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A Review on Study and Analysis of Strength, Permeability and Void Ratio of Pervious Concrete

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Abstract*: Commonly pervious concrete has little to no fine aggregate and has just enough cementious paste to coat the course aggregate particle while preserving the interconnectivity of the voids.[00] Pervious concrete is answer key for taking storm water runoff. Therefore, this review paper discussed about different parameter which affect on development and performance of a pervious concrete. Porous or Pervious concrete consist of no-fines, open-graded Portland concrete mixtures usually with 15-25% voids, which enables water to be drained quickly. Pervious concrete is traditionally used in parking areas, zoo areas, shoulders, low volume road, pedestrian walkways, sidewalk green house floor, and swimming pool decks.
Keywords: No-fine concert, Aggregate size, Water cement ratio, permeability.

I. INTRODUCTION

Pervious concrete is mixture of gravel , cement, water, little to no sand (fine aggregate) with or without admixtures. When pervious concrete is used for paving the open cell structures allows the strome water to filter through the pavement and into the underlying soils. We can also say that pervious concrete helps in protecting the surface of the pavement and its environment. Pervious pavement act as both a pavement and storm water management tool . The aggregate is usually of a single size and is bounded jointly in a cement paste. Using sufficient paste to coat and bind the aggregate particles together creates high permeable system with interconnected voids which drains quickly. We can be also provided a perforated pipe to collect it and drains to the required treatment plant.

II. LITERATURE REVIEW

Properties of pervious concrete Incorporating Recycled Concrete Aggregate (M. Rerry)
In this paper he/she use the RCA which is the amount of cement paste left on an aggregate is influenced by method used to crushed the concrete as well as the dimension the concrete is crushed The shape and texture is also dependent on which type of crusher. RCA is used in pervious concrete because it specially effect on density, strength,& permeability. In that, they are taken 0.10, 20, 30, 50, 100% of RCA in pervious concrete and test is conducted for compressive strength & Conductivity. The results show that hydraulic conductivity compressive strength is decreased with increased RCA % & lower at 100%.

A. Experimental study of pervious concrete pavement

(Vikram1, Mehla R. P.2 (IJRASET) 2015) In this paper, Various mix proportions were prepared by replacing cement with silica fume (6%) & addition of super plasticizers (0.13-0.25%) with varying size of aggregate (4.75-20) have been used for studying properties of fresh and harden pervious concrete. W/C ratio kept constant 0.34. different properties of pervious concrete e.g., workability, compressive strength, split tensile strength, flexural strength t 7,28,56 days and bond strength at 28 & 56 days have been studied experimentally. Results showed that strength of pervious concrete is decreased with addition of Silica flume & superplastizers. The mix proportion with aggregate size (4.75-10 mm) gives better strength compared to (10-20 mm) & (4.75-20 mm)

B. Development of Mix Proportion for Functional and Durable Pervious Concrete

(Wang, K.1, Schaefer, V. R.2, Kevern, J. T.3, and Suleiman, M.T.4)
Portland cement pervious concrete (PCPC) mixes made with various types and amounts of aggregates, cementious materials, fibres , and chemical admixtures were evaluated. Porosity, water permeability, strength, and freezing-thawing durability of the concrete were tested. The results indicated that the PCPC made with single-sized coarse aggregates generally had high permeability but not adequate strength. Addition of a small amount of fine sand (approximate 7% by weight of total aggregate) to the mixes significantly improved the concrete strength and freezing-thawing resistance while maintaining adequate water permeability. Addition of a small

amount of fibre to the mixes increased the concrete strength, freezing-thawing resistance as well as void content. Based on these results, performance-based criteria are discussed for proportioning functional and durable PCPC mixes.

C. Evaluation of Structural Performance of Pervious Concrete in Construction

(S.O. Ajamu1, A.A. Jimoh2, J.R. Oluremi3) Aggregate/cement ratio of 6:1, 8:1 and 10:1 respectively were used to produce three different batches of fresh concrete using18.75mm aggregate size and same ratios were used for 9.375mm coarse aggregate size to produce another three different batches. In each case, aggregate/cement ratio of 6:1 gave the highest compressive strength compared to other aggregate/cement ratio of 8:1 and 10:1. The highest compressive strength obtained was 8.2 N/mm2 and 10.8 N/mm2respectively for 18.75 mm and 9.375mm coarse aggregate sizes. These values fall within the values stipulated by ACI 552R-10 (2.8 N/mm2-28 N/mm2). It was found that the aggregate/cement ratio of 10:1 produced pervious concrete of higher co-efficient of permeability of 3.12x10-3 cm/sec and 3.89x10-3cm/sec for aggregate size 9.375mm and 18.75mm respectively.

5 .Pervious Concrete for sustainable Development (Karthik H. Obla, Ph.D., P.E.)

Here author discussed about importance of pervious concrete, application, materials, properties of pervious concrete. Because pervious concrete is a special type of concrete with high porosity used for concrete flat work application that allows water from precipitation and other sources to through it, thereby reducing the runoff from site and recharging GWL. In this they have also mentioned about design, construction testing and maintenance of pervious concrete.

D. An Innovative No-Fines Concrete Pavement Model

1) *(Sirile Eathakoti1, Navya Gundu2, Markandeya Raju Ponnada):* In this paper, an innovative model that can transport water percolated into the pavement has been suggested in this direction. Different combinations of Cement, water and Course aggregate with different maximum size and gradation were adopted for trial mixes to arrive at M20 grade concrete.M20 grade concrete is achieved with a w/c ratio of 0.45, Course aggregate of nominal size 20 mm and with a cement to Course aggregate ratio of 1:4. Its density and flexural strength were observed to be 21 KN/M2 and 35 kg/ cm2 respectively. A pavement slab suitable for low traffic volume roads is designed as per IRC SP62: 2004 which allows storage of water up to 125 lit./m3of concrete pavement giving time for infiltration thereby reducing the runoff and recharging the ground water or sufficient time for transport of it. A perforated pipe can be provided at center of the pavement above sub-base such that it collects the water stored in concrete and drains it to the required treatment plant or a recharge pit. This however needs further investigation and trials before practical implementation.

E. Strengthening of Pervious Concrete for High Load Road Application; a Review

Due to the significantly reduced strength associated with the high porosity, pervious concrete mixtures currently cannot be used in highway pavement structures. This paper provides the review of improving the mechanical properties of pervious concrete through different factors i.e. using additives, using different type and size of aggregates, different w/c ratios; without considerable effect on permeability. This review paper aims at looking for a vision to introduce pervious concrete with optimum Mechanical properties for using in Highways as an alternative for storm water mitigation and increasing the ground water level.

F. High Strength Pavement using no fines concrete

1) (Dr.M. mageswari): In spite of having low compressive strength and flexural strength, no fine concrete has properties of capable of being used as rigid pavement for low traffic volume roads. To overcome this they had prepared different combination of cement, GGBS, water and course aggregate with different maximum size and gradation were adopted for trial mixes at M20 with W/C ratio 0.36, Course Aggregate (20-10mm) and cement is partly replaced with 30%of GGBS & Cement 1:4. Its compressive strength were observed to be 20.4kN/m3.

F. Feasibility of porous pavement: a case study at hatkeshwar area of ahmedabad city

1) Parmar Manisha, 2.Dr. A. M. Jain): for this study hatkeshwar area of ahmedabad city has been selected with the specific road network nearby to the naro -naroda corridor link joining ctm cross road to karnavati bunglows. The above road network has the history of the accumulation of water in the area during the monsoon season for long duration. To study the above objective the rainfall data for the area during the different day, month is collected. The volume data is the other important aspect for identifying the low volume road. The quality of soil sub grade is the other data, which is collected for determining the thickness of porous

asphalt concrete at this road network. The soil quality is also useful in order to identify suitability of disposal of the seepage ground water nearby to the stream/artificial drainage link.

G. Studies on Applicability of Pervious Concrete for Pavements

The paper determines the possibility of achieving maximum compression strength and permeability in concrete by replacing fine aggregate with coarse aggregate and cement along with the addition of admixture in

H. An Experimental study on pervious concrete as a pavement layer

*1) (*K. Nagababu, E. V. Raghava Rao, D. Satheesh): This paper explains in detail about the use of pervious concrete as pavement material. In this study, we considered mix proportion of pervious concrete from reference mix of M40 in that by changing the fine aggregate content to 0-18% by replacement method. i.e. the fine aggregate volume is replaced by coarse aggregate volume in mix proportion, there will be no change in volume of aggregate hence we had difficulty in finding volume of cement paste occupying volume of voids, because volume of aggregate and volume of cement paste will be constant in proportions, therefore we found relationship of varying fines with permeability, porosity (without cement paste), failure load and compressive strength. As it satisfies the criteria of using it of sub-base for concrete pavement as permeable and dry lean concrete sub base.

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Order to increase the permeability of concrete. In this study, the pervious concrete is obtained by removing the fine aggregate wholly (0%) and partially as 10% and 20% replacing the coarse aggregate. From the results, we came to know that, the mix M3 with 20% fine aggregate yields good compressive strength and flexural strength. The permeability rate is higher for mix M1 with 0% fine aggregate. The mix M 2 with 10%fine aggregate yields good compressive strength and flexural strength.

J. Pervious Concrete: New Era For Rural Road Pavement

(Darshan S. Shah1, Prof. Jayesh kumar Pitroda2 Prof. J.J. Bhavsar3): In rural area cost consideration is the primary factor which must be kept in mind. So that in rural areas costly storm water management practices is not applicable. Pervious concrete pavement is unique and effective means to meet growing environmental demands. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swell, and other costly storm water management devices. From the above case study I have conclude that there is a considerable saving in amount about 29 Rs / m3 or 193 Rs / m2 or 18 Rs / feet2 for construction of 1m * 1m * 0.15 m size pavement.

K. Experimental study of Pervious Concrete using M- Sand

(A.Panimayam1, P. Chinnaduraj2, R. Anuradha3, Rajalingam.M4, Ajith RAJ5, Godwin6): This paper reports an experimental investigation on Pervious concrete trial mixes with different size of aggregate, with and without fine aggregates. Tested for its mechanical properties such as compressive strength, water permeability, and porosity. In this study, the pervious concrete is obtained by removing the fine aggregate wholly (0%), 5%, 10% and 15% of replacing coarse aggregate with M sand. The compressive strength test and permeability is done in laboratory after curing. Then the compressive strength of pervious concrete is compared the compressive strength of M20grade of concrete

III.CONCLUSIONS

From this literature paper I have concluded that the development of pervious concrete providing the optimal combination of strength and void content is depend on size of aggregate , aggregate-cement ratio. But no particles should be smaller than 5 mm. Flaky or elongated particles should be avoided. The air content of no-fines concrete ranges from 13%-28% for aggregate-cement ratio 4:1. Porous concrete is cited as a material typically used in low traffic areas such as residential streets, parking lots, recreation trails, plazas, and other paved area. To obtain greater strength up to N/mm2., we have to use some strength increasing admixture like superplastizer, VMA, HRWR. River Sand or Crushed granite or other local quarry dust with maximum aggregate size12.5-9.5mm is also useful.

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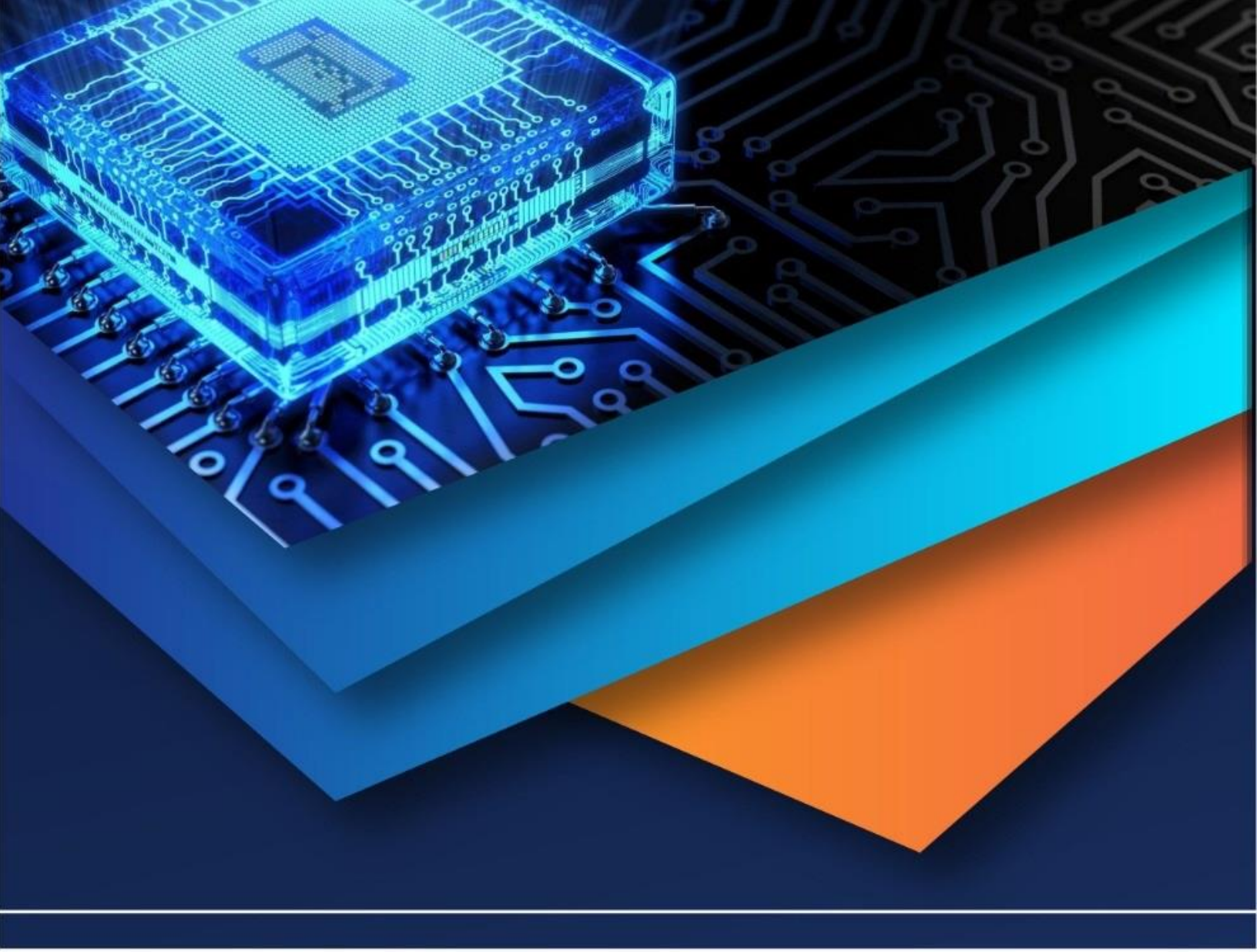

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