Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 2, February-2016

An Experimental Study On Strength And Permeability Properties Of Pervious Concrete

Krupal M limbani[1], Prof. Umang Patel[2], B.M. Marvadi[3]

[1]*PG Student, M.E. (Civil) Infrastructure Engineering, L.D.R.P. Institute of Technology & Research, Gandhinagar, krupallimbani@gmail.com*

[2] *Faculty, Department of Civil Engineering, L.D.R.P. Institute of Technology & Research, Gandhinagar, umang_civil@ldrp.ac.in*

[3] *Faculty , Department of Civil Engineering, L.D.R.P. Institute of Technology & Research, Gandhinagar, bhupendra_civil@ldrp.ac.in*

Abstract *— In many countries pervious concrete is used as construction of foot path, low traffic areas, parking lots, and river banks is becoming popular. It is necessary to performing test for evaluating structural performance of pervious concrete. In this paper study about to determine the effect of various mix design and size of aggregate with constant water/cement ratio on compressive strength and permeability of pervious concrete. Also use the fly ash and