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Behavior of Pervious Concrete by Gradation Method,

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Abstract - *Pervious concrete is a lower slump concrete, open graded material consisting of hydraulic cemen(ordinary Portland cement)t, major quantity of coarse aggregate, admixtures and water. Because pervious concrete contains little or no fine aggregates such as sand, it is sometimes referred to as "no-fines" concrete. It is a special type of concrete having a high void content of about 30%, is becoming popular nowadays due to its potential to reduce the runoff to the drainage systems which can provide a water flow rate around 0.34 cm/second.*

Pervious concrete has a large open pore structure hence less heat storage and faster. Pervious concrete also find its effective application in low loading intensity parking pavements, footpaths, walkways and highways. The pervious concrete is considered as an Environmental Protection Agency (EPA) for providing pollution control, storm management and suitable development. Here, pervious concrete mix is designed without sand and adding silica fume as an admixture using ACI 522R-06 code, the mechanical strength of the concrete is increased to an extent.

Key Words: Pervious Concrete, Opc 43-Grade Of Cement, Silica Fume,Permiability, "Routhfutch's Method"

1.INTRODUCTION

The special type of concrete with high porosity used for concrete flatwork applications that allow water from precipitation and other sources to pass directly through thereby reducing the runoff from a site and allowing ground water recharge. Pervious concrete is made using large aggregates. The concrete paste than coats the aggregates and allows water to pass through the concrete slab. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walk way, and green house. It is an important application for sustainable construction and is one of many low impact development techniques used by builders to protect water quality.

1.1 Porosity

Pervious concrete is formed by the mixture of only coarse aggregate, Portland cement, and water and little to no sand. An identical porous or pervious concrete pavement having a voids of 15 to 25% and allows of huge quantity of water per minute to percolate through an each square meter. with awareness restricted amount of water and cementations material are used to make the a paste that makes a thick coating over the aggregate particles without flowing off during batching and placing. Using just enough paste to coat the particles maintains a system of organized voids.

Fig 1: Pervious Concrete Cube

2 OBJETIVES OF THE STUDY

The main objective of this investigation is to develop a strong and durable pervious cement concrete (PCC) mix using different types of fine aggregates with varying the quantity of fine aggregates. In addition, it is also aimed to compare the properties of these PCC mixes.

To evaluate the Compressive strength and split tensile strength of pervious concrete of having different gradation.

To obtain the permeability of pervious concrete by constant head method with different gradation.

3. METHODOLOGY

1) The cubes were casted in steel moulds having the inner dimensions of size of 150 mm*150 mm*150 mm
2) Cement and coarse aggregate are remixed tharoughly by the help of manual mix as shown in the below fig(2) the mix proportions adopted for all mixes as1:0:4.3:0.34 by the standard mix design procedure as discussed in the above (cement: fine aggregate: coarse aggregate: water)

3) Total three mixes were prepared in the laboratory with the use of different grades of aggregates such as AB, BC and CA and we have to prepare three cubes for 7 days and 28 days respectively for the determination of coefficient of permeability and to determine the average compressive strength .
4) The ratio of the different grades of aggregates are selected by the "ROUTHFUTCH'S METHOD" well known as Gradation method.
5) The concrete was prepared and poured into the moulds in three layers and compaction was provided with the help of 16 mm tamping rod by hand compaction.
6) The casted specimens where kept for one day in the moulds after 24 hours the moulds was removed and specimens were transferred to pond for curing of 7 days and 28 days.
7) Later The specimens have been tested and recorded the readings and testing procedure have been discussed in the forthcoming section.

Fig 2: Materials for casting the cube

3.1 Routhfourth's Method of Gradation

This method is used when a number of materials have to be mixed together for obtaining a desired gradation this method is well known as Routhfourth's Method of Gradation.The desired gradation may be decided either based on recommended grain size's distribution charts or by the help of tables or by usage of a theoretical equation.
We are selecting the 3 grades of aggregates from different places and names ad A,B & C type of aggregates

1) **A type of aggregates** : These are collected from Davanagere city. And it is having aggregates sizes of 20mm retained, 16.5mm retained, &12.5mm retained.
2) **B type of aggregates :** Are collected from Ranebennur city, And is having aggregates sizes of 16.5mm retained, 12.5mm retained, &10mm retained.
3) **C type of aggregates :** Are collected from Magod village Near Ranebennur (locally available), And is having aggregates sizes of 10mm retained, 5.5mm retained, &4.75mm retained.
4) **Reference mix :** 19.5mm passing 9.5mm retaining(as per ACI522R-10)

