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A Study on Pervious Concrete: A Review

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Abstract: ***Pervious concrete is a mixture of gravel, aggregate, cement, little or no sand with or without admixture. Pervious Concrete is a specialty concrete used to allow water to intentionally pass through the surface of a pavement and allow storm water to eventually absorb back into the surrounding soils or evaporate. This keeps runoff water from downstream urban flooding and erosion. Pervious concrete pavements are "best management practices" to collect, clean and cool storm water. In urban region due to increase in impervious area infiltration is reducing, therefore, ground water level is going down. Scarcity of groundwater is observed and hence use of pervious concrete to eliminate this problem improve groundwater recharge should be adopted. its void content range from 18-35%.the infiltration rage of pervious concrete will fall into range of 80-720 litres per square meter.***

Keyword: pervious concrete, permeability, compressive strength, aggregate size, porosity

I. INTRODUCTION

Majority of Indian population depends on ground water for drinking as well as domestic use. Depletion of ground water is observed due to growth of urban areas that lead to increase in impervious area. In urban region due to increase in impervious area infiltration is reducing, therefore, ground water level is going down. In India rainfalls are uneven and uncertain in terms of distribution, intensity and frequency. Scarcity of groundwater is observed and hence techniques to improve groundwater recharge should be adopted. Use of Pervious Concrete is one of the methods. Conventional normal weight Portland cement concrete is generally used for pavement construction. The impervious nature of the concrete pavements contributes to the increased water runoff into the drainage system, over-burdening the infrastructure and causing excessive flooding in built-up areas. Pervious concrete has become significantly popular during recent decades, because of its potential contribution in solving environmental issues. Pervious concrete is a type of concrete with significantly high water permeability compared to normal weight concrete. It has been mainly developed for draining water from the ground surface, so that storm water runoff is reduced and the groundwater is recharged.

II. LITERATURE REVIEW

R sri ravindrarajah and a yukari have conducted various experiments on the properties of pervious concrete and they also use various proportion of fly ash instead of cement. They studied various properties such as porosity, unit weight, compressive strength, weight loss on drying, water permeability on constant water head and free drying shrinkage. The properties were investigated with three pervious concrete mixer made with 0%, 20% and 50% of fly ash substitution. Based on result obtained they also established relationship between porosity and permeability and also between porosity and compressive strength. Based on their result pervious concrete with high porosity showed low compressive strength and high water permeability. The result showed that water permeability was not affected when 50% fly ash was used but the stability of drying shrinkage was increased with the use of fly ash.[1]

S.O. Ajamu, A.A. Jimoh, J.R. Oluremi evaluate the structural performance of the pervious concrete in construction. So they have studied the effects of different aggregate size on porosity, specific gravity and compressive strength on pervious concrete.

They also study the pervious concrete as a pavement material to be used for parking lot and walkway. They have produced the specimen in 6:1, 8:1, and 10:1 in the aggregate cement ratio. They have used coarse aggregate in the form of 9.375 and 18.75. So the cube for tested for 7, 14, 21 and 28 days. From this it can be concluded that aggregate cement ratio of 6:1 had the highest compressive strength of aggregate size of 9.375 produced the best results and pervious concrete made with aggregate size 9.375 give more compressive strength compared to aggregate size 18.75.

Felipe Montes, Srinivas Valavala and Liv M.Haselbach studied the test method of porosity measurement of pervious concrete. However there is still confusion about the definition of porosity but porosity is defined as ratio of volume of void to total volume but the definition of void should be derived. Dry mass and submerged mass of pervious specimen was obtained by water displacement method. They have used a method to determine the porosity during test which involves holding a cylinder underwater and shaking for three minutes to remove air bubble then submerged was recorded. This method was successful but shaking portion was difficult.

So the time test was adopted in which enough time was allowed for water to penetrate into the pores to get accurate result of porosity. So it can be concluded that water displacement method performed on core filled offers good flexibility to obtain samples.

