

Mechanical properties of Pervious concrete

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Abstract - Pervious Concrete is a special high porosity concrete used for flatwork applications that allows water from precipitation and other source to pass through there by reducing the runoff from a site and recharging ground water levels. Durability and water absorption are important properties of pervious concrete. It is made of using large aggregates with little no fine aggregates. It consists of cement, coarse aggregate and water with little fine aggregates. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and greenhouse. It is an important application for sustainable construction and is one of many low impact development techniques used by builders to protect water quality. Pervious concrete pavement is a unique and effective means to meet growing environmental demands. It is instrumental in recharging groundwater and in reducing stormwater runoff. Pervious concrete can be used for many numbers of applications, but its primary usage is in pavement industry.

Key-words - Pervious concrete, porosity, durability, Compressive strength etc.

Objectives - To determine compressive strength and permeability properties.

Introduction

Pervious Concrete is a special type of concrete in which no fine aggregates are used and gravel has been used in place of the coarse aggregate. Pervious Concrete is a homogeneous mixture of cement, aggregate / gravel and water. Pervious Concrete is also called as “no-fines” concrete. Concrete Durability is one of the most important considerations in the design of new structures and when assessing the condition of existing structures. Concrete construction is becoming increasingly complex and the importance of producing structures that are both cost effective and durable has never been higher. The main purpose of durability is about minimising the rate of deterioration. Pervious concrete has the same basic constituents as conventional concrete that is, 15% -30% of its volume consists of interconnected void network, which allows water to pass through the concrete. Pervious concrete can allow the passage of 3-5 gallons (0.014 - 0.023m³) of water per minute through its open cells for each square foot (0.0929m²) of surface area which is far greater than most rain occurrences. Apart from being used to eliminate or reduce the need for expensive retention ponds, developers and other private companies are also using it to free up valuable real estate for development, while still providing a paved park.

Uses of Pervious Concrete:

1. The pervious concrete is used in some areas with limited traffic volumes and loads.
2. We can construct the pavement for Zoo areas & Subgrade for conventional concrete pavements with the help of pervious concrete.
3. Bridge embankments & solar energy storage systems can be constructed by using pervious concrete.
4. The pervious concrete pavement has holes that can cumulate heat uch pavement can adjust the temperature and humidity of the earth's surface and eliminates the phenomenon of hot island in cities.

Materials Used:

Aggregates: In Pervious concrete, various sizes of coarse aggregate range from 9.5mm to 19mm¹³ are used without fine aggregate and the addition of admixtures. However, to increase the strength of pavement it is necessary to decrease the size of aggregate. The aggregate content ratio used by various authors is shown in the table (1) for different aggregate to cement ratio and for different water to cement ratio. Igneous rocks are preferable as coarse aggregate for concrete due to their higher strength. The physical properties of aggregates to be used in pervious concrete should be similar to conventional concrete. Dolomite is best suitable aggregate, which provides higher compressive strength¹⁴. Typically higher strengths are achieved with angular aggregates.

Table-1: Mix proportions used by various Researchers

Year	Aggregate (Kg/m ³)	Cement (Kg/m ³)	Water (Kg/m ³)	Aggregate To Cement ratio (A/C ratio)	Water-Cement Ratio (W/C ratio)	Author
1995	1740	348	135.72	5:1	0.390	Dutta and Ghaffori ¹⁰
	1800	300	125.4	6:1	0.418	
2010	1486.9	330.4	115.6	4.5:1	0.35	B.Huang . H. Wu, X.Shu ¹⁹
	1586.9	352.6	123.4	4.5:1	0.35	
2010	1524	305	101	5:1	0.33	O.Deo,Neithalath ¹⁸
	1544	309	102	5:1	0.33	
2013	1560	367	110.1	4.25:1	0.30	E.Lim K.H.Twan ⁴
	1560	495	148.5	3.15:1	0.30	
2014	1600	200	70	8:1	0.35	A.Ibrahim,E.Mahmoud ²⁰
	1600	150	52.85	12:1	0.35	

Cement:- The amount of cement used by various authors is shown in the Table-1. Cement or cementing material provides good durability and strength to the concrete. The thickness of cement coating plays a vital role in knowing the structural and hydrological performance of pervious concrete pavements. The increase in the size of aggregates reduces the amount of cement coating which firmly reduces the strength and increases the permeability. Pervious concrete usually has zero slumps when compare to conventional concrete.

