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Storm Water Runoff By Using Permeable Pavement

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ABSTRACT: Permeable pavements require further research and field studies to refine design guidelines, assess long-term performance, and optimize maintenance practices. In order to refine the design guidelines, evaluate long-term performance, and optimize maintenance practices for permeable pavements, more research and field studies are needed. Permeable pavement is being investigated as a means of reducing stormwater runoff and minimizing environmental impacts. In addition, these pavements remove pollutants and sediments from the runoff, improving the quality of the water.

KEYWORDS: Permeable Pavement, Water Quality, Stormwater Runoff.

I. INTRODUCTION

Storm water runoff is collected, stored, treated, and reused as part of management practises for sustainable drainage management of runoff. For a range of urban, commercial, and industrial sectors, permeable pavement is an effective storm water runoff management solution. Sustainable practises for both energy and water are currently hot topics because climate change and global warming are major problems on a global scale. A permeable pavement's primary purpose is to collect, treat, and filter surface runoff in order to improve groundwater recharge. Due to their inadequate structural stress and geotechnical design constraints, permeable pavement systems (PPS) have traditionally been employed for light-duty pavement. PPS are a quick and easy technique to facilitate a stable pavement for both automotive and pedestrian use.

One of the greatest storm water management solutions is a permeable and porous pavement, which may collect water on the pavement surface and then allow it to penetrate into the subgrade layer and groundwater. Since conventional road paving is often impervious, it collects a lot of storm runoff water, which contains pollutants from traffic and related activities. A permeable pavement offers a better way to lessen the substantial amount of runoff from the pavement and the contaminants that are carried by it.

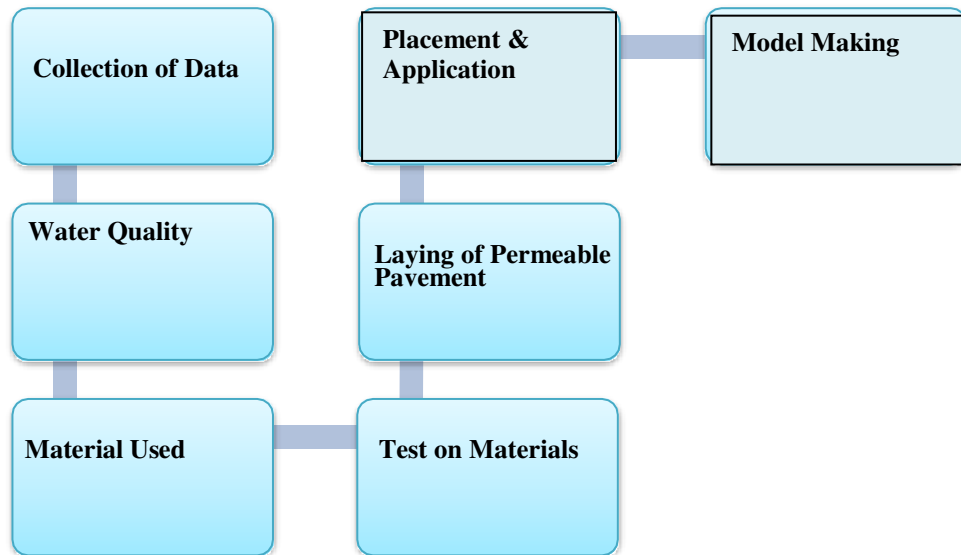
II. OBJECTIVE

- To reduce the heat effect and waste management costs associated with storm water runoff by analyzing storm water runoff.
- To create natural hydrological conditions and replenish ground water levels.
- To minimize the risk of flooding caused by surface water.

II. RELATEDWORK

The transition from grey to green infrastructure, or "urban surface evolution," is anticipated to result in an increase in the usage of permeable pavements. The urban heat island effect, runoff, noise from the roads, and water quality are all significantly reduced by these pavements. Permeable pavements are referred to as "cool pavements" by the United States Environmental Protection Agency (USEPA) because they may be used to reduce urban heat islands (Li, 2013). Up until recently, the majority of permeable pavement applications were concentrated on places with little traffic and/or vehicle traffic, like walkways, parking lots, and residential streets. But in the future, permeable pavement is predicted to become more prevalent due to improvements in pavement technology and more strict environmental laws.

III.METHODOLOGY



After choosing a topic for this study, a thorough literature review is conducted to learn about previous work that has been done in the same field of study. Following a review of the literature, the study's goals are chosen while taking into account the limitations of earlier research. For the use of recent work, a real-world case study is chosen. Data is gathered from the website with legal authorization. Following that, we gather a variety of material types, shapes, and sizes to prepare the project model. And as required by IS, we took the test on it. Norms After gathering all of the data and receiving good results, we made the decision to create a model framework. After deciding on the shape and size of the model structure, we first build the 2D cross section of the model in the AutoCAD software.

Conduct a comprehensive evaluation of the site to ascertain whether permeable pavement would be appropriate there. Take into account elements including soil type, groundwater table, slope, and current drainage patterns. Design planning: Create a design plan that details the permeable pavement system's layout and technical requirements based on the site evaluation. Consider the projected traffic loads, local laws, and the pavement's intended purpose (such as a road, parking lot, or pedestrian walkway). Surface preparation: Clean up the area by removing any plants, debris, or pavement that may be there. To guarantee appropriate drainage and get rid of any low spots or standing water, grade the surface. Install a permeable subbase layer, which is often made up of granular components like crushed stone or aggregate.