B.HUANG, J.CAO, X.CHEAN AND X.SHU Conducted to study of permeability and strength properties of pervious concrete. A preliminary study has been conducted to study. the effect of aggregate gradation of 4.75mm,9.5mm and 12.5mm on the strength and permeability characteristics of pervious concrete based on limited laboratory and analytical results. the compressive strength and indirect tensile strength of pervious concrete with larger size aggregate was larger, which can be attributed to the smaller air void and more the cement paste between aggregate if considering a aspect ratio. For pervious concrete, due to high air void, Darcy's Law is no longer valid. Therefore, proper procedures should be used to characteristic the permeability of pervious concrete. The values of pseudo-coefficient of permeability increased as aggregate size increased, which means the hydraulic conductivity increased as aggregate size increased.

Darshan S. Shah, Jayeshkumar Pitroda conducted to study on durability and water absorption properties of pervious concrete. This paper represents the experimental methodology and experimental results related to durability and water absorption. 8 Cylinders of size 100 mm Ø and 200 mm height are prepared to investigate both these properties and this cylinder are immersed in sodium chloride (NACL) with concrete mix proportion 1:6, 1:8, and 1:10 with different size of gravel 18.75 mm and 9.375 mm. That's conclusion is 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.

M.Uma Maguesvari and V.L. Narasimha have study on characterization of pervious concrete for pavement application. Four sizes of coarse aggregate namely-4.75mm to 9mm, 9mm to 12.5mm, 12.5mm to 16mm, 16mm to 19.5mm. Mixes were prepared with the water cement ratio of 0.34, maintaining the aggregate cement ratio as 4:1.This study illustrates angularity number, which influence properties and behavior of pervious concrete with fine aggregate and coarse aggregates. It is observed that the increase in fine aggregate results in reduction of volume of voids which in turn increase of compressive strength, flexural strength and split tensile strength. Angularity number is more for higher size aggregate and which is reduced when size of aggregate reduces. The range of compressive strength varies between 10 N/mm2 to 26 N/mm2 when the angularity number varied from 8 to 4. Coefficient of permeability increases from 0.4cm/sec to 1.26 cm/sec when the angularity number is in the range of 4 to 8. The optimum mixes in each coarse aggregate size are identified based on the compressive strength.

A.K. Jain, Dr. J.S. Chouhan, S.S. Goliya presented to a effect of shape and size of aggregate on permeability of pervious concrete the shape of aggregate in measured in terms of there angularity number and used of three type of aggregate are flaky, angular and irregular to used having angularity number 13,10,and 7. Higher angularity number produce more permeability. Rate of reduction of permeability with increase Water/Cement ratio is more for pervious concrete having aggregate with higher angularity number.

L. K. Crouch, P.E Jordan Pitt, Ryan Hewitt have performed a experiment by using three variable mixes and standard mix for a uniform gradation, varying aggregate amount, and varying aggregate size. They have determined compressive strength, static modulus of elasticity and effective air void content. They have also established a relationship effective air void content vs static modulus of elasticity and effective air content vs compressive strength. The compressive strength and static modulus of elasticity was higher in a uniform gradation but compressive strength and elastic modulus was less when increases aggregate amount was used.

John T. Kevern, Liv Haselbach, Vernon R. Schaefer designed a site to determine the quantity and quality of stormwater effluent for same size pervious and traditional concrete parking areas. Sensors were installed to determine the characteristics the stormwater. Pervious concrete system consisted of 15 cm of pervious concrete over a 45 cm compacted limestone-aggregate base layer and the traditional system consist 15 cm of concrete pavement over a compacted soil sub grade. So during the day Pervious concrete was approximately 5° C warmer than the traditional pavement right after the hottest period of the day but both pavements cooled to similar temperatures during the night. From this it was concluded that less energy was stored during heating in the pervious concrete rather than the traditional concrete system.

Ashraful Alam1, Liv Haselbach, William F. Cofer, has developed a method to show the pervious concrete pavement model using finite element method includes vertical porosity distribution of pervious concrete layer. They have used finite element software (ABAQUS) to develop the model and perform analysis and they have used a software Everfee of pavement structural analysis for porosity distribution model. So it was concluded that there was significant difference in tensile stress using the modified vertical porosity distribution in the previous concrete layer as compared to an averaged porosity model in the previous concrete layer.

