

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

Permeable Pavement: A Solution for Storm Water Run-Off

Jeroosha Julius D¹, Sharath C.E¹, Sumaiya Fathima¹, Prasanna N.G, Smt. Bandhavya G.B ², Smt.Swathi D.P³

U.G. Students, Department of Civil Engineering, NDRK Institute of Technology, Kandali, Hassan-Karnataka, India¹

Assistant Professor, Department of Civil Engineering, NDRK Institute of Technology, Hassan-Karnataka, India²

Assistant Professor, Department of Civil Engineering, NDRK Institute of Technology, Hassan-Karnataka, India³

ABSTRACT: Managing runoff in urban areas offers many challenges for engineers, landscape architects, and planners. As cities grow, the amount of impermeable surfaces-those that do not allow water to infiltrate into the ground-increases. Examples of impervious surfaces are asphalt roads, concrete sidewalks, parking lots, building roofs, and areas of highly compacted soils such as in subdivisions. If not properly managed, the storm water runoff produced by these impermeable surfaces can have negative effects on nearby surface waters. When waters from storm events do not infiltrate the soil, the storm water management system, consisting of storm water structures and pipes, quickly directs them to streams, rivers, and lakes. Such increases in storm water runoff can have detrimental effects on nearby lands and receiving streams resulting in flooding, increased peak flows, groundwater or stream base flow reductions, increased stream velocities and stream bank erosion, increased water temperatures, and reduced water quality. Storm water must be managed in such a way as to prevent or minimize these negative impacts from urban growth

KEYWORDS: Permeable Pavement, Stormwater Runoff, Geotextiles, Permeable Interlocking Concrete Pavers.

I. INTRODUCTION

Permeable pavements are alternative paving surfaces that allow storm water runoff to filter through voids into an underlying stone reservoir. It has emerged as a widely used technology for on-site storm water control. It allows storm water to both infiltrate into an underground storage basin or exfiltrate to the soil and **ultimately recharge the ground water**. While permeable pavements can withstand truck loads when referred to previous experimental studies, permeable pavement has not been proven in areas exposed to high repetitions of trucks or in high speed areas. The rest of the pavement structure consists of aggregate layers with numerous large interconnected air-voids that can store water and allow it to flow through them. The most commonly used permeable pavement solutions are pervious concrete, porous asphalt, and permeable interlocking concrete pavers. The type of pavers used in this study is **permeable interlocking concrete pavers**. In this study permeable pavement is designed to capture some or part of the rainfall and runoff from storms, and conveying water to conventional storm water drainage systems. The use of filtered water from the pavement drains for agriculture productions is one of the alternate ways for irrigation.

II. OBJECTIVES

The study was conducted in which the pavement helps in,

1. Ground water recharge
2. Reduce heat island effect
3. Reduce stormwater runoff
4. Recreating natural hydrologic condition

International Journal of Innovative Research in Science, Engineering and Technology

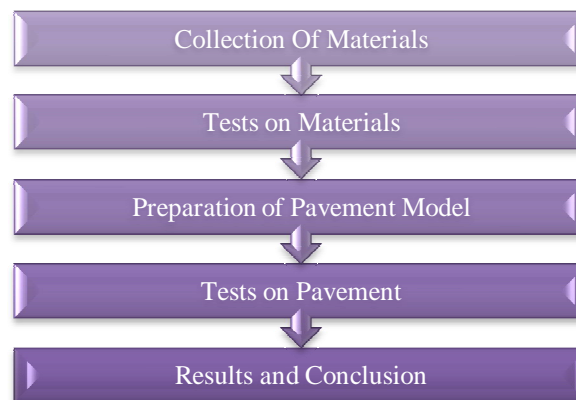
(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

III. METHODOLOGY

The process carried out by following steps



The materials used in this working model was the materials which were locally available in that locality. This was the methodology used in the preparation of the working model.

MATERIALS USED:

- 1.Coarse aggregates of different sizes
- 2.Fine aggregate
- 3.Pavement bricks
- 4.Perforated PVC pipe

TESTS CONDUCTED:

1. Sieve analysis for soil in order to find the grain distribution and type of soil
2. Aggregate crushing strength
3. Double ring infiltrometer test for soil and permeable pavement

PROCEDURE FOLLOWED IN IMPLEMENTATION OF THE PAVEMENT IN COLLEGE CAMPUS:

STEP 1: SITE INVESTIGATION AND SELECTION

In order to implement the permeable pavement it is said that the granular soil is a best type of soil type which has more strength as a sub grade material and also has voids which allow water to penetrate through it at the same time. From the previous studies it is known that the slope of the existing soil layer should not be more than 0.5%. The flat area with the slope less than 0.5% was inspected and selected for the installation of pavement working model in the college campus.

