Volume 8, Issue 05, May 2023 ISSN (online): 2456-0006
International Journal of Science Technology Management and Research

Application of Previous Concrete as Sustainable Material

Mr. Ankit Jagale
Department of Civil Engineering
Late G. N. Sapkal College Of Engineering, Anjaneri,
Trimbakeshawar, Nashik, Maharashtra, India

Prof. D.P. Joshi
Department of Civil Engineering
Late G. N. Sapkal College Of Engineering, Anjaneri,
Trimbakeshawar, Nashik, Maharashtra, India

Abstract: In this paper — The composite Perforated pavements are a new type of pavement with high porosity which usually used for flat work applications in order to allow water to pass through it .It reduces the volume of direct water runoff from a site and increases the quality of storm water and water pollution .Due to the high flow rate of water through perforated pavement, rainfall can be captured and percolate into the ground, recharging groundwater, supporting sustainable construction, reducing storm-water runoff, and providing a solution for construction that is sensitive to environmental concerns.

An attempt is made in this project perforated pavement concept at decided location of Surface runoff data is collected from the site location and various tests are performed to check its efficiency against surface runoff.

Keywords: Perforated pavements, storm-water runoff.

I. Introduction

Perforated pavement systems have emerged as a topic of considerable interest in recent years. The main objectives of perforated pavement systems are to increase groundwater recharge, reduce surface runoff, treat Storm water and prevent pollution of receiving water bodies through surface runoff. Typically, perforated pavement systems enable storm water to infiltrate through the pavement surface, into the filter layer and eventually releasing it as flow either through pipeline or surrounding soils.

Moreover, perforated pavement systems have large hydraulic conductivity rates except when residue has accrued on the pavement surface Furthermore, various types of substances such as dust particles, rubber from tires and other particles from surrounding environment have a major effect on urban runoff waste. Traditionally, perforated pavements are used for light duty pavement due to insufficient structural loading and geotechnical design considerations. Perforated pavement systems are useful for light vehicles and pedestrian as well as storm water treatment, infiltration, storage and distribution.

With rapid industrialization and population growth, large amounts of land are being used in infrastructures such as roads, footpaths and parking lots in both urban and rural areas. It is now imperative to design and manage these developments in an integrated way so that this can reduce runoff, as well as pollutants that are transported during storms. Urban runoff is one of the main causes of pollution and hence stormwater management is an increasing priority worldwide.

Urbanization of the landscape has an appreciable negative impact on the quantity and quality of runoff water entering our lakes and streams. By replacing natural land covers (like grasslands and forests) with impervious surfaces (like parking lots and streets), we lose the water retaining role of the soil and vegetation. Increased runoff from impervious surfaces causes dangerous floods, severe erosion damage to our stream channels, diminished recharge of groundwater, and degraded habitat for our fisheries. These same impervious surfaces can transport the many pollutants deposited in urban areas, such as nutrients, sediment, bacteria, pesticides, and chloride. In the worst cases, the amount of pollutants in urban runoff are high enough to prevent us from being able to swim or fish in our local waters.

Efforts to reduce the impacts of urban runoff have been happening for some time at federal, state, and local levels. which identify performance standards and limits for things like peak flow, runoff volume, phosphorus, and total suspended solids. As part of their permit, each city must prepare a management plan to meet these prescribed limits by implementing best management practices (BMPs). BMPs are practices, treatments, and technologies that can alleviate one or more if these negative effects. Permeable pavement is one of these BMPs that is believed to improve water quality and reduce the impacts of urban runoff.

For permeable pavement to function effectively, there are many components that must perform and work well. These components include the physical and structural stability of surface pavement, the ability to handle traffic speed and loads, the ability to store stormwater within the aggregate beneath the pavement surface, the ability of the subgrade soil to infiltrate water, and the absence of clogging to ensure water infiltration and continuous functionality.

RESEARCH MOTIVATIONS

- The Development of standard structural design procedures: there is a need to develop a universal thickness design method for perforated concrete similar to the other pavement materials such as asphalt concrete or traditional conventional concrete. This will not only help in understanding the material behavior but help in the implementation of pervious concrete in different parts of the world.

- Life cycle costs: the initial and maintenance costs of peforated pavements over a long- term period needs to be collected and published in order to appreciate the benefits of pervious concrete pavements, and make recommendations for implementation.

II. LETERATURE SURVEY

JAMES, W .AND VON LANGSDORFF [1]. Studied the relationship, between infiltration capacity and the age of a permeable concrete paver installation for various land uses and maintenance practices .Appropriately designed interlocking concrete block pavers may reduce the amount of pollutants reaching receiving waters, by allowing water to infiltrate into the subsurface layers .

MEYSAM KAMALI A, MADJID DELKASH B. [2]. Studied the construction of permeable pavement PP)in sidewalks of urban areas is an alternative low impact development (LID)to control storm water runoff volume and consequently decrease the discharge of pollutants in receiving water bodies.

