# REVIEW PAPER ON GROUND WATER RECHARGE THROUGH PERMEABLE ROAD

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**Abstract** : The main aim of the topic to choose for a research has been highlight and introduce the new technique and the importance of conservation of water, storing the water beneath the surface. The various papers we studied on the permeable road pavement and experimental study papers on the porous asphalt pavement. To find out the behaviour of pavement and there percolation or infiltration of rain water or surface water and runoff. The paper we studied covers the work of our project which is carried out by professors and students. The paper mentioned in review paper is accomplish the conclusion and their results to our project work. The main fuction or objective of this review paper to elaborate the research work done by the different authors and different publication to make it useful and time saving task for further research work. The literature paper gives the ideas and some extraordinary techniques. The paper also looks various maintainance work which is carried occurring in the roads is there utility period.

**1. Introduction** : The most valuable commodity on the earth is water. The water is a life of living things on the earth, without water we cannot survive. The growth of population is increasing day by day, and the demands of the portable water is also increase. This population led to shortage of water today therefore we need to save the water. Recharging groundwater and techniques to prevent shortage of water. Rain pours into the cities may causes the runoff, leads the wastage of rainwater. There are many ways to avoid the ground water and use of this water by recharge the ground water table. Since the most of the cities are covered with the road, therefore we thought the allowance of water by penetrating the road pavement surfaces.

The currently the trends of road is bituminous roads and concrete roads. The roads have to achieve pavement durability and to increase the infiltration rate. The design should be modified could enhanced the purpose of the roads, it could be help to conserve the rainwater and runoff water through street. There are numbers of experiments and researcher model study the infiltration effect on permeable concrete and bituminous roads an theire performance on low traffic area. The pavement have the property to clean the water in term of physical, biological, chemical factors. The pavement have various different layers of soil and sub-soil grade.

**2. Literature Review:-**

1. Peter T Weiss, Masoud Kayhanian, John S. Gulliver & Lev Khazanovich (2017), "Permeable Pavement in Northern North American urban areas: research review and knowledge gaps" International Journal of Pavement Engineering. DoI: 10.1080/10298436.2017.

This paper describes how the concept of permeable pavements have evolved over the past two decades and major research that occurred in the areas of usage of such roads in parking lots and commercial areas of low speed and light traffic zones. The various methods of design of permeable pavements like considering its hydrologic design & storage requirements have been discussed. Information regarding mix design, material properties and hydrological performance of those used in the pavement and their impact on performance of the pavement have been discussed. Geo textiles have been used and it has been discussed that concrete paver clogged at this layer. Clogging of voids has been discussed with recommendations of carrying out frequent maintenance works. After the evaluation on water quality, it was found that the infiltrated water had chemical, biological and metallic impurities. According to this paper, the infiltration capacity of the permeable pavement top layer decreases over time and the use of geo textiles limit the filtration rates. However, the pavement can improve the quality of runoff water by filtration of solid impurities also discusses the unresolved issues regarding methodology to measure sub grade infiltration, pavement characteristics & reduction of contaminants.

2. Akihiro Moriyoshi, Toshiro Jin, Takaaki Nakai, Hiroshi Ishikawa (2012), "Evaluation method for porous asphalt pavement in service for fourteen years" Construction and Building Materials- Elsevier pp. 190-195.

This paper describes the evaluation methods on porous asphalt in Kyoto Jukan expressway in Japan which was examined using photographic evidence on pavement surface. This paper describes the results of evaluation methods using crack distribution, aggregate movements using 35mm camera and water permeability test to obtain longer life span of porous asphalt in Kyoto Jukan expressway. Field permeability was also performed to determine the clogging of porous asphalt due to aggregate movement. This movement was measured by tensile strain or deformation of aggregate during wheel tracking test in laboratory namely, conventional type and Hokkaido type. It was concluded that in 3D crack analysis, photography measured by camera and water permeability tests are useful; to evaluate the degree of damage of porous asphalt. The tensile strain of porous asphalt under wheel tracking test was caused by the movement of aggregate and caused longitudinal cracks but not according to Kytoto specifications. The durability of porous asphalt was found to depend upon mixture composition and binder properties. It highlighted that re crust stone was useful to maintain the durability of porous asphalt.

3. Terry Lucke and Simon Beecham (2011), "Field investigation of clogging in a permeable pavement system" Construction and Building Materials- Elsevier pp. 603-615.

This paper tells that the permeable pavement is commonly used for commercial and industrial building to minimize the environmental impact on it. The permeable interlocking concrete pavement PICP is very effective for filtering and retaining sediments for storm water runoff. In this paper the problems discussed are that the pavements are not restricted to water related issues. Normally we are using the pavement for the roads which are to be designed for the use of vehicular traffic consisting of sub grade, one or more layers of base course are to be compacted and surface seal. The paper shows the urban storm water runoff contains significant concentration of suspended and colloidal pollutant. In this paper, research study is perception that permeable pavement that are used as a source control devices, and designed to infiltrate runoff. The result of this experimental study is to quantify the sediment accumulation process that occurred in different layers of PICP for the service over eight years. The overall performance of PICP system was satisfactory after eight years of continuous service.

4. Jannathul Thasni, Jouhar Shareef, Krishnapriya P.P, Ramees K, Sameer M, Shamiya Fazil P. (2018), "Water absorbing pavements by using Porous Concrete" International Research Journal of Engineering & Technology vol.05 issue: 05 ISSN: 2395-0072.

This paper discusses the overall importance of adopting a permeable pavement of both rigid and flexible in nature and how they are effective in recharging the groundwater by allowing the surface water to penetrate through its interconnected voids into the base layers underneath. It also explains the concept of no fines concrete, which consists of 15-35% of larger voids than conventional concrete pavement. The papers includes review papers of previous publications and how the same can be constructed using conventional materials i.e. aggregates, cement, admixtures…etc. Also discussed are the methodology adopted to design a permeable concrete, the advantages over conventional pavements, its impact on environment, disadvantages and the regular or periodic maintenance carried out to maintain the pavement's utility period. After thorough study it was concluded that the porous concrete allows percolation of water through it. The aggregates less than 20mm shall only be used. A Certain amount of fly ash can also be used as enhances, which also is a good way of utilizing a waste product. However, higher percentages of fly ash could ruin the entire pavement course.

5. C.F. Yong, D.T. McCarthy, A. Deletic (2012), "Predicting physical clogging of porous and permeable pavements" Journal of Hydrology 481-Elsevier pp. 48-55.

This paper talks about the clogging of the voids, created in a permeable pavement structure which affects or reduces the rate of filtration of surface water. An initiative was taken by the authors to understand the main physical processes that govern the clogging of these pores over its time of service. The same was understood though a black box model. This consisted of a monolithic porous asphalt, a hydrapave (clay & concrete) and permapave (a product of enviss™
Australia). The porous asphalt consisted of a 75mm top layer of standard bituminous asphalt with crushed aggregates giving about 40% voids. The hydrapave consists of 80mm, laid on a 50mm clean stone course without use of sand. The permapave consists of 50mm thick paver of 10-12mm gravel, bound using polyethylene based glue, placed over a 350mm sub base. After the experimentation, it was found that porous asphalt had clogging on its surface, causing quick water ponding. The hydrapave had clogging just above the geo textile layer which is beneath the surface course whereas the permapave did not show any visible signs of clogging. The paper also stated that the model only addressed the physical clogging and suggested that the clogging caused due to biological processes could be depicted to identify the overall clogging cause.

6. Bin Yu, Liya Jiao, Fujian Ni & Jun Yang (2015), "Long term field performance of porous asphalt pavement in China" Road Materials and Pavement Design, 16:1, 214-226, DoI: 10.1080/14680629.2014.944205.

This paper takes a look at case studies of porous asphalt pavements in USA, Europe and Japan and its effect of quicker drainage compare to conventional bituminous pavements. Porous asphalt pavements are a part of flexible pavements which consists of an open graded friction course. This paper covers the complete design carried out by the authors considering various factors like site suitability, traffic volume, climatic conditions, skid resistance etc. The pavement was then tested for its rutting performance, roughness and most important of them all, its permeability or the infiltration of water through the pavement layers. After carrying out the experiment over five years of use, it was found that the pavement was effective in reducing the noise levels. The permeability initially increased and then decreased after 15 months of use. The drainage was found 900ml/15sec after 5 years. The skid resistance was found to be satisfactory and under the limits. Effective noise reduction was also observed.

**3.Maintenance and Repairs :**

Any work under civil engineering can only be a success if the design is accompanied by regular maintenance and repair works. Similarly, the roads also are required to undergo regular maintenance in order to work efficiently and this becomes absolute necessary as roads are constantly hit by wear and tear and also are acted upon by weather conditions. The various defects caused are

Wearing of surface layer

Potholes

Clogging of voids

**3.1. Following are the maintenance works to be carried out –**

1. **Routine maintenance**: Activities under this are to be carried out throughout the year irrespective of the road condition and include
   Cleaning and sweeping
   Maintenance of curb, shoulder and sub grade
   Rectification of corrugations
   Cleaning of drains and clearing of chocked culverts
2. **Periodic maintenance**: Is to be carried out periodically as the defects arise. It is the preventive measure to be taken against any defect to get worse and is also called as preventive maintenance and includes
   - Surface dressing
   - Improving drains by clearing the voids
   - Pothole filling
   - Major patch repairs
   - Remaking after major failure
   - Clearing mess after landslides or storms

## 3. Advantages:-

Permeable pavements allow quick percolation of water through its layers.
They are effective in removing and filtering out the surface impurities like sand, silt, dried leaves of plants, plastic wrappers…etc.
Pavement drainage layers are found to be effective in removing heavy metal impurities like zinc and copper.
Prevent water logging on the roads and streets.
Suitable to be used for parking lots, basements, residential driveways and colony streets.

## 4. Scope of future work:-

The permeable pavements, despite having several above stated advantages, come with few major drawbacks related to the life span and maintenance costs. This is due to the impact of water that ultimately hampers the pavement layers with use and time. To make a durable pavement in accordance with provision of surface water percolation, an impervious, strong and durable pavement surface can be provided, giving a designed slope towards the shoulders such that the surface water drains or runs off towards the end of road. An arrangement like canal provision or provision of pervious layers can be provided beside the run of road such that the runoff water is then allowed to percolate in to the ground.

## 6. Reference:


1. Peter T Weiss, Masoud Kayhanian, John S. Gulliver & Lev Khazanovich (2017), "Permeable Pavement in Northern North American urban areas: research review and knowledge gaps" International Journal of Pavement Engineering. DoI: 10.1080/10298436.2017.
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3. Terry Lucke and Simon Beecham (2011), "Field investigation of clogging in a permeable pavement system" Construction and Building Materials- Elsevier pp. 603-615.
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