Table 1: Physical Properties of Cement

SL-NO	PROPERTY	VALUES OBTAINED	REQUIREMENTS AS PER IS: 8112-1989
1	Specific gravity Of cement	3.12	Not less than 2.50
2	Fineness (%) Of cement	3%	Not greater than 10%
3	Normal consistency (%)	33%	----------
4	Initial setting time (min)	45 min	Not less than 30 min
5	Final setting time (min)	370 min	Not more than 600 min

Natural Coarse Aggregate

The coarse aggregate are used in the experiment is 20mm .The physical properties for procured aggregate have been evaluated as per the code IS: 2386-1963. The obtained results are presented in Table 4.2.

Table 2: Physical Properties of Natural Coarse Aggregate

SL.NO	PROPERTY	VALUES OBTAINED
1	Specific gravity Of aggregate	2.69
2	Water absorption (%)	0.4%
3	Bulk Density(kg/m^3)	1688 kg/m^3

3.2 Mix design Based on ACI 522R-06

Control factor : The control factor is assumed as 0.75.
Cube strength is to be assumed : 200kg/cm^2
Maximum size of aggregates are taken : 20mm
Bulk density of cement :1440kg/cm^3
Bulk density of coarse aggregate is taken as :1540kg/cm^3
Average of 28 days compressive strength = 200/0.75=266.67kg/cm^2
Water cement ratio is 0.34
Aggregate/cement ratio by volume (4:1)
Corresponding density of concrete : 2050kg/m^3
Aggregate cement ratio by weight (4*1545.51)/1440=4.3

Cement: Aggregate: Water
The ratio is to be taken for the experiment is 1:0:4.3:0.34(cement : fine aggregate : coarse aggregate: water)
Quantities of materials per m^3 concrete:
Cement: 540 Kg/m^3
Coarse Aggregate: 1746 Kg/m^3
Water: 186 Kg/m^3
Silica fume: 60 Kg/m^3

3.3 Compressive Strength Test:

The compression test on specimen is conducted with the capacity of 2000kN compression testing machine and the machine is having the least count of 1.00kN. The specimen is placed over the compression-testing machine and the load is applied over the specimen at a constant rate of 0.14Mpa/min (general range of loading is 0.14 to 0.35 Mpa /min as per the code recomended) till to the failure of the specimen and the corresponding load is noted as ultimate load. The test is conducted on the specimens after 28 days of cuing period and the obtained results

Fig 3: Cube Compressive Strength

3.4 Permeability Test:

Permeability of porous concrete for various mixes was determined by using constant head Permeability meter (Fig 4.6). The permeability meter consists of 150mm inner diameter PVC pipe with sufficient drainage facilities. Flexible sealing material (M-seal) was applied around perimeter of sample to prevent water leakage between perimeter of sample and inner surface of permeability meter. Co-efficient of permeability for each mix was determined using the following equation and the obtained results are presented in the coming chapter.

$$K = QL/AHt$$

Where,

K = co-efficient of permeability (cm/sec)
Q = volume of water collected in t (sec)
H = head causing the flow (mm)
A = cross-sectional area of sample (cm^2)
L = height of sample (mm)
t = time in sec.

4. Results and Discussions

4.1Cube Compressive Strength

Table 3 represents the cube compressive strength results for the pervious concrete. The specimen is placed in the compression-testing machine and the load is applied till to failure the specimen and the corresponding load is notes as ultimate load. The test is conducted on the specimens after 7 and 28 days of curing period

Compressive Stregth = Load/Area

Table no 3 cube compressive strength for 7 days for AB MIXES

Sl.No	Failure load(KN)	Compressive Strength(N/mm^2)	Average Compressive Strength(N/mm^2)
01	75	3.33	
02	90	4	4
03	105	4.67	

Table no 4 cube compressive strength for 7 days for BC MIXES

Sl.No	Failure load(KN)	Compressive Strength(N/mm^2)	Average Compressive Strength(N/mm^2)
01	105	4.67	
02	90	4	4.67
03	120	5.33	

Table no 5 cube compressive strength for 7 days for CA MIXES

Sl.No	Failure load(KN)	Compressive Strength(N/mm^2)	Average Compressive Strength(N/mm^2)
01	90	4	
02	90	4	4.44
03	120	5.33	

