sufficient strength and infiltration rate.

4. A high w/c ratio reduces the adhesion of paste to aggregate and cause the paste flow and fill the voids. A low w/c ratio will prevent good mixing and tend to cause balling in the mixer. The w/c ratio between 0.25 to .0.35 shows good result.

5. Generally, the unit weight of porous concrete is lower than that of conventional concrete due to the presence of voids in the material. The unit weight of porous concrete typically ranges from 1600 kg/ m3 to 2100 kg/m3.

CONCLUSIONS:

The following inferences can be made from the examination and discussion of the experimental results.

1. The compressive strength of porous concrete can be increased by partially replacing the coarse aggregate with fine aggregate

2. the permeability of porous concrete is inversely proportional to the addition of fine aggregate

3. It has been found that the NRMCA (National Ready Mixed Concrete Association) method for porous concrete design consistently yields excellent results.

REFERENCE:

1. **"Experimental Investigation of Compressive Strength and Infiltration Rate of Pervious Concrete by Fully Reduction of Sand" 2018 by** Aneel Manan a, Mushtaq Ahmad b*, Fawad Ahmad c, Abdul Basit a, Muhammad Nasir Ayaz Khan d.

2. **"A Study on Compressive Strength of Pervious Concrete" 2018 by** Muhammad Zeeshan, Asim Farooq,

3. **"Improvement of compressive strength of pervious concrete" 2022 by** Prem Dutt Sharma , Sumit Singh , Shivendra Yadav, Yogendra Tiwari, Nageshwar Singh.

4. **"Evaluation of structural performance of pervious concrete in construction" 2012 by** Ajamu Solomon Olalere, johnson rotimi oluremi.

5. **"Experimental Study on Permeability of Concrete" 2018 by** Honglu Yang, Rentai Liu, Zhuo Zheng, Haojie Liu, Yan Gao, Yankai Liu Research Center of Geotechnical and Structural Engineering, Shandong University, Jinan, Shandong ,250061,

6. **"Porous concrete with optimum fine aggregate and fiber for improved strength"2019 by** Savitri s.karanth,U.Lohith kumar and Naveen Danigond, 2019.