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CONSTRUCTION AND PERFORMANCE OF POROUS ASPHALT PAVEMENT FOR RAINWATER HARVESTING

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ABSTRACT – Porous asphalt pavements allow for land development plans that are more thoughtful, harmonious with natural processes, and sustainable. They conserve water, reduce runoff, promote infiltration which cleanses stormwater, replenish aquifers, and protect streams. Rainwater & storm water Harvesting being an essential need of the future, it can be achieved not only through roofs but also through concrete and asphalt roads. The research has focused on improving quality and quantity of ground water. Study investigates performance of aggregates and porous asphalt used in projects, such as properties of aggregates like impact value, crushing value, specific gravity, abrasion test. Tests performance on porous asphalt includes ductility test, fire point test and penetration test. This paper summarizes the construction and performance of porous asphalt pavements. It includes comparison study of porous asphalt pavement and convectional asphalt pavement.

***Key Words*:** Porous asphalt, recharge ground water, aquifers

1.INTRODUCTION

Porous asphalt pavements allow more careful, natural-process-friendly, and long- lasting land development plans. They preserve water, decrease runoff, facilitate infiltration to clean storm water, replenish aquifers, and protect streams. Having appropriate design as well as construction, porous asphalt pavement of porous asphalt shall provide an economic and environmentally friendly approach to storm water management.

Porous asphalt pavements, unlike traditional pavements, are usually constructed over an uncompact sub-grade in order to optimize soil infiltration. Ageotextile fabric is above the un-compacted sub-grade which prevents fines from migrating from the sub-grade to the reservoir of stone which is made up of evenly graded dirt free crushed stone having 40% of void that act as a structural stratum and a temporary storage area for water as it infiltrates into the soil underneath it. The stabilizing course, also known as the choker course, is a slender coat of uncontaminated, minor, small crushed stones that is often put over the top to stabilize paving surface.

2. LITERATURE REVIEW

1 .Properties of porous asphalt pavement

An open graded surface covers an underlying stone recharge bed in a traditional porous pavement. The water seeps through the soil after flowing all the way through the porous structure and into the aggregate stratum. If toxins were on the soil during the flood, the water carries them across the stone bed. They then penetrate through the sub-base, where they are acted to natural water purification processes. Porous asphalt pavement operates in parking lots, low-traffic highways, and sidewalks in this way. It was designed to have a porous top 75 mm layer of asphalt. Rainwater is able to flow freely and without ponding. The water is then deposited underneath it in a 225 mm thickness open-graded aggregate surface bedding.

(Cahill et al. 2004)

2. Strength & effectiveness of porous asphalt pavement

The porous asphalt structure's waterproof and cohesive layer is crucial. It islocated between the top layer of porous asphalt and the middle layer. It is made up of asphalt or asphalt and gravel that have been pre-coated. It serves two key purposes: The first

consideration is water-tightness. Porous asphalt drains water from the surface as a surface layer, so a waterproof and cohesive layer can separate the water from the middle layer. Water will erode the middle layer and other pavement structures if this does not happen. At the same time, the waterproof and cohesive layer's ability to ensure bond strength is a vital feature.

The results of the outdoor experiment show that the right mix of join materials will produce excellent results. Furthermore, it can serve as a realistic guide for the potential application of a waterproof and cohesive layer with SBS changed asphalt. (Jiang X., 2017)

3.Artificial recharge methods

The method of restoring water to an aquifer by human effort is known as artificial recharge. Artificial aquifer recharge's key goal is to conserve water for later usage while also enhancing water quality. (Kavuri and colleagues, 2011)

Groundwater replenishment by artificial aquifer recharge is critical in India'sdry and semi-dry areas. These methods have long been employed in developed continents, but they have only recently gained popularity in developing countries like India. (A. Bhattacharya, 2010)

4.Benefits of recharging to aquifers

Porous permeable pavements have comparable performance to other asphalt pavements. They can also be built for a variety of conditions, much like other asphalt pavements. These are usually applied in construction work of parking lots, side-walks, roadside path-ways, roadside shoulders, road drains, permeable sub base under traditional bituminous or concrete pavements and low volume roads are all popular uses for Porous Asphalt Pavements. (Chavan-Patil & Chokakkar, 2018)

3. METHODOLOGY

There are certain main factors unique to the project must be taken in to account while considering the feasibility of project. These can be classified such as

1) primary, 2) secondary and 3) other constraints which may be considered as per their importance in feasibility and economic consideration.