Admixtures:- Mineral additives could lead to the improvement of concrete properties such as mechanical strength and durability. Air entraining admixtures can reduce freeze-thaw damage in pervious concrete.

Water:- Water to cement ratio between 0.27 to 0.30 is used successfully. The stronger paste may not increase the overall strength.

Literature Review

S.O. Ajamu(2012),concluded that two different sizes of coarse aggregate (crushed stone or granite) were used in this study. The sizes are 3/8-inch (9.375mm) and 3/4-inch (18.75mm) granite. The specific gravity test carried out on the two aggregate sizes gave average value of 2.7. Three batches of test specimen were produced from each of the aggregate size representing aggregate cement ratios of 6:1, 8:1 and 10:1 with no fines in the mixes and concluded that the smaller the size of coarse aggregate should be able to produce a higher compressive strength and at the same time produce a higher permeability rate. The mixtures with higher aggregate/cement ratio 8:1 and 10:1 are considered to be useful for a pavement that requires low compressive strength and high permeability rate.

Darshan S. Shah(2014),In this study two tests, Water Absorption and durability test are done.The Dimension of 100*200mm height cylinders are casted and are immersed in water for 28days curing. The tests are conducted as per IS: 2386 – (PART – III) 1963 while the durability tests are done as per IS 445:2000 and conclude that water absorption and durability are inversely proportional to each other means that, concrete made by 1:6 mix proportion has more durability and less water absorption and concrete made by 1:10 mix proportion has more water absorption and less durability.

Manoj Nallanathel(2016), this study observed that compressive strength and permeability of concrete is greatly affected because of variation in mix proportion. Pervious concrete has more water permeability because of the presence of interconnected air voids in the matrix. Because of the presence of high porosity pervious concrete acts as light weight concrete with minimum compressive strength. There is a strong correlation between the density and porosity of pervious concrete mixtures. Additionally, there is a good correlation between pavement infiltration rate and both density and porosity. The use of pervious concrete is increasing day by day due to its capacity to reduce the incidence of flooding, and to assist in recharging the groundwater table. By the use of admixtures the compressive strength can be increased which will effect the water cement ratio.

Er. A.S. Sidhu(2015),observed that Currently, porous concrete pavement is becoming a popular choice over the world as an effective stormwater runoff management device. There are a lot of previous studies that have been conducted by other researchers in order to improve the conventional porous concrete pavement. The main problem of porous concrete pavement is its strength. Due to high voids content in the concrete, it is hard to produce concrete with high strength.

BIJI U.I(2016), Several admixtures have been tested as part of this research with the objective of increasing strength, durability and workability of pervious concrete. Improved strength, durability and workability would lead to a wider application of pervious concrete. The types of admixtures that were tested as part of this research included delayed set modifier, viscosity modifier, and cellulose fibers. The ability to discharge, place, and finish pervious concrete within a relatively short time span is a major concern for concrete producers. The relatively short working time window with pervious concrete often leads to a very fast paced, labor intensive effort.

Rajesh Kumar(2015),Observed that the voids ratio increases, compressive strength & flexural strength values are reduced. The compressive strength of pervious concrete with 12mm size aggregates are more compared to 20mm size aggregates. Compared to conventional mix, large quantity of admixtures (HRWR &VMA) are required for pervious concrete.

Conclusion

On the basis of existing review of literature it can be concluded that that compressive strength and permeability of concrete is greatly affected because of variation in mix proportion. Pervious concrete has more water permeability because of the presence of interconnected air voids in the matrix. Because of the presence of high porosity pervious concrete acts as light weight concrete with minimum compressive strength. There is a strong correlation between the density and porosity of pervious

concrete mixtures. It has also been found that the smaller the size of coarse aggregate should be able to produce a higher compressive strength and at the same time produce a higher permeability rate.

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