Table no 6 cube compressive strength for 28 days for AB MIXES

Sl.No	Failure load(KN)	Compressive Strength(N/mm²)	Average Compressive Strength(N/mm²)
01	120	5.33	
02	135	6	6.22
03	165	7.33	

Table no 7 cube compressive strength for 28 days for BC MIXES

Sl.No	Failure load(KN)	Compressive Strength(N/mm²)	Average Compressive Strength(N/mm²)
01	150	6.67	
02	135	6	6.89
03	180	8	

Table no 7 cube compressive strength for 28 days for CA MIXES

Sl.No	Failure load(KN)	Compressive Strength(N/mm²)	Average Compressive Strength(N/mm²)
01	135	6	
02	135	6	6.67
03	180	8	

Permeability values by constant head method

Fig 4 Permeability test setup (Constant head)

Table no 8 Permeability values for AB Mixes

Particular	Trail 1	Trail 2	Trail 3
Q	8000ml	5667ml	2834ml
T	3min	2min	1min
K	$22.12*10^{-3}$	$23.49*10^{-3}$	$24.06*10^{-3}$
Average Permeability : $23.21*10^{-3}$ cm/sec			

Table no 9 Permeability values for BC Mixes

Particular	Trail 1	Trail 2	Trail 3
Q	7500ml	4200ml	2300ml
T	3min	2min	1min
K	$20.12*10^{-3}$	$17.419*10^{-3}$	$19.06*10^{-3}$
Average Permeability : $19.021*10^{-3}$ cm/sec			

Table no 10 Permeability values for CA Mixes

Particular	Trail 1	Trail 2	Trail 3
Q	7500ml	5000ml	2500ml
T	3min	2min	1min
K	$20.12*10^{-3}$	$20.12*10^{-3}$	$20.12*10^{-3}$
Average Permeability : $20.12*10^{-3}$cm/sec			

5. CONCLUSIONS

1) Lesser the aggregate size more will be the compressive strength.
2) As the aggregate size increases, the compressive strength of the concrete decreases.
3) Increase in the size of the aggregates increases the permeability in the concrete..
4) And as the decreases in the size of the aggregates, the permeability will be lesser.

REFERENCES

[1] Ghafoori, N., and Dutta, S., "Building and No pavement Applications of No-Fines Concrete,"Journal of Materials in Civil Engineering, Volume7, Number 4, November 1995, pgs. 286-289.

[2] Montes, F., Valavala, S., and Haselbach, L.M. "A New Test Method for Porosity Measurements of Porland Cement Pervious Concrete," Journal of ASTM International, Vol. 2, No 1, January 2005, pp.13.

[3]] National Ready Mixed Concrete Association (NRMCA), "Freeze – Thaw Resistance
of Pervious Concrete",Silver Spring, Maryland, May 2004, 17 pages

[4] National Ready Mixed Concrete Association(NRMCA), "What, Why, and How?Pervious Concrete", Concrete in Practice series, CIP 38, Silver Spring, Maryland, May 2004, 2 pages

[5] Richard c Meininger, " No Fines Pervious Concrete for Paving," Concrete Intenational Vol. 10, No. 8, August 1988, pp. 20-27

[6] Rushton B., "Infiltration Opportunities in Parking- Lot Design Reduce Runoff and Pollution", Storm water, 2002

[7] Sneha Sanjay Ganpule, S. V. Pataskar (2011),"Use of Porous Concrete as a Green Construction Material for Pavement" International Journal ofEarth Sciences and Engineering, ISSN 0974-5904,Volume 04, No 06 SPL, October 2011, pp. 764-767

[8] S.O. Ajamu, A.A. Jimoh, J.R. Oluremi (2012), "Evaluation of The Structural Performance ofPervious Concrete in Construction" International Journal of Engineering and Technology Volume 2 No. 5, May, 2012

[9] Sri Ravindrarajah, R. and Aoki, Y., "Environmentally friendly porous concrete", Proceedings of the Second International Conference on Advances in Concrete and Construction, Hyderabad, India, Feb. 2008.

[10]. Yang, J., and Jiang, G. (2003). "Experimental Study on Properties of Pervious Concrete Pavement Materials".Cement and Concrete Research, V. 33,p. 381-386

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