A Review Study on Water Absorbing Pavement

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Abstract— Water Absorbing pavement is a new technique in Pavement construction. Through this technique we can find a solution for the low ground water level, effective management of storm water runoff, Agricultural problems, etc. Pervious concrete can be introduced in low traffic volume areas, walk ways, sub base for concrete pavements, inter locking material etc. Pervious concrete as a paving material have the ability to allow water to flow through itself to recharge ground water level and minimize surface storm water runoff. This property of porous concrete reviews its applications and engineering properties, including environmental benefits, strength and durability. By replacing a part of cement with flash, then it results the safe disposal of waste material. Hence it acts as an eco- friendly paving material.

Keywords: Pervious Concrete, Storm Water, Ground water Recharging, Light Weight, Waste Material Management, Strength, Durability

I. INTRODUCTION

Porous pavement is a storm water drainage system that allows rain water and runoff to move through the pavements surface to storage layer below, with the eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce storm water volume, treat the storm water quality, and replenish the ground water supply and lower air temperatures on hot days. Due to increased void ratio, water conveyed through the surface and allowed to infiltrate and evaporate, whereas conventional surfaces will not do so. A porous pavement surface therefore becomes an active participant in hydrological cycle: rain fall and snow melt are conveyed back through soil into ground water. And also this pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices. In doing so, pervious concrete has the Ability to lower overall project costs on a first-cost basis. In previous concrete, carefully controlled amounts of water and cementitious materials are used to create a paste that forms a thick coating around aggregate particles. A pervious concrete mixture contains little or no sand, creating a substantial void content. And that's why it is also known as No fines Concrete. Using sufficient paste to coat and bind the aggregate particles together creates a system of highly permeable, interconnected voids that drain quickly. For porous concrete, water permeability is the main specification requirement instead of its strength and continuity of the open pores is the main concern in the production of porous concrete. The high water Permeability of porous concrete makes it to be considered as an environmentally friendly concrete. When the component materials of porous concrete, environmentally unfriendly Portland cement is partially replaced by supplementary cementitious materials, such as fly ash, ground granulated blast furnace slag and coarse aggregates by recycled concrete aggregate, then the porous concrete could be considered as environmentally concrete for sustainable construction.

II. HISTORICAL BACKGROUND

Permeable concrete has been partial used as a pavement material and recently developed for this particular purpose. On the other hand, Permeable concrete has been used widely in Europe, Australia and the Middle East as a structural building material (Macintosh et al.1965). Use of Permeable concrete became more common during the material shortages after World War II, for cast-in-place load bearing walls of single and multistory buildings. Construction of two residential houses and a sea groyne 61 m long and 2.15 m wide (Francis 1965) is the earliest known application of Permeable concrete occurred in England in 1852.

From the past 20 years Permeable concrete has been used in south-eastern America in pavement applications. In the beginning no-fine concrete developed in Florida as a method of recharging the Everglade aquifers while controlling the water and reducing some of the detrimental effects caused by urban sprawl. Permeable concrete was mostly used for two-storey structures; still this expanded to five- storey buildings in the 1950's and continues to develop. During recent years Permeable concrete has been used as a load bearing material in high rise buildings up to ten-storey. No- fine concrete is used in Germany where a high rise building was constructed using conventional concrete for the six bottom storey and Permeable for the remaining thirteen upper storeys. Canada where Permeable concrete was used for construction of a number of multistory residential houses in the Toronto area around 1960.

III. AIMS AND OBJECTIVES

Permeable concrete is mostly used in non-pavements applications and a limited use in pavements applications. This assignment purpose is to assess the suitability for Permeable concrete to be used for the construction of road pavements.

1) To reduce the surface runoff of the storm water
2) To increase the life of road.
3) To avoid the Accidents.
4) To infiltrating runoff into the ground
5) To increase the ground water table level.

IV. LITERATURE REVIEW

1) Jayeshkumar Pitroda & J. J. Bhavsar in 2013, they have studied that on rural area. They said that, perforated concrete is a relatively new concept for Rural Road Pavement. With increase into the ground water level, agriculture problems. The previous concrete is used as paving material. They states that, In the rural area, Cost consideration is very important factor which must be kept in mind. So that in rural areas Costly storm water management practices is not applicable. They conclude

that is to capture the rainwater & allowing it to seep into the ground. This pavement technology creates more efficient land use by eliminating the need for relation ponds, swell & other costly storm water management devices.

