Journal of Advances and Scholarly Researches in Allied Education
Vol. XV, Issue No. 2, (Special Issue) April-2018, ISSN 2230-7540

Pervious Concrete Paver Blocks

Sandesh S. Raut[1]* Abhijit Warudkar[2]

[1] PG Scholar, Department of Civil Engineering, Imperial College Of Engineering and Research, Wagholi, Pune, Maharashtra, India

[2] Assistant Professor, Department of Civil Engineering, Imperial College Of Engineering and Research, Wagholi, Pune, Maharashtra, India

Abstract –Abstract – Pervious concrete, which is also known as Porous Concrete, Permeable Concrete, Gap-Graded Concrete, No-Fines Concrete, Enhanced-Porosity Concrete etc is nowadays gaining more popularity in storm water management. Pervious concrete paving blocks are permeable blocks that provide runoff control while serving as the wearing course for low-traffic volume roads, parking lots, walk/bike pathways and other applications like residential roads, alleys and driveways, shoulders & medians, under overpasses & bridges. Application of pervious concrete includes mainly groundwater purifier, heat reducer and sound absorber.This paper is an intended preliminary study on the characteristics and application of Pervious Concrete Paver Blocks.

Key words: Pervious, Porosity, Storm Water, Runoff Control, Groundwater Purifier

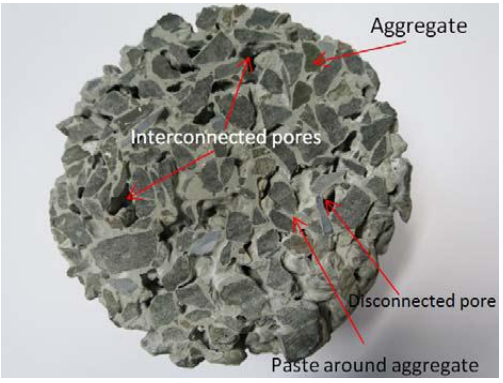
----------X----------

INTRODUCTION

Pervious concrete is a concrete which has same composition as that of conventional concrete which consists of cement, sand, aggregate and water but partially or completely omitting fine aggregates. The recent concern for environmental and sustainable development, promotes the utilization of porous concrete .The use of pervious concrete can address these issues of environmental and sustainable development .The porous concrete paver blocks(PCPB), despite having low strength and high permeability ,have a very wide range of applications like permeable pavement, groundwater purifier, heat a reducer and sound absorber. Pervious concrete paver blocks can widely be used for storm water management and has been successfully used for filtering the groundwater and reducing the pollutants entering the natural water streams rivers and ponds. Use of pervious concrete paver blocks on a large scale can also help in increasing the ground water table over a period of time. Use of pervious concrete has cost advantages over the use of conventional concrete also.

CONCEPT

When rain falls on the surface of impermeable concrete, much of it will flow off into storm drains, creeks, rivers, and low areas without getting purified which will increase the volume of water entering the storm drains/drainage system and will also contaminate the water in the streams or river.With the use of pervious concrete paving blocks, this water is captured and contained. This contained water percolates into the ground and is used to recharge the ground water and also provides a natural filtration.Thus the use of pervious concrete paver blocks mitigates surface pollutants.It is not an oil-based pavement material, it reduces first flush pollutants like oil, other automotive fluids and various chemicals. The use of pervious concrete paver block treats pollutants naturally by not allowing contaminated water to percolate into the ground and let the soil chemistry & biology treat the percolated water naturally.



The Figure represents an example of PCPB cross-sectional area. It is a combination of good quality aggregate covered with adequate cementitious paste that leads to the formation of

interconnected and disconnected pores. A balance between interconnected and disconnected pores will lead to PCPB with adequate permeability and reasonable strength.

MIX DESIGN

In order to make the concrete drain the water, it should have voids .This can be achieved by taking out most, if not all, of the fine aggregate. The design approach of PCPB is mainly based on proper selection of narrowly graded coarse aggregate. The aggregate size can range from 3/8 in(0.9 cm) to 3/4 in(1.9 cm) .If the aggregates are too coarse then the texture of concrete will be too open, if aggregates are too fine then there will be less voids in the porous concrete blocks. Thus narrowly graded coarse aggregate should be used for maximum number of voids. The optimum water content that should be used in PCPB depends mainly on the gradation and physical characteristics of aggregate as well as the cementitious materials type and content.

The typical w/c ratio that can be utilized is 0.27 to 0.40. The workability is assumed to be satisfactory. Generally, the aggregate-cement ratios (A/C) are in the range of 4 to 6 by mass. These A/C ratios lead to aggregate contents between 1300 kg/m3 to 1800 kg/m3. Higher A/C ratios have been used in laboratory studies, but with significant reduction in strength. Since there is cementitious material in the mix, we can use chemical admixtures. Admixtures have become a very important part of pervious concrete. The following types of admixtures can be used in the mix-

– Retarder or Hydration Controlling Admixture

– Water-Reducing Admixture or Mid-Range

– Viscosity Modifying Admixture

– Air-entraining admixture

KEY PROPERTIES

The key physical properties typically used to characterize pervious concrete are unit weight, compressive strength, permeability, air voids, and porosity.

