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DESIGN OF PERVIOUS PAVEMENT FOR THE LIGHT LOAD BEARING PARKING

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ABSTRACT

Multi-storied commercial and residential buildings, which significantly increase the demand for water supply, are increasingly being constructed in urban India. In many states of India such as Bihar, Delhi, Gujarat, Haryana, Madhya Pradesh, Punjab, Rajasthan and Tamilnadu, the ground water is plunging at an alarming rate. Responsible town planners, architects and civil engineers must be proactive and integrate rainwater harvesting techniques in the design of all types of buildings, parking lots and low-trafficked roads/streets. For example, Public Works Department (Buildings and Roads) engineers can integrate government buildings with porous asphalt parking lot. This would recharge the ground water in over-exploited/critical areas of India. The revolutionary technology presented in this paper addresses that very need. The porous asphalt pavement which can be used for parking lot or low-traffic roads/streets works. The top 75 mm asphalt layer is specially designed to make it porous. Rainwater goes through it rapidly without any ponding. The water is then stored in an underlying open-graded stone bed, which is about 225 mm thick. From there, water percolates slowly into the underlying soil. The porous parking lot or street can be integrated with a roof rainwater harvesting system in the buildings adjacent to it by diverting the roof water to the stone bed.

KEYWORDS: Asphalt, Porous Pavement, Parking lot, Road surface, Pervious coating

INTRODUCTION

Porous asphalt pavements offer developers and planners a new tool in their toolbox for managing storm water. These pavements allow water to drain through the pavement surface into a stone recharge bed and infiltrate into the soils below the pavement. Such pavements have been proving their worth since the mid-1970s, and recent changes in storm water regulations have prompted many consulting engineers and public works officials to seek information about them. With the proper design and installation, porous asphalt can provide cost-effective, attractive pavements with a life span of more than twenty years and at the same time provide storm-water management systems that promote infiltration, improve water quality, and many times eliminate the need for detention basin. The performance of porous asphalt pavements is similar to that of other asphalt pavements. And, like other asphalt pavements, they can be designed for many situations.

Common applications of Porous Asphalt Pavements are parking lots, side-walks, pathways, shoulders, drains, noise barriers, friction course for highway pavements, permeable sub base under the conventional flexible or rigid pavements and low volume roads. In addition, porous asphalt can also be used as an application for tennis courts, patios, slope stabilization, swimming pool decks, green house floors, zoo areas etc.,

The Economic Benefits includes:- reduction in storm water runoff, including reduction of temperature, total water volume, and flow rate, increase in groundwater infiltration and recharge, provides local flood control, improves the quality of local surface waterways, reduces soil erosion, reduces the need for traditional storm water infrastructure, which may reduce the overall project cost, increases traction when wet, reduces splash-up in trafficked areas, extends the life of paved area in cold climates due to less cracking and buckling from the freeze-thaw cycle, reduces the need for salt and sand use during the winter, due to little or no black ice, requires less snow-ploughing, reduces groundwater pollution, creates green space (grass groundcover, shade from tree canopies, etc.), offers evaporative cooling.

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Porous asphalt pavements are generally not used solely for pavements for high traffic and heavy wheel loads.

Selection of Materials

❖ **Selection of Aggregate**

The first step in the selection of the materials that are suitable for its design. It mainly includes the selection of aggregates. The aggregates used for the surface course of the 'Porous Asphalt Pavement' should be crushed angular stone with maximum size not exceeding 19 mm with the aggregates passing 4.75 mm IS sieve not more than 10 percent and shall meet the requirements of Indian Standard Specifications (IS : 2386)

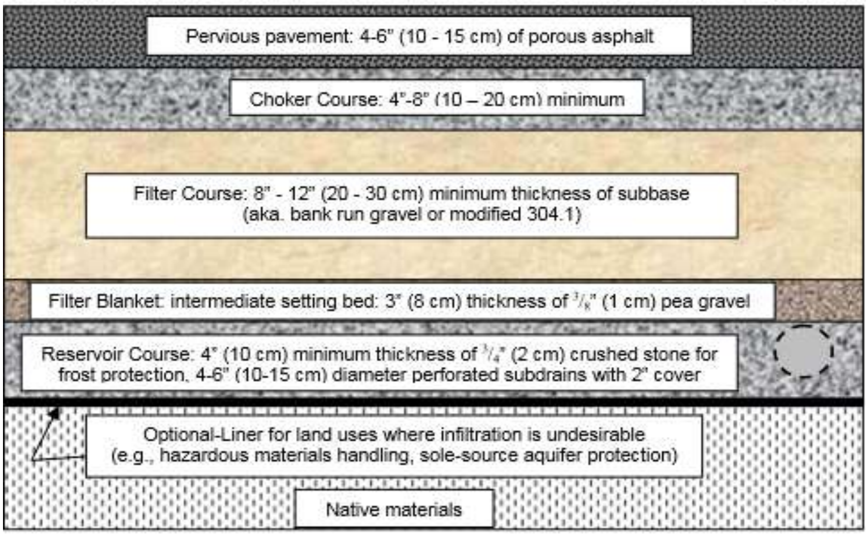
S.NO.	Sieve Size(mm)	Percentage Passing%
1.	19	100
2.	12.5	85-100
3.	9.5	55-75
4.	4.75	10-25
5.	2.36	5-10
6.	0.075	2-4

