

Permeable Pavements: A Review

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Abstract

Permeable pavement is a distinctive type of pavement that permit rainwater to pass through into the groundwater. The importance of permeable pavement is to reduce water logging, runoff and improve the quality of water. Permeable pavement surface can be built using porous asphalt and pervious concrete, paving stones and interlocking pavers. This study demonstrated that permeable pavement system is changing the way of human development with natural environment. Its application in highway, road shoulder, parking area and airport runway etc; results improvement in terms of water quality and quantity. The purpose of this paper is to review existing research on permeable pavements and to highlight contemporary sustainable development trends in research and construction industry.

Keywords: Permeable Pavement, Concrete, Pervious, Runoff, Waterlogging.

Introduction

Pavement is a lifelong surface material sited down on an area planned to resist vehicular foot traffic such as a road or passageway. Normally two types of pavement based on design respect i.e. flexible pavements and rigid pavements are used. These are impermeable pavements. The main problem with impermeable pavement is its water-resistant surface which generate drainage or water logging problem. Permeable pavements are the solution of these problems. Porous material are used at surfaces of permeable pavement so that water can pass between the voids

Permeable Pavement System:-

Types of permeable pavement and application.

Following are the some common types of permeable pavements -

Permeable asphalt pavements and macadam pavements is linked to conventional asphalt pavement but is comparatively porous. Permeable asphalt pavement contains three component concentrated on a penetrable subgrade.

- . Surface layer.
- . Filter layer.
- . Reservoir layer.

Surface layer is the uppermost layer and consist of a 5 cm – 10 cm (2”-4”) thick porous or open graded asphalt mix. This mix is also known as an open graded friction course (OGF).

The filter layer is provided beneath the surface layer and its thickness varies from 5 cm -7 cm (2”-3”) depth. It consists of open graded crushed aggregate (can be treated with asphalt or not).

The reservoir layer is provided under the filter layer and lies between 5 cm -7 cm (2”-3”) depth.

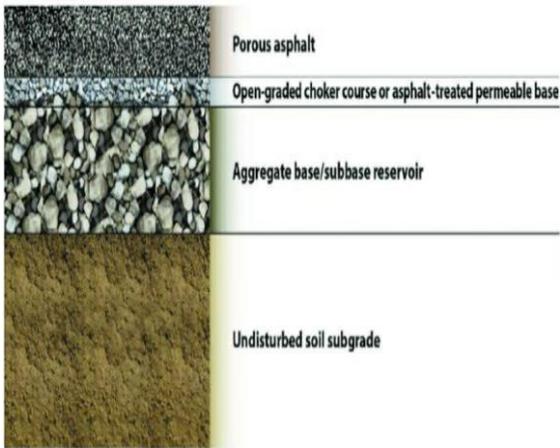


Fig:-1 Permeable asphalt pavement

(Source Google)

Permeable concrete pavement consist of following constituents

- .Surface layer
- .Choke layer
- .Open graded base layer Reservoirs
- .Open graded sub-base reservoirs

Surface layer consist of Portland cement, open graded coarse aggregate range from 4"-8" depending on the expected traffic load. Choke surface is a permeable layer 1"-2" thick and consists of small sized open graded aggregate.

Open graded base reservoirs has 3"-4" thick crushed stone aggregate layer. The size of the stones used in open sub base reservoirs layer are bigger than the stone used in the base layer. Water get deposited in the voids between the stones. This layer may be required in pedestrian or residential drive way application.

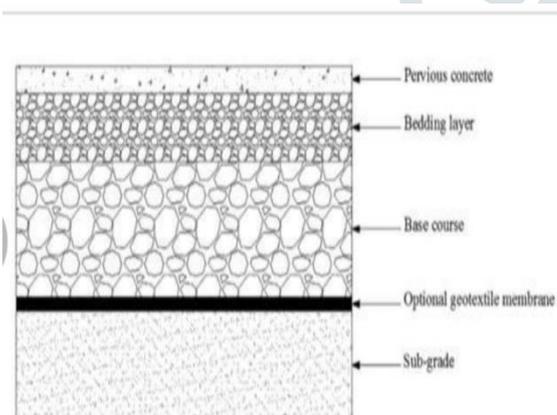


Fig:-2 Permeable concrete pavement

(Source Google)

Interlocking concrete paver block are made of especially porous concrete.