III.CONCLUSIONS

A. It was concluded that submerging a cored sample for 30 min, tapping the core against the container 5 times, and inverting it 180° is sufficient for filling most of the pores in the sample and therefore is sufficient for estimating the porosity of typical sized pervious concrete samples[3]

B. 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. [2]

C. Pervious concrete is one of finest solution towards water logging problems especially at parking and walk ways. It also helps in saving precious water

D. The smaller size of aggregate should be able to produce a Higher Compressive Strength and at the time produce a higher permeability rate.

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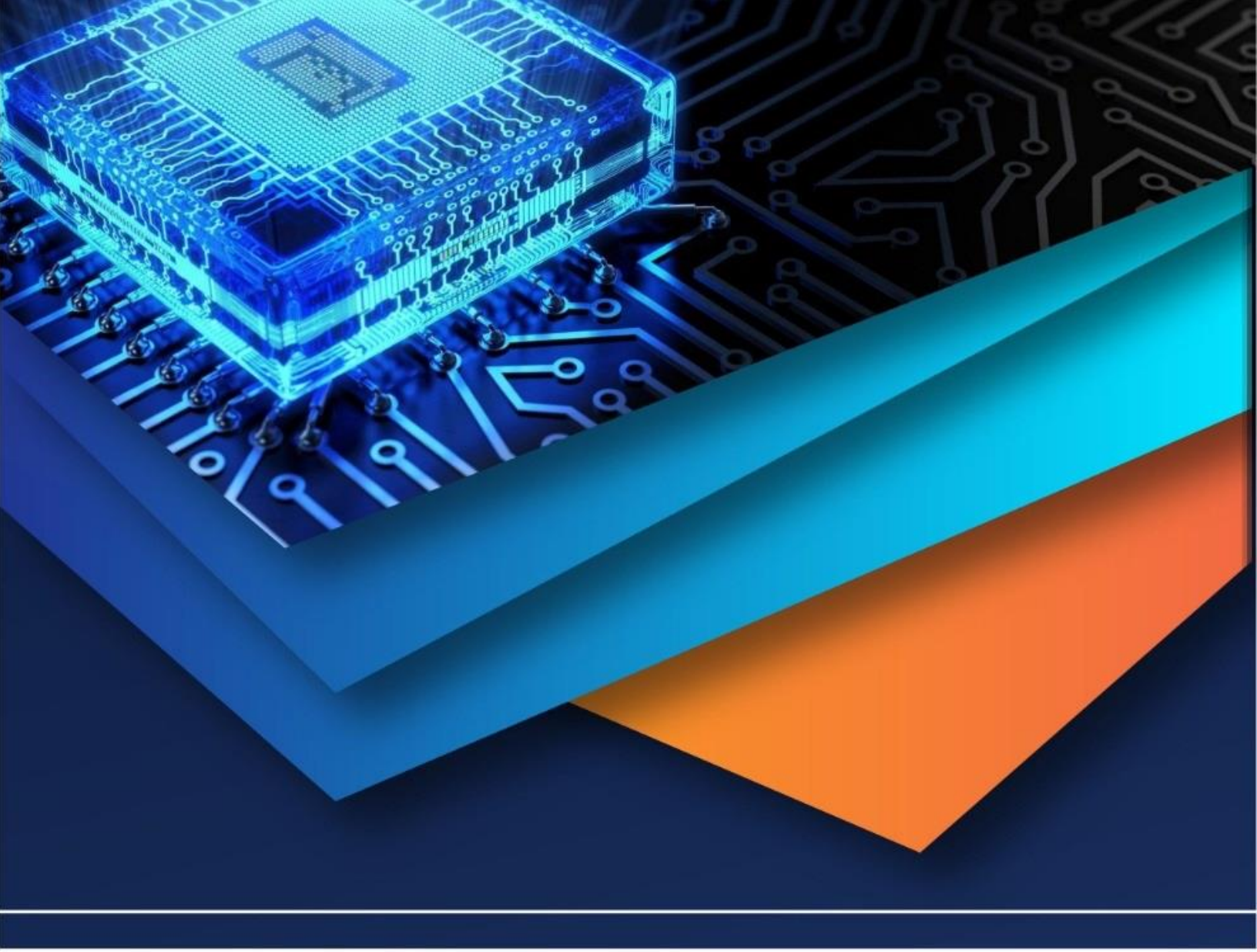

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