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SCOPE OF PERMEABLE CONCRETE AS AN ALTERNATIVE PAVEMENT SOLUTION

Praveen Kumar
B.Tech (Civil Engineering) Student in MDU, Rohtak, Haryana
Email- praveenkmr0047@gmail.com

Abstract: *Buildings and air-tight concrete roads are increasingly covering our cities. Furthermore, the city's environment is far from naturalistic. Rainwater is not drained below due to the ordinary concrete pavement's inadequate water and air permeability. Plants struggle to grow adequately without a continual supply of water in the soil. Furthermore, because the soil has great difficulty transferring heat and moisture with the air, the temperature and pressure of the Earth's surface in big cities cannot be controlled. Because of its excellent environmental effects, permeable concrete is becoming increasingly popular as an Alternative Pavement Solution. among other advantages, pervious concrete pavement allows storm water to permeate through the pavement, reducing or eliminating the need for optimum constructs. As a result, it is seen as a greener alternative to typical concrete pavement systems.*

The researcher has studied previous literature and adopted conceptual based secondary data collected from books, National and International journals, and published reports to explore the use and scope of Permeable concrete. This study describes the scope of Permeable concrete and its advantages in different ways towards sustainability. It also describes the use of Permeable concrete as an alternative pavement solution and its challenges. This would aid investigators in furthering their knowledge of pervious concrete pavements in numerous aspects in the future.

Key Words: *Permeable Concrete, Pervious Concrete, Alternative Pavement Solution*

1. INTRODUCTION :

Permeable concrete, also known as pervious concrete, no fine concrete, and porous pavement, is a highly porous concrete used in the normal use of concrete that directly draws water from sediments and other sources. Allows passage, reduces spillage and allows penetration capacity. Permeable concrete pavement is appropriate as an alternative pavement solution for "green" industrial practices and is the best for environmental protection, rainwater management and sustainable development, Recognized by the US Environmental Protection Agency (EPA) as a management practice.
The potential of pervious concrete in storm water management and sustainable development has sparked huge attention. (Percoa, USA). Concreted surfaces are so common in today's cities that people don't consider the influence they have on water quality and environmental health. But here's the harsh reality: As more of the country's usable land is concrete over, more precipitation ends up falling on impervious surfaces like parking lots, roadways, walkways, and streets, instead of penetrating into the ground. Rainwater passing throughout paved surfaces gathers everything from oil and grease spills to deicing salts and artificial fertilizers, causing a disparity in the ecological system and a slew of troubles such as corrosion, flash floods, underground water depletion, and contamination of rivers, lakes, and surrounding waters. In this way, Permeable concrete pavement is one-of-a-kind and very effective way to address critical environmental challenges while also promoting green, long-term growth. Permeable concrete helps recharge groundwater, by absorbing stormwater and enabling it to sink into the ground and fulfil U.S. environmental standards Environmental Protection Agency (EPA). Permeable concrete is made out of a paste made up of carefully measured quantities of water and cement concrete ingredients that create a thick layer surrounding aggregates. The porous concrete mixture contains less or no sand, which causes considerable voids. Using enough paste to coat and bond the aggregates creates a highly porous, interconnected system of voids that are expelled rapidly.

2. ADVANTAGES :

It is built of stone cement with less sand and has an open-cell system that enables air and water to pass through. Permeable concrete's capacity to enable water to pass across it charges up ground water while reducing pollutants and

storm water runoff. Permeable concrete is used to enable storm water to percolate through the pavement, reducing or eliminating the necessity of additional control constructions like reservoirs. The following are some of the benefits of using Permeable concrete pavement that improve the environment:

1. As the pavement is air and water permeable, water will be able to penetrate and replenish the groundwater resources over time, additionally, the soil can be kept moist as a result of the pavement's permeability.
2. The Permeable concrete pavement reduces the noise generated by vehicles, creating a quiet and comfortable atmosphere.
3. It is safer and more comfortable for drivers to drive on the permeable concrete pavement during rainy days, since it has no puddles on it and does not glisten at night.
4. It is possible to adjust the Earth's temperature and humidity using such pavements. This prevents cities from becoming hot islands because the Permeable concrete pavement can accumulate heat.