Material used :

- **Fine aggregate :**

The particles that stick to the 0.075 mm IS sieve after passing through the 4.75 mm IS sieve. Used when extremely compacted, smooth surfaces are desired. For our model work, we used fine aggregate of a 40mm dimension.

- **Coarse aggregate :**

It speaks of materials that are grainy and irregular. It is a filler material that permits water to pass through. For our model work, we used coarse aggregate in the sizes 80mm and 60mm.

- **Pipes made of polyvinyl chloride (PVC) :**

PVC (polyvinyl chloride) pipes are frequently used to make irrigation, water mains, and sewage pipes. They are affordable due to their lightweight, strength, durability, and ease of recycling. They also enable the passage of collected water. For our model work, 4 inch PVC pipe was employed.

- **Geotextile fabric :**

Between the subbase and base course or between the base course and PICPs, a layer of geotextile fabric may be positioned. This fabric serves as a separator, encouraging water filtration, preventing the mixing of various layers, and



limiting the migration of small particles into the deeper layers.

Test on materials

- **Abrasion Value Test :**

To ascertain how resistant aggregates are to wear, abrasion value tests are performed in laboratories. The Los Angeles Abrasion Test or L.A. Abrasion Test is another name for it. This test aids in determining the strength and calibre of construction-related aggregates such as crushed stone, gravel, and sand.

- **Impact Value Test :**

The Impact Value Test is a technique used to assess the toughness and durability of coarse aggregates, most commonly gravel or crushed stone. It gives a hint as to how impact resistance and fragmentation resistance of the aggregate are.

Name of Test	Standard value	Result
Abrasion Test	<60%	15.46%
Impact Value Test	<30%	12.6%

Laying of permeable pavement :

- **Sub grade :**

It is the soil layer beneath the pavement which carries the design load, receives infiltration water, and is prone to ground water infusion due to seasonal changes or upward capillary migration. Key elements in calculating the thickness of different pavement layers are homogeneity, permeability, and subgrade bearing capacity.

- **Sub base :**

The base layer is made up of a graded aggregate foundation that radiates the pavement load in a controlled manner to the sub-grade. A second layer of base material, known as a sub-base, which is likewise made of a layer of coarser-graded aggregate but is typically necessary for heavy-duty pavements or weak sub-grades. To provide lateral support and prevent uneven sub-grade loading, the aggregate base and sub-base both commonly extend beyond the pavement border.

- **Base course:**

An asphalt road, racing track or sports field's base course in permeable pavements is a layer of material. It is situated beneath the wearing course and, occasionally, an additional binder course-containing top layer. If a sub base course exists, the base course is built directly on top of it. Other than that, it is constructed immediately over the sub-grade. Base course thickness is typically determined by the characteristics of the underlying layer and ranges from 100 to 150 mm (4-6 in).

- **Surface course :**

A flexible pavement's surface course shields the base course beneath it from traffic and provides enough tyre friction to reduce noise in populated areas. Additionally, it provides adequate light reflection for driving at night. These surfaces are either given by a thin asphalt layer or a bituminous film overlaid with stone.



• Model of permeable pavement

• Placement and application :

1. For access and service roads, service lanes, and residential driveways Parking spaces
2. Pedestrian and bicycle paths
3. Slope stabilization and erosion control
4. Irrigation of land
5. Golf course parking and cart pathways
6. Tennis Court

V .RESULT

- Stormwater runoff is a serious environmental problem since it can result in flooding, erosive processes, and water body pollution. By allowing water to permeate through the surface and into the ground, permeable pavement is a type of pavement made to address these problems. Using permeable pavement models to manage stormwater runoff can offer a number of advantages, such as:
- Permeable pavement enables rainwater to seep into the ground, lowering the amount of stormwater runoff. By doing so, the strain on stormwater management systems can be lessened, and the chance of floods can be decreased.
- Water quality is improved because of natural filtration that takes place as it passes over permeable pavement, which can remove contaminants and debris. This enhances the water quality that eventually reaches groundwater

VI. CONCLUSION

- Stormwater Management: Permeable pavement enables rainwater to permeate through the pavement's top layer and into the soil beneath, reducing the amount and speed of stormwater runoff. This lessens the demand on the infrastructure for stormwater management and helps to minimise flooding.
- Groundwater Recharge: Permeable pavement encourages groundwater recharge by enabling water to seep into the ground. This is particularly significant in regions where groundwater resources are necessary for the supply of drinking water or the health of the ecosystem.
- Enhancement of Water Quality: Permeable pavement functions as a natural filter, capturing impurities and toxins in stormwater runoff. The pavement's porous design and filtering layers help to filter out sediment, oil, heavy metals, and other undesirable substances before they get into the groundwater beneath or the neighbouring bodies of water.
- Pavement that is permeable can help with reducing heat islands.
- Storm water management can be improved by the use of permeable pavements.



- It can only use for low volume traffic roads.

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