Unit Weight:

Unit weight, which describes the density of fresh pervious concrete, is a good indicator of its mechanical and hydrological properties and offers the best routine test for monitoring the quality of pervious concrete. Depending on the mixture, the materials used, and the compaction levels and procedures, the unit weight of fresh pervious concrete is commonly between 1680 to 1920 kg/m3.

Compressive Strength:

The compressive strength of the pervious concrete increases with increase in age and as the aggregate/cement ratio reduces. Also, the compressive strength of the 3/8'' aggregate is greater than that of 3/4" for the same age and aggregate/cement ratios Pervious concrete mixtures can have compressive strengths ranging from 3.5 MPa to 28 MPa. The typical pervious concrete compressive strength is approximately 2500 psi (17 MPa) (Tan et al. 2003). Zouaghi et al. (2000) showed that the compressive strength of a mix is linearly proportional to unit weight but inversely proportional to void ratio.

Permeability:

The permeability of pervious concrete is a measure of the water flow through the pore spaces or fractures in the previous concrete. The permeability of pervious concrete is determined using the falling head permeability test and is estimated based on Darcy's Law. Permeability is an important parameter used in the hydrological design of pervious concrete. Typical permeability values range from (120 L/m2/min or 0.2 cm/s) to (700 L/m2/min or 1.2 cm/s) (Montes and Haselbach 2006).

Air Voids:

The average pore sizes of pervious concrete typically range from 2 mm to 8 mm. The void ratio ranges from 15% to 35% by volume.

Porosity:

The porosity of pervious concrete is a function of the concrete materials, their proportions, and the compaction procedures. The typical porosity of pervious concrete ranges from 15% to 30%. Porosity affects the properties of pervious concrete, including compressive strength, flexural strength, permeability, and storage capacity, and is regarded as an important parameter in many design calculations (Montes et al. 2005). Porosity can be measured using the water displacement method proposed by Montes et al. (2005).

ADVANTAGES:

There are wide ranges of advantages of PCPB. Some of them are:

Environmental - reduced storm water runoff, recharge groundwater, efficient land use by reducing the need for retention ponds.

Economic - the management effort made in preventing excess, Runoff during heavy rainfall is prevented, Reduces cost to maintain large detention ponds.

Safety - increased safety for drivers, improves driving in wet weather conditions, reduces nighttime glare and lessens the risk of hydroplaning.

LEED Credit - American rating agency to evaluate the environmental performance of a building. Gain in credit with the help of storm water design, water efficient landscaping, recycled content, regional materials.[10]

Cost Advantages-

-Reduces Storm water utility fees

-It eliminates the need for detention ponds, retention ponds & other costly storm water management practices

- Provides for more efficient use of land

CONCLUSION:

This paper reviewed the different characteristics, applications and advantages of previous concrete paver blocks. This paper concludes with scope of research on PCPB like on the advanced structural behavior, thermal behaviour on field, fatigue and life cycle analysis of PCPB.[4] Indeed, research in these directions will help promoting the wider use of PCPB in different applications.

REFERENCES:

A Review Paper On Permeable Concrete As A Road Pavement Satish Kumar, Dr. Devinder Sharma, Er. Neeraj Kumar.S

Analysis of pervious concrete properties Rama Mahalingam, Shanthi Vaithiyalingam Mahalingam

Design of Porous Pavements Shivam Gupta

Improving pervious concrete pavements for achieving more sustainable urban roads Alessandra Bonicellia, Gilberto Marinez Arguelles, Luis Guillermo Fuentes Pumarejo

Monitoring in situ performance of pervious concrete in British Columbia - A pilot study Rishi Gupta

Pervious Concrete Darrell F Elliot, FACI Buzzi Unicem USA

Pervious Concrete Physical Characteristics And Effectiveness In Stormwater Pollution Reduction Say Kee Ong, Kejin Wang, Yifeng Ling, and Guyu Shi

Pervious Concrete: Mix Design, Properties and ApplicationsMohammed Sonebia, Mohamed Bassuonib, Ammar Yahiac

Quality evaluation tests for pervious concrete pavements' placement Milena Rangelov, Somayeh Nassiri, Zhao Chen, Mark Russell, and Jeffery Uhlmeyer

Studies on Characterization of Pervious Concrete for Pavement Applications M.Uma Maguesvaria, and V.L. Narasimhab

Corresponding Author

Sandesh S. Raut*

PG Scholar, Department of Civil Engineering, Imperial College of Engineering and Research, Wagholi, Pune, Maharashtra, India