STEP 2: DIMENSIONS AND MARKING

From the previous experimental studies of working model and also reference from the journal papers, the dimensions were selected by considering the structural design and it was marked for the same. The selected site was marked according to the dimensions i.e., length = 1.5m and breadth = 2m

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

STEP 3: EXCAVATION AND SUB GRADE PREPARATION

Most storm water agency guidelines for permeable pavement construction recommend that the sub grade not be compacted in order to help promote water infiltration. While this benefits water infiltration, an uncompacted sub grade tends to consolidate when saturated under vehicular loading, causing settlement and possible rutting of the pavement surface. The design may need to balance infiltration against compaction by conducting laboratory Proctor density tests, and then compacting the in-situ sub grade in test areas followed by infiltration tests. This approach establishes a relationship between soil sub grade density and infiltration, and indirectly the strength of the soil sub grade to sustain traffic loads when saturated. In addition, sub grade preparation should be completed during dry weather conditions. Placement of the open- graded aggregate base and sub base should be completed as close in time as possible to minimize risk of sedimentation of the permeable pavement system. The site was excavated up to a depth of 45cm deep. The sub grade was again filled by soil of depth 2 cm and compacted.

STEP 4: PREPARATION OF SUB BASE LAYER AND ARRANGEMENT OF DRAIN PIPE

Compaction of the open-graded aggregate is required for all applications. This provides a stable platform for the placement of the surface course, structural capacity for traffic support and prevention of settlement. Drain pipe is installed in a trench along the lowest point of the permeable pavement sub grade. The pipes are surrounded with open-graded aggregate offering protection during construction. The pipes should be perforated, polyvinyl chloride (PVC). The aggregate of size 40mm was placed on the sub grade layer, later the perforated PVC pipe of diameter 40mm was placed on the aggregate layer and again a layer of about 15cm thick was filled on the pipe of the same size of aggregate.

STEP 5: LAYING OF BASE LAYER AND GEOTEXTILE

Sub base layer is also called as reservoir layer. The selected aggregates were crushed aggregate materials which maximize structural capacity and porosity for water storage. Geotextiles are typically composed of polyvinyl chloride, ethylene propylene diene monomers or high density polyethylene. They may be used to vertically separate the open-graded base from adjacent pavements and building structures. In other cases, they may enclose the sides and bottom to create a no infiltration design for water storage and flow control. For the base layer a thickness of 8cm of aggregate size 20mm and above was filled in the reservoir layer. A thin layer of geotextile was laid on the sub base and the joint material was placed and compacted lightly.

STEP 5: LAYING OF CONCRETE PAVERS AND JOINT MATERIAL

The perforated concrete blocks of thickness 60 mm was laid on the top and it was filled with the joint material in between for the percolation of the rain water and penetration of the storm water runoff.



CONCRETE PAVERS



COMPLETED PAVEMENT

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

IV. EXPERIMENTAL RESULTS

The standard field test generally used to measure infiltration soils uses a double-ring infiltrometer (ASTM D3385-09). The double-Ring Infiltrometer Test (DRIT) methodology involves driving two rings (a 600mm diameter outer ring, and a 300 mm inner ring) a certain depth into the soil. Two rings are used to prevent or minimise lateral movement of water during the test. Water is then added to the rings at an appropriate flow rate in order to maintain a constant head in both rings over the duration of the test. The volume of water added over time is then used to calculate the infiltration of the soil and also on the permeable pavement when conducted on the same. The infiltration rate of the permeable pavement was **6 ltr/sec** and the surface infiltration rate of the soil was **0.5 ltr/sec**.

V. CONCLUSIONS

The runoff from the storm water when reaches the water body it will pollute the surface water of the fresh water body. By providing this type of pavement the runoff will infiltrate into the pavement and water gets filtrated. The filtered water with proper drain system will reach the water body with least amount of pollutants in it. The infiltration rate is high in permeable pavement compared to the soil and also other flexible and rigid pavements. Through this study we can conclude that this type of system can be adopted in the urbanisation and development of pavement system. It is a futuristic concept of urbanisation with can be improved to implement in highways by conducting experiments and by improving the strength and substituting other materials and also other technology that is by improving the maintenance technique and also improving the geotextile type. The study was successful which covered all the contents discussed above and this technology of pavement can be upgraded with future technology

REFERENCES

- [1] Review Of Permeable Pavement Systems By Miklas Scholz, Institute For Infrastructure And Environment, Scotland, Uk, Building And Environment(2007).
- [2] Field Survey Of Permeable Pavement Surface Infiltration Rates: By Eban Z Bean, J.Irrig. Drain Eng.2007.133:249-255.
- [3] Simulation Of The Storm Water Volume Control Performance Of Permeable Systems: By Shouhong Zhang, J.Hydrol.Eng 2015.
- [4] Permeable Pavements: New Technique For Construction Of Road Pavements In India By A. M. Admure
- [5] Experimental Results On Permeable Pavements In Urban Areas: A Synthetic Review By Mariana Marchioni
- [6] S.Deepika, K. Lalithanjali, M. R. Ponmalar, B. Vinushitha and T. Manju , (2015)"Influence of Recycled Aggregate based Pervious Concrete with Fly ash." In International Journal of Chem Tech Research.
- [7] Kolluru Hemanth Kumar , "Review Paper on Permeable Pavement Systems."
- [8] H. M. Imran, Shatirah Akib and Mohamed Rehan Karim , (2013) "Permeable Pavement and Stormwater Management System : A Review." In Environmental Technology, 2013.