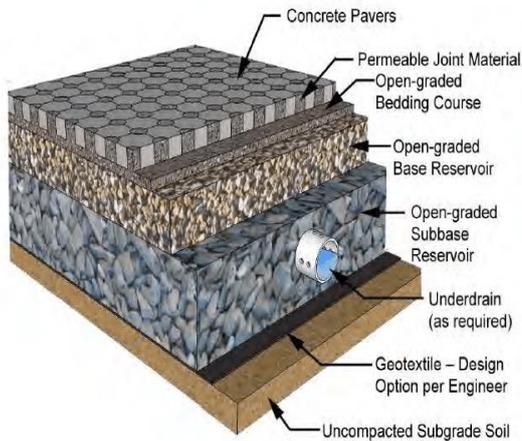


Fig:-3 Interlocking concrete paver block

(Source Google)

Some major application of permeable pavement are:-

- . The runoff can filter into ground, it reduce the waterlogging and recharge groundwater.
- . Permeable pavement reduce the noise of vehicle by absorbing it.
- . It have holes that can cumulate heat so these pavement adjust the temperature of the earth's surface, and can eliminate the hot island phenomenon in cities or urban areas.
- . During rainy days, permeable pavement has no splash on the surface.
- . It helps to decrease surface runoff coefficient and flood peak flow.

Permeable asphalt and concrete pavement are more liable to clogging. Due to clogging of voids porosity and water filtration capability of permeable pavement get reduced. Once these voids are fully clogged, these system have to be removed subsequently.

Literature Review

AASHTO(American Association of State Highway and Transportation Officials)1993-provide the guidelines for design and rehabilitation of both rigid and flexible pavement .

John T. Kevern, et al explained behaviour of pervious concrete system. The maximum difference between the pavement and the conventional pavement occurred during the moderate condition the permeable concrete pavement experience more cooling and heating rate than traditional concrete pavement.

H.M.Imaran ,et al said that asphalt permeable pavement is very efficient in removing organic carbon and metal form of storm water but less effective in reducing nitrogen and ammonia.

Saddeh shadi , et al carried out a laboratory and field test series on design of permeable (asphalt , concrete) pavement. They use the mechanistic- empirical design approach by UCPRC at CSULB. They observed that both test section (asphalt ,concrete) performed well in terms of distress.

R. ramakumar and N. Moorthy observed the need of permeable pavement to solve traffic problem in urban area due to the waterlogging or to reduce the in balance in ecosystem.

Beeldens A et.al stated that a special design is used in order to ensure the combination of the water storage capacity and bearing capacity of permeable pavement and these parameter are assigned to base and sub base layer respectively. They concluded that for different types of foundations various thickness to be adopted . Thickness of permeable pavement depend on various loading conditions.

Benjamin O.et.al determined the performance of our permeable pavement system with respect to infiltration, durability and water quality after 6 years of daily use. In result they concluded that all four permeable pavement system gave no indication of wear. Rainwater fully infiltrated through permeable pavement system with practically no runoff. For all permeable pavement system zinc and copper concentration was below the toxic level.

E.Z.Bean et al studied how does the permeable pavement related to the infiltration on them .There is an increase in the pollution because of the asphalt surface which take runoff water . To avoid this and to reduce runoff permeable pavement should be installed to allow water to pass from the surface and act as a filter . Vacuum sweeper should be used once in a year to maintain CGP sites filled with sand . Voids should be improved by removing 1.3 cm layer of material.

Conclusion:-

The outcome of this paper will provide a useful information about the permeable pavement its types, needs and its present applications. This paper describes about the various studies literature conducted on permeable pavement . Permeable pavements are the best solution for problem of increased waterlogging and decreed stream water quantity.

It can eliminate the hot island phenomenon in cities or urban areas.

It reduce storm runoff, recharge ground water and absorb noise.

It eliminates the need for detention ponds and costly water management system.

Permeable pavements get clogged after three or four years of construction due to the sedimentation of fine particle into the voids in surface, base and sub-base layers. More research work is required to overcome its disadvantage such as clogging under certain circumstances.

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