2) Mr. Gaurav UttamShinde & Dr. S. S. Valunjkar in 2015, in this paper intentional on Cost and Time Control in Storm Water Management using Pervious Concrete. They study the pervious concrete in metro cities & the previous concrete has introduced in metro cities as a road pavement material. They said that, in metro city pavement pervious concrete is new concept because of problems in urban area related to low ground water table & storm water management. In this paper one case study is analysed. Considering rainfall data, traffic volume data, soil & geotechnical investigation data of a residential colony which was taken as a part of a case study, the suitability of a previous concrete was checked. Cost comparison between conventional method of storm water management and storm water management using previous concrete pavement is checked. This paper states that, in metro cities cost consideration is the primary factor. Maintenance of costly storm water management system is difficult to execute in cities due to its large population. They also states that, previous concrete pavement is irreplaceable and effective means to meet growing environment and population demand.
3) Saurabh Y. Kale, Amit P. Halwele[2], Kartik Rathod[3], Mayur A. Jirapure In 2017, they perform the research on Permeable pavement system and their uses. In this paper, they studied about Permeable pavement system, sustainable drainage system, porous pavement, storm water, sustainability, filtration, drain, geothermal heating and cooling. Water quality control and maintainace are highlighted, deliberated about recent innovation, advantage and disadvantages in this paper. They concentrated on the use of permeable pavement in sustainable urban drainage system. The moto of this paper is to show the application of permeable pavement in drainage system.
4) Jannathul Thasni. P, JouharShareef, (2018), in this paper has summarize research on water absorbing pavement by the porous concrete, they discuss about the solution for low ground water level, agriculture problem,Management of storm water runoff. Application and engineering property of porous concrete are discussed, they also studied about material of porous pavement such as cement, aggregates, water, admixture and etc. Benefit, advantage and disadvantage, durability, strength of porous concrete are also highlighted. In this paper they discourse about replacement of cement by fly ash which result is safe disposal safe material in porous concrete hence its acts eco- friendly paving pavement.
5) Mosoud Kayhanin, Hui Li, & John T. Harvey in 2019, they considered that on the perforated pavement in Highways for storm water runoff management and pollution prevention. They have discuss & summarize the major findings of these collective studies related to, Hydraulic performance evaluation of permeable pavement, Permeability measurement of porous asphalt and previous concrete paved surfaces, Clogging evaluation of permeable pavement surfaces, and Water quality and pollution control issues. They said that In the future, permeable pavements including the Full Depth Permeable Pavement (FDPP) will be part of an integrated sustainable transportation program. They states that, if FDPP designed property, it can be used as an alternative best management practice (BMP) for storm water runoff management. They states that the specific characteristics of FDPP throughout the life of pavements. Surface pavement remain highly permeable and unclogged, Allowing minimum permeability of subgrade soil to infiltrate the captured runoff, assuming no adverse impact on underground water.

V. METHODOLOGY

A laboratory study evaluating strength and infiltration, concrete mix was performed. The experiments included compressive strength tests, infiltration rate test on clean specimens.

For experimentation M-25 controlled concrete using locally available building materials and OPC-53 grade cement is used with suitable dose of admixture (conplast SP430).

Grade 53 OPC cement was used with aggregate size retain on the 4.75mm sieve and passing through 10 mm seive.

A steel tamping rod with 16mm diameter and 0.6m length and having bullet ends was used for compacting the concrete.

The fine fractions in the concrete is reduced from 5%, 10%, 15%, 20% for that fine fractions of 4 cubes are prepares (1 fine fraction >2 cubes, for 0% fines by reducing the cement content to in the actual) Mix designing of M-25 controlled concrete is done and results are validated by casting 4 cube samples (150cm×150cm×150cm) and subsequently testing infiltration rate and compressive strength after 7 days and 28 days Compaction on the sub-base will occur in a single pass with the use of a plate or roller compactor to provide a Smooth uniform working surface.

Any irregularities in the sub-grade will be smoothed during this phase of construction. This aggregate is required to be saturated before the concrete is poured to minimize the loss of moisture from the concrete.

The thickness of this sub-base layer is dependent upon the underlying sub-grade and the intended use for the pavement. This layer ranges in thickness from 100 mm for footpaths to 250 mm for heavily trafficked areas.

Mixing, Placing and Finishing Requirements This phase of the pavement construction is the most important, as the placing and finishing methods for Permeable concrete are considerably different to conventional concrete.

VI. FUTURE SCOPE

Permeable concrete can be used in building for rainwater harvesting as well as for cooling purpose by providing permeable wall.

In the presence of clayey soil, water can be percolated through providing borehole at every 1-2km with the help of drainage system. Water can be filtered and stored as fresh water below the ground.

We can also give direction to water specifically according to need. By providing certain angle to the flaky aggregate water which gets drained will make its way to the slope going down towards the sewer line or any other drainage arrangement. This could be useful where soil strata have less water absorption capacity.

In the past due to the scarcity of cement, the pervious concrete has been used extensively.

The pervious concrete has lost its importance after Successful production of cement in large quantities.

But now-a-days, the usage pervious concrete has gained its popularity due to many advantages.

By using the pervious concrete we can able to recharge the ground water table and the storm water disposal can also be done.

So, in future to tackle aforesaid problems and to protect People from flood prone areas, the pervious concrete is one effective solution

VII. Conclusion

From the Above discussion and study of all literature reviews and implementing proper methodology we can determine, Porous concrete allows water passes through it. It is not composed of fine aggregates.

Effective utilization of waste product (fly ash), and making it as an eco-friendly concrete. Lesser percentage of fly ash gives high strength than higher percentage. Higher percentage of fly ash weaker in cement bonding.

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