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Permeable Pavement Systems for effective Management of Strom water Quality and Quantity

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Abstract

Pervious concrete blocks, also known as permeable or porous concrete blocks, offer an innovative solution for sustainable urban development by allowing water to pass through their structure, reducing surface flowing water and promoting groundwater recharge. This project focuses on the design, development, and testing of pervious concrete blocks to secure their strength, permeability, and environmental benefits. The study involves selecting appropriate mix proportions of cement, coarse aggregates, and water, while minimizing or eliminating the use of fine aggregates to achieve the desired porosity. Various additives and admixtures, such as fly ash, silica fume, and superplasticizers, are explored to enhance the mechanical and durability properties of the blocks. Experimental tests, including compressive strength, permeability, porosity, and water absorption tests, are conducted to evaluate the performance of the developed blocks. The results are compared with conventional concrete blocks to highlight the advantages and limitations of pervious concrete in different applications. The project aims to contribute to sustainable construction practices by promoting the use of pervious concrete in pavements, sidewalks, and parking lots, reducing urban flooding and mitigating the urban heat island effect. The findings emphasize the potential of pervious concrete as an eco-friendly alternative for modern infrastructure development. Pervious concrete is a special type of concrete with high porosity that allows water to pass through, reducing surface runoff and promoting groundwater recharge. It is an environmentally friendly material used in sustainable construction, particularly in urban areas where storm water management is a major concern. This project aims to develop and analyze pervious concrete blocks for use in sidewalks.

INTRODUCTION

Previous concrete block is a special type block to having High porosity. Because of this, various strategies are being investigated by Engineers to protect and restore natural ecosystems in the world1. Storm water management has become a prime factor for cities and municipalities due to increased urbanization. The impervious nature of conventional pavement systems has resulted in

increased storm water runoff quantity that has stemmed in a large volume of first flush containing unacceptable level of pollutants and unwarranted flash floods.3-6 The impervious pavement acts as a heat storage media release the heat back into the atmosphere during night times. Because of which, Urban Heat Islands (UHI) has to lead to thermal discomfort which will increase the electricity bills and increase in CO2 emissions due to high usage of air conditioners.

To reduce the impact of urbanization, a lot of research is going on to use eco-friendly materials7-9 and adopted detention and retention basins to reduce runoff10. By considering all strategies, to reduce the effect of urbanization on groundwater and other environmental factors, the pervious concrete pavement is considered. By considering all strategies, to reduce the effect of urbanization on groundwater and other environmental factors, the pervious concrete pavement is considered as the best solution in structural, hydrological, economic point of view. such as USA and Japan since 1980's Pervious concrete is a mixture of Portland cement, water, coarse aggregate and in some cases, chemical admixtures. The absence of fine aggregate helps in increasing the voids and water.

AIM & OBJECTIVES

Aim: To Permeable Pavement Systems for effective Management of Stromwater Quality and Quantity.

Objective:

1. To study control pollutant found this surface runoff.
2. To study water absorbing roads allows any water that accumulates to drain through the surface and into the ground.
3. To study water absorption give an idea on the internal structure of aggregate.
4. To study permeable pavements may give urban trees the rooting space they need to grow to full size.
5. To study the concrete paste then coats the aggregates and allows water to pass through the gap between coarse aggregates.

RESEARCH WROK

Methodology:

By Using Volume Batching Method:- A Method of measuring concrete ingredients by volume instead of weight.

Material :-

Materials	Proportion
Cement (kg/m³)	374
Coarse aggregate (kg/m³)	1,660
w/c ratio (mass)	0.3
Cement/aggregate ratio (mass)	1:4.4

CASTING:- Pervious concrete is cast using a mixture of cement, water, coarse aggregate, and sometimes admixture.

Fig.1 CASTING

Cement: Portland cement or blended cements are the primary binder using 53 grade of cement. **Coarse aggregate**: Typically 9.5 mm to 12.5 mm in size Water: The water-to-cement ratio is usually between 0.28 and 0.40.

CURING:- The typical curing period is considered to be 7, 14, and 28 days.

7 days: At this point, the pervious concrete will have gained a substantial portion of its compressive strength.

14 days: Further strength development occurs, with the concrete reaching closer to its full potential strength.

28 days: Considered the standard curing period for most concrete types, including pervious concrete

Testing :-

The previous concrete block will test on using CTM (Compression Testing Machine) We are find out the strength of previous concrete block. On 7 Days ,14 Days ,28 Days.

Fig.2 Compression Testing

RESULTS

1. **7 Days Curing** as result to found that a concrete usually achieves around 65% in a pervious concrete block.
2. **14 Days Curing** as result to found that a concrete typically reaches about 90% in a pervious concrete block.
3. **28 Days Curing** as result to found that a concrete considered to have reaches it full or design strength, Typically around 99 % of its ultimate strength.

Cement (kg/m^3)	Aggregate	w/c	Compressive Strength (MPa)	Void Content (%)	Density (kg/m^3)
375	20-10 mm	0.30	8.30	32.44	2041.481
		0.35	8.44	28.59	2063.963
		0.40	8.89	25.33	2129.383
	10-6 mm	0.30	8.44	38.44	2088.889
		0.35	9.48	34.25	2077.037
		0.40	11.70	30.21	2147.16

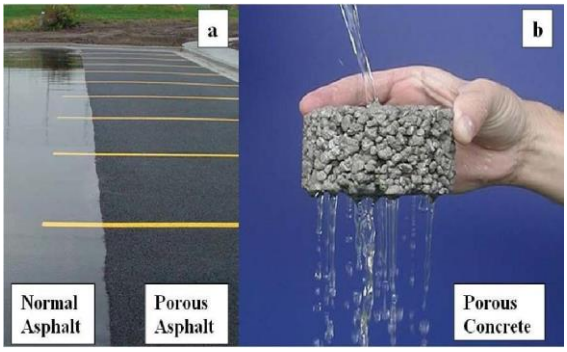

Fig.3 Percolation Pavement

CONCLUSION

1. Compressive strength of pervious concrete depends upon the porosity of concrete, binder material.
2. Using up to 30% Fly ash as a cement replacement has the same effect as using pure concrete for making pervious concrete block .
3. Using a 53 grade of cement to increasing a strength of the pervious concrete block .
4. Following terms plays a crucial role in the strength of pervious concrete:
   a. Size of coarse aggregate
   b. Water-cement ratio
   c. Aggregate to cement ratio.
5. The void ratio and unit weight are two important parameters of pervious concrete block in the context of mix design.

FUTURE SCOPE

1. Pervious concrete block reducing runoff and the replenishing groundwater.
2. Pervious concrete block helps to refilling groundwater reserves.
3. Pervious concrete block allows water to reach tree roots, promoting good health for tree growth in urban environments.
4. Pervious concrete block allows rainwater infiltrate through the pavement, reducing Stromwater runoff and maintain flooding.
5. Pervious concrete block is well – suited for pavement in area with light traffic, such as parking lots, w*alkway, residential streets, and low volume raods.*

Fig 3 . Previous concrete block

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