Table no 1

❖ **Selection of Binder**

Porous Asphalt Pavements demands the use of modified bitumen which may be either Polymer modified of Crumb Rubber modified. The selection of the binder shall be made in accordance with IRC: SP: 53 (First Revision), 2002 and shall confirm the specification requirements as under 'Polymer and Rubber Modified Bitumen – Specifications, IS: 15462 – 2004'.
Grade of Bitumen 70-80

❖ **Cross-sectional of Porous Pavement**



Cross-Section of Porous Pavement

Pervious Pavement

Different blending proportions of the three aggregates available at the asphalt batch plant were tried so that the combined aggregate met the desired range of gradation for porous asphalt. The following proportions met the requirement:
15 mm aggregate (60%);
10 mm aggregate (32%);
stone dust (8%)

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A trial batch of 1200 kg was made at the batch plant with 6 percent bitumen and 4 percent cubber rubber using 720 kg 15 mm aggregate; 384 kg of 10 mm aggregate; and 96 kg of stone dust. The mix temperature was 120 C (248 F). The sampled bituminous mix was analyzed for bitumen content and gradation by conducting extraction test. Both dry and washed gradations were determined

Choker Course

The stone choking layer is placed on the stone reservoir course so as to fill and level its open large surface voids and to make it stable and smooth for asphalt paver. It was placed in 50 mm (2 inches) thick layer and compacted well with an 8-ton steel wheel roller in static mode only until a smooth surface was obtained for paving above it. The gradation of this course was same as that of the stone filter course as given in Table. The finished, rolled surface was tested by pouring water over it; water disappeared instantly from its surface.

Stone reservoir course

The function of the stone reservoir course is to temporarily store rainwater which percolates slowly into the natural subgrade below. The actual gradation of the clean stone used in constructing this course is given in Table it met the recommended AASHTO 2 gradation. The total thickness of the stone reservoir course was 365 mm (14.4 inches). Being the first ever porous asphalt parking lot in India, it was designed very much on the safe side. It was laid and compacted in two lifts with an 8-ton steel wheel roller. Four roller passes were applied in static mode and there were no roller marks. Rolled stone reservoir course was tested for effectiveness by poring water over it from a bucket; water disappeared from the surface instantly.

Stone filter course

It was necessary to provide a stone filter course between the finished subgrade and the stone reservoir course so that fines from subgrade do not migrate upwards into the stone reservoir course thereby reducing its storage capacity. The thickness of the stone filter course was 75 mm (3 inches). The gradation of the aggregate actually used in this course is given in Table 1; it met the AASHTO 57 gradation. The filter course was compacted lightly with a 2-ton steel wheel roller to maintain its integrity and avoid compacting the natural subgrade.

Subgrade

The existing subgrade was tested for its average water infiltration capacity, which was determined to be 46.5 mm/hour (1.83 inches/hour) which is well above the minimum reasonable water infiltration rate of 12.5 mm/hour (0.5 inch/hour). After removing the garbage, excess soil was excavated to the required level and grade keeping about 150 mm (6 inches) soil to be excavated last. This was done to keep the final subgrade relatively un-compacted from the construction equipment.

Design of Permissible Asphalt Pavement

There are three considerations required when determining the thickness of the layers of porous pavements:

1. SITE CONSIDERATIONS: To ensure that the site is acceptable.

2. HYDROLOGICAL DESIGN: To ensure the porous pavement meets the potential storm water runoff demands.

3. STRUCTURAL DESIGN: To ensure that the porous pavement withstands the anticipated traffic loading.

Most often, the thickness of the stone recharge bed will be controlled by soil infiltration rates (site considerations) and water quantity (hydrological design) rather than structural requirements, while the porous asphalt surface layer will be determined by the traffic loads (structural design).

RESULTS

Aggregate Test Results

S NO	Properties of aggregate	Name of Test	Result
1.	Specific Gravity	Specific Gravity	2.54
2.	Toughness	Aggregate Impact Value	18%
3.	Strength	Aggregate Crushing Value	24%
4.	Hardness	Abrasion Value	32%
5.	Water Absorption	Water Absorption	0.30%

Table no 2

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Bitumen Test Results

S NO	Name of Test	Result
1.	Penetration Test	71.54
2.	Softening Point Test	52
3.	Ductility Test	105cm
4.	Flash Point	300°C
5.	Fire Point	320°C

Table no 3

Stability Test Results

Marshall Stability test

No. of Blows	Marshall Stability ,kg	Flow, mm
50	1213.6	4.60
60	1395	3.75
75	1607	2.36

Table no 4

CONCLUSION

In this paper, we go through the various test of the pervious pavement material like aggregate (such as crushing test, abrasion test, Crushing Strength test etc) and On bitumen (such as penetration test, softening point test, ductility test, flash and fire point test) the appropriate results of test are shown above for the pervious pavement for parking and this above results of various aggregate and bitumen combination sample of 1200 gm and tested by the Marshall Stability test for the pervious pavement for parking, The desire strength per achieved in stability (in kg) and flow value (in mm) as shown in the above stability test results which is appropriate strength for the pervious pavement for parking and The design can be used for the implantation of the Car parking and the drainage problem can be minimize using this pavement.

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