EBAN Z .BEAN; WILLIAM F .HUNT; AND DAVID [3]. Studied the surface infiltration rates of 40 permeable pavement sites were tested in North Carolina, Maryland, Virginia, and Delaware Two surface infiltration tests pre and post maintenance were performed on 15 concrete grid paver lots filled with sand .Maintenance was simulated by removing the top layer of residual material 13–19 mm..The median site surface infiltration rate increased from 4.9 cm /h for existing conditions to 8.6 cm /h after simulated maintenance.

MIKLAS SCHOLZ,PIOTR GRABOWIECKI [4]. Studied the wide-range but diffuse literature on predominantly permeable pavement systems(PPS), highlight current trends in research and industry, and to recommend future areas of research and development .The development of PPS as an integral part of sustainable drainage systems is reviewed in the context of traditional and modern urban drainage .Particular emphasis is given to detailed design, maintenance and water quality control aspect .

MD .AMINUR RAHMAN, PHD STUDENT, DR MONZUR A .IMTEAZ, SENIOR LECTURER, ARUL ARULRAJAH, [5]. Studiedthat Permeable pavements are increasingly being used as urban storm water management systems .Permeable pavement systems enable storm water to infiltrate through the pavement surface and into the filter layer.

III. RESEARCH GAP

The review of literature available shows that, the location of permeable pavements and maintenances of permeable pavements were critical to maintaining high surface infiltration rates. But for high volume roads, the high strength perforated pavements needs to be developed with reduced abrasion/raveling. This material if developed can certainly reduce the overall side effects of those caused by traditional pavements and can be used in various classes of roads, including, highways.

Objective

- To solve traffic jam problems due to water logging on roads
- To increase the quantity of water retained on site and penetrate into aquifers thus promoting healthy water levels which sustain our steams and drinking water.
- Eliminating the high cost of underground piping systems.
- Preventing pollutants from reaching watercourses which frequently occur with regular storm water systems during heavy rainfall events.

METHODOLOGY

This section presents the methodology of the research. It consists of four sections; the first section presents the literature review. The second one represents methods and materials of pavement. In the third section procedure of model making is shown. the fourth section presents performance of tests and the last section explains numerical validation.

- Literature review
- Materials

- Model making
- Performance of tests.

Literature Review

This section presents us the study of almost 10 research papers based on previous researches on perforated pavements which includes evaluation of pavements, detailed study of materials, performance and use of this concept.

Materials

In the materials and methods section types of perforated pavements, various materials used, detailed study of design of the pavement is discussed and the American standards are taken into account which provides the standards required for the construction.

Model Making

In this section a step wise description of construction of pavement right from preparing the module to the placing of pavement blocks has been discussed.

Performance of Tests

This is the major part of methodology which discuss the performance of aggregates and pavements with using various tests, In this section actual working of pavement is going to be tested and the results are found out.

IV. TEST PROGRAMME DESCRIPTION

Infiltration Rate of pervious concrete

This test method covers the determination of the field water infiltration rate of pervious concrete. Tests performed at the same location across a span of years may be used to detect a reduction of infiltration rate of the pervious concrete, thereby identifying the need for remediation. The infiltration rate obtained by this method is valid only for localized area of the pavement where the test is conducted. To determine the infiltration rate of the entire pervious pavement multiple locations must be texted and the results averaged.

The field infiltration rate is typically established by the design engineer of record and is a function of the design precipitation event. This method does not measure influence on in- place infiltration rate due to sealing of voids near the bottom of the pervious concrete slab. Visual inspection of concrete cores is the best approach for determining sealing of voids near the bottom of the pervious concrete slab.

1) Apparatus:

- Infiltration ring – A cylindrical ring, open at both ends have a diameter of 300±10 mm, with minimum height of 50mm. The bottom edge of the ring shall be even.
- Balance-scale accurate to 10g
- Container-a cylindrical container typically made of plastic having a volume of at least 20L.
- Stop Watch- accurate to 0.1 s.
- Plumbers Putty
- Water-Potable Water

2) Procedure:

- Infiltration Ring Installation-Clean the pavement surface by only brooming off trash, debris, and other non-seated material. Apply plumbers putty around the bottom edge of the ring and place the ring onto the pervious concrete surface being tested. Press the putty into the surface and around the bottom edge of the ring to create a watertight seal. Place additional putty as needed.
- Prewetting- Pour water into the ring at a rate sufficient to maintain a head between the two marked lines. Use a total of 3.60±0.05 kg of water. Begin timing as soon as the water impacts the pervious concrete surface. Stop timing when free water is no longer present on the pervious surface. Record the amount of relaxed time to the nearest 0.1 seconds.
- Test- The test shall be started within 2 minutes after the completion of prewetting If the elapsed time in the prewetting stage less than 30 seconds, then use a total of 18.00±0.05 kgs of water. If the elapsed time in the prewetting stage is greater than or equal to 30 seconds, then use a total of 3.60kgs of water. Record the weight of water to the nearest 10g.Pore the water into the ring at a rate sufficient to maintain a head between the two marked lines and until the measured amount of water has been used. Begin time as soon as the water impacts the pervious concrete surface. Stop timing when free water is no longer present on the pervious surface. Record the testing duration (t) to the nearest 0.1s.
- If a test is repeated at the same location, the repeat test does not require prewetting if conducted within 5 minutes after completion of the first test.If more than one test is conducted at a location on a given day, the infiltration rate at that location on that day shall be calculated as the average of the two tests. Do not repeat the test more than twice at the same location on a given day.

Cost and Benefit Analysis of Permeable Pavements in Water Sustainability

UC Davis at one point was ranked #1 in Sierra Club's magazine 2012 Cool Schools Survey for its sustainable practices in transportation, waste management, and green purchasing. This magazine ranks schools based on their environmental achievements and goals. UC Davis' West Village was praised by the magazine for being the largest planned zero net energy community. Its wide variety of eco-friendly public transportation methods give students more options to travel while reducing their ecological footprint. In their cafeterias', UC Davis buys organic and sustainably grown vegetables and manages an extensive recycling and composting program. The university is also a leader in green innovations with the creation of a bio digesting machine, hybrid racing car, and improvements in lighting technology. Since then UC Davis has fallen in ranking to an embarrassing #55 in 2014. We believe that through the use of permeable pavement, a practice of ranked #5 campus, Stanford University, we will be able to increase our water sustainability ratings and thus our ranking as well. Permeable pavement is a practice of paving which allows stormwater to infiltrate into the ground instead of becoming runoff water. This method allows the recharge of underground water storage basins which will eventually be absorbed by the soil. Other benefits include reduced flooding, removal of pollutants, diminished deicing.

CONCULSION

- As we know pervious concrete does not have sand therefore its compressive strength is less as compared to conventional concrete.
- The range of water cement ratio 0.26 -0.45 will provide the best aggregate coating and paste stability.
- If w/c ratio is more workability is less
- If w/c ratio is less adhesion of cement and aggregate is less and dry.
- If the void content is more, then the percolation rate will be high but the compressive strength will be low.
- If the void content is less, then the percolation rate will be low and compressive strength will be high.

From the table.no.5.4 we can see that pervious pavement is more economical and cheap

REFERENCES

1. JAMES, WILLIAM AND HARALD VON LANGSDORFF. Towards Restoring Infiltration in Permeable Pavers—Initial Demonstration of Rapid Clean-Out Concepts. Journal of Water Management Modeling 25:C405. https://doi.org/10.14796/JWMM.C405 © CHI 2016. www.chijournal.org ISSN 2292-6062.
2. MEYSAM KAMALI A, MADJID DELKASH B,'The influence of paving-block shape on the infiltration capacity of permeable paving', uly 2007Land Contamination & Reclamation 15(3):335-344
3. EBAN Z .BEAN; WILLIAM F .HUNT; AND DAVID A ,' STUDY ON THE SURFACE INFILTRATION RATE OF PERMEABLE PAVEMENTS' Prepared for: Interlocking Concrete Pavement Institute 1444 I Street, NW - Suite 700 Washington, DC 20005
4. MIKLAS SCHOLZ,PIOTR GRABOWIECKI Review of Permeable Pavement Systems,' November 2007 Building and Environment 42(11):3830-3836
5. MD .AMINUR RAHMAN, PHD STUDENT, DR MONZUR A .IMTEAZ, SENIOR LECTURER, ARUL ARULRAJAH,' Recycled construction and demolition materials in permeable pavement systems: geotechnical and hydraulic characteristics 0959-6526/© 2014 Elsevier Ltd.
6. C.F .YONG, D.T .MCCARTHY, A .DELETIC, 'Predicting physical clogging of porous and permeable pavements' Journal of Hydrology, Volume 481, 25 February 2013, Pages 48-55.
7. BENJAMIN O .BRATTEBO, DEREK B .BOOTH , Long-term stormwater quantity and quality performance of permeable pavement systems, Water Res. 2003 Nov;37(18):4369-76. doi: 10.1016/S0043-1354(03)00410-X.
8. SANSALONE, J., KUANG, X. & RANIERI, V. (2008) Permeable Pavement as a Hydraulic and Filtration Interface for Urban Drainage. Journal of Irrigation and Drainage Engineering. 134. (5), pp. 666–674.
9. M.I..RODRÍGUEZ-ROJAS A, F .HUERTAS FERNANDEZ A, B .MORENO B, G .MARTÍNEZ B, A.L . GRINDLAY , ' The use of urban drainage systems in sustainable cities," WIT Transactions on Ecology and The Environment, Vol 210, © 2016 WIT Press, www.witpress.com, ISSN 1743-3541 (on-line)
10. Bear, J., Dynamics of Fluids in Porous Media, American Elsevier Publishing Company, NY, 1972.
11. Majersky, Gregory. "Filtration of Polluted Waters by Pervious Concrete". Liquid Asset Development. Retrieved 3 October 2012
12. Collins, Kelly A. Hunt, William F. Hathaway, Jon M. "Hydrologic and Water Quality Comparison of Four Types of Permeable Pavement and Standard Asphalt in Eastern North Carolina." (2007). Permeable Interlocking Pavement Institute. Web. Accessed May 13,2015.

.