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# Sustainable Drainage System by Using Pervious Pavements and Its Applicability in Pune City

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***Abstract*-** **Permeable paving is a range of sustainable materials and techniques for permeable pavements with a base and sub base that allow the movement of storm water through the surface. In addition to reducing runoff, this effectively traps suspended solids and filters pollutants from the water. Examples include roads, paths that are subject to light vehicular traffic, such as car/parking lots, cycle paths, service or emergency access lanes, roads and residential sidewalks and driveways.**

**The goal is to control storm water at the source, reduce runoff and improve water quality by filtering pollutants in the substrata layers and increase subsurface water level.**

**Our project is based on design of permeable pavement by using pavement block techniques and pervious concrete. We have used pavement block by using crumb rubber which is a waste material and requires lots of space for its disposal at the same time the natural materials like aggregate and sand are saved because of waste rubber used in manufacturing of paving blocks whereas pervious concrete is made using Portland cement, fly ash and course aggregate. Thus the road which is designed is eco-friendly as it harvest's the water and solves the problem of disposal waste rubber at the same time preserves the quarries.**

**The study is based on a laboratory model which proves the working of paving system**

## I. INTRODUCTION

Pervious paving systems are paved areas that produce less storm water runoff than areas paved with conventional paving. This reduction is achieved primarily through the infiltration of a greater portion of there in falling on the area than would occur with conventional paving

Permeable pavements, an alternative to traditional impervious pavement, allow storm water to drain through them and into a stone reservoir where it is infiltrated into the underlying native soil or temporarily detained. They can be used for low traffic roads, parking lots, driveways, pedestrian plazas and walkways. Permeable pavement is ideal for sites with limited space for other surface storm water BMPs. The following permeable pavement types are illustrated.

Depending on the native soils and physical constraints, the system may be designed with no under drain for full infiltration, with an under drain for partial infiltration, or with an impermeable liner and under drain for a no infiltration or detention and filtration only practice. Permeable paving allows for filtration, storage, or infiltration of runoff, and can reduce or eliminate surface storm water flows compared to traditional impervious paving surfaces like concrete and asphalt.

The purpose of this study is to investigate the use of alternative porous pavement materials as well as to refine porous pavement design process. It is expected that the study will advance knowledge on porous pavement and make them more durable, economical, and environmentally friendly.

An optimal permeable pavement design is one that is just strong enough to handle design traffic load and speed while maintaining the necessary porosity to provide sufficient porosity and storm water management.

## II.LITERATURE REVIEW

Beeldens .A.(2006) Stated that To ensure the combination of the bearing capacity and the water storage of the pavement, a special design is applied where both parameters are assigned respectively to the base and the sub base layer. In her paper describes various thickness to be adopted under different foundations. She also determined the thickness based under different loading conditions.

Henderson V.(2011) States that The appropriate level of compaction is of key importance to obtaining the desired permeability and strength during construction of the pervious concrete pavement. However, the durability of its surface largely determines the operational life of the pavement. Surface durability is particularly critical in pervious pavements, as the rougher surface and open-graded structure can generate propitious conditions for the disaggregation of aggregate particles from the pavement surface, causing irregularities in its structure and uniformity. This problem, commonly known in pavements as raveling, occurs when high shear stresses are applied to the pavement, such as when a truck suddenly brakes or performs a sharp turn, fracturing the bonding between the aggregate and the paste.

John S. Gulliver (2015) states that case studies on permeable pavement applications in cold climates provided several lessons learned. Comparative, three-year asphalt and concrete permeable pavement studies performed at M. N. Road near St. Michael, Minnesota revealed a positive picture of porous asphalt and concrete pavements compared with conventional pavements, including resistance to loading, increased skid resistance, and an increase in snow and ice melting rates.'

Studies of Professor Jonathan Rosenbloom(2013) indicate, permeable pavement provides a long-term cost savings over comparable impervious pavement options. The current research indicates that the short-term, initial cost of permeable pavement may, in some cases, be more expensive than impervious pavement. However, that same research suggests that permeable pavement may last longer and has fewer costs associated with maintenance, inlets, pipes, and detention pools, resulting in an overall decrease in costs over the life of the pavement. Importantly, we were unable to find a study that factored in or considered cost savings stemming from a reduced flow of stormwater when using permeable pavement. If water flows through permeable pavement are accurate, local governments stand to save additional costs by reducing the volume of water entering the municipal stormwater system, potentially resulting in less maintenance and associated costs.'

The main objective of SiddharthTalsania's(2015) investigation is to increase the strength and permeability of pervious concrete and decrease the cost of pervious concrete by replacing cement with various industrial waste materials such as waste glass powder, hypo sludge, ceramic waste and rice husk ash. This paper describes the literature which is based on pervious concrete in which fly ash, silica fume and ground granulated blast furnace slag is partially replaced by cement in pervious concrete and various industrial waste such as waste glass powder, hypo sludge, ceramic waste, rice husk ash partially replaced by cement in concrete.

S.Deepika(2015) states that aggregate in concrete is a structural filler which accounts for non-porous and impervious behavior whereas pervious concrete is unique which uses a single size aggregate without fines and it would prove to be effective for growing environmental demands. It also captures rainwater and allows it to seep into the ground. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swell, and other costly storm water management devices. Generally, it has low strength and very good permeability. In this paper, partial replacement of recycled aggregate (RA) for making pervious concrete (PC) was studied. PC was prepared by partial replacement of cement with class F fly ash.

Interlocking Concrete Pavement Institute (ICPI)(2004) provides construction guidelines to design professionals and installers of interlocking concrete pavements. Several resources are available on this website that review the steps necessary for constructing interlocking concrete pavements.This pavement structure is commonly used for both pedestrian and vehicular applications. Pedestrian areas, driveways, and areas subject to limited vehicular use are paved with units 2 3/8 in. (60 mm) thick. Streets and industrial pavements should be paved with units at least 3 1/8 in. (80 mm) thick.Compaction of the soil subgrade and aggregate base materials are essential to the long-term performance of interlocking concrete pavements.Installation steps typically include job planning, layout, excavating and compacting the soil subgrade, applying geotextiles (optional), spreading and compacting the sub-base and/or base aggregates, constructing edge, restraints, placing and screeding the bedding sand, placing concrete pavers, compacting concrete pavers, sweeping in jointing sand and final compaction.

## III.OBJECTIVES OF PROPOSED WORK

The overall objective of this our project is to assess the storm water drainage efficiency by using pervious pavement system from impervious surface runoff. One bench-scale study (hydraulic study) determined the flow rates. Another bench-scale study (turbidity study) will examine the role of suspended particles in pollutant removal performance of this porous pavement. Results from the two bench-scale experiments will be used to refine the full-scale investigation.

Our project focuses on the hydraulic bench-scale study for Pune city.

The primary objectives of the ongoing hydraulic bench-scale study are to:

1. Determine the discharge volume of the system;
2. Determine the breakthrough time of the effluent discharging out of the system;

Secondary goals of this hydraulic study are to:

1. Determine the flow rate of storm water through the system;
2. Compare the total suspended solids (TSS) of the influent storm water with that of the effluent.

## V. MATERIALS USED

1. Crumb rubber pavers.
2. Course aggregate, Cement, Water for pervious concrete.
3. Transparent plastic box.
4. Perforated UPVC pipe.
5. Waste mosquito sheet used as geo-synthetic sheet.
6. Gravels.
7. Crushed stone aggregate.
8. Bucket (source of water).

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