3. PERMEABLE CONCRETE AS A SUSTAINABLE PAVEMENT MATERIAL :

Because of its environmental benefits, the use of pervious concrete as a pavement material in low-volume road applications has grown in popularity in recent years. Researchers in the field of civil engineering have focused attention on drainage challenges in the transportation sector with the advent of Permeable concrete.

Even though the surface nature looks to be rough and non-uniform, it can effectively drainage water in a wide volume through its interconnected pore-like formation. Because of its physical, economic, and road user benefits, the pervious concrete pavement system has emerged as a viable alternative among several solutions for low-impact innovation in pavements. Permeable pavements are proven to remove pollutants from stormwater effectively as a solution to water pollution and contamination. (Torres et al. 2015).

Concrete's unique feature is that without fine aggregate, it becomes porous and allows water to move easily through the underlying soils. It improves the efficiency of storm water management by ensuring optimum rate of penetration and thereby reducing storm water runoff, water pollution, and soil pollution. The notion underlying pervious concrete is that the cement concrete is placed and compacted with an accumulation of linked pores, resulting in numerous benefits such as reduced runoff, improved ground water refill, dissolved particles filtering, flood control, and so on.

As a result of the growing usage of permeable concrete in the concrete sector due to its numerous advantages, it has the potential to become a desirable long-term roadway material.

4. PERMEABLE CONCRETE FOR GLOBAL WARMING CONTROL :

To combat the effects of 'Urban Heat Islands,' (UHI) some researchers are investigating permeabilized as a pilot project for solar energy systems or geo thermal heat exchangers. Yanga et al. (2016) have described that an urban heat island (UHI) is a place where heat generates as a result of urban development and human actions.

Traditional asphalt materials may attain temperatures of 50–65°C in the summer, and they have a reflectivity of 5–40%, which means they soak up 95–60% of the energy that reaches them rather than reflect it into the atmosphere. Because of porosity permeable concrete has a larger accessible surface area than normal concrete, which aids in lowering heat reflection and improving heat convective. (Ferguson 2005). This heat convection approach keeps it cooler than the regular one during windy conditions. (Qin and Hiller 2013).

5. PERMEABLE CONCRETE UNDER VARIOUS RAINING CONDITIONS :

PCP is being used as an eco - friendly product in various nations. The major goal of utilising this sort of pavement is to allow water to permeate via its pore structure and reach subsurface layers, reducing runoff and reducing destruction and fatalities. The decrease of PCP's permeability rate during the period is one of the most key threats. Though some penetration models for PCP under dry conditions have been developed, the minimal focus has been made on the use these of PCP under different raining conditions.(Saaly et al., 2019) this study shows that the porosity rate of PCP varies greatly depending on the monsoon climates, and experimental exponential short-term performance models may accurately forecast the porosity rate over time.

6. CHALLENGES:

Because of its poor workability under severe loads, the researchers recommend using permeable concrete pavement only for basic and low-volume urban infrastructure. Due to its low compression strength, porous concrete cannot withstand strong traffic loads and vehicles. A better design combination could also help to expand the use of permeable concrete in higher traffic road infrastructure. In addition, the cost of servicing and maintenance is substantial. Without good and regular maintenance and cleaning, the drainage function may be completely lost. Asphalt concrete pavements require additional safeguards in order to have a long service life.

7. CONCLUSION:

Research in the past has shown that Permeable concrete pavement mixtures are appropriate for use as pavement materials in low-traffic locations such as local roadways, sidewalks, parking lots etc. A number of benefits associated with pervious concrete have been attracting urban developers and contractors. Permeable concrete is made up of gravel or stone, cement, water, and less or no sand, and it has an open cell structure that lets water and air flow across. (ACI Committee, 522). Pervious concrete is a type of pavement that is extensively used as an environmentally friendly alternative to regular asphalt and concrete pavement. As a result, pervious concrete functions as a water system and aids in the preservation of the pavement's surface and environment. thus, we can see it as an alternative pavement solution. This study discussed the uses, scope, advantages and challenges of Permeable concrete. Although there are many environmental and economic benefits of using Permeable concrete. There are a lot of challenges also, that should be discussed during the pre-construction meeting. overcoming these challenges necessitates rational approaches to the development of design, construction, and maintenance strategies (Schaefer et al. 2016).

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