Primary determinations should be considered for the most weight because oftheir importance in carrying the project in forward direction. As secondary and other considerations are beneficial with prioritizing between sites and informing design.

The following are some common construction procedures for porous pavement:

- Install the porous pavement considering late in the construction process.
- To prevent soil compaction, excavate the subgrade soil with machinery that has oversized tyres or tracks.
- Place the aggregate stone recharge bed carefully to avoid damaging the fabric. The aggregate should be poured in 8 to 12 inch layers around the edge of the bed and using a light roller or vibratory plate compactor, a single pass of tracked equipment compacted the material.When using a stabiliser course, it`s important to make sure the aggregate is the right size to interlock with the recharge bed aggregate. The stabiliser course should be approximately 1 inch thick.
- The porous asphalt should be laid in 1- to 4-inch-thick lifts, as directed by state or national open-graded asphalt mix construction guidelines. (It's best to use track pavers.)
- A 10-ton static roller can be used to compress the porous asphalt in two to four passes. After final rolling, restrict traffic for at least 24 hour

TESTING OF MATERIAL

1.Testing of bitumen

1.1 Penetration value

1.2 Ductility test

1.3 Flash and fire point test

1.4 Softening point Test

2.Testing of Aggregate

2.1 Crushing value test
2.2 Impact value test
2.3 Abrasion value test

Properties of asphalt binder (60/70 grade)

Sr. no.	properties	Results
1	Penetration at 25°C	62
2	Softening point (°C)	48
3	Ductility (cm)	>100
4	Density (kg/m3)	1030

Values of trap metal

Sr. no.	Test properties	Results
1	Impact value	21.6%
2	Crushing value	19.1%
3	Abrasion value	23.2%
4	Flakiness index	19.4%

General Comparison Between Porous Asphalt & Convectional Asphalt

Porous Asphalt	Convectional Asphalt
Allows Infiltration of water to the lower course	Prevent Water Infiltration of water to the lower course
Less durable because it require additional regular maintenance to make sure the pores do not get clogged	High durability asphalt when implemented property and require less maintenance
Higher binder content	Lesser binder content
Can carry a moderate traffic load	Can carry high traffic load
Can be implemented in heavy rainfall region regardless of traffic loading	Can be use in any construction projects under any loading condition
Reduction of water spray of urban roads	High water sprays on the roads
Prevent the pollution by removing surface runoff	Removing the surface runoff by proper cross slope to sewer pipe which may get clogged

4. CONCLUSION

1. Unlike conventional pavements, porous asphalt pavements are typically built over an un- compacted sub-grade to maximize infiltration through the soil.

2.Pervious paving systems are paved surfaces that contain less storm water runoff than conventionally paved surfaces.

3.The efficient way of recharge of ground water is to convert the operation of unlined irrigation systems to take care of extra monsoon rainfall.

4.Porous asphalt surfacing is a new technique of road construction which permits get water into asphalt mixes.

5.Rainwater harvesting serves many purposes, including providing available water to customers during a drought, recharging groundwater, and minimizing runoff and water logging during rainy seasons

6.The results reveal that the holding of bitumen is connected with mixed binder material such as lime substance at lesser concentration of bitumen. The relationship deviates from the linear line when binder content approaches 4.5 percent, but the volume of preserved binder increases until it reaches 5.5 percent binder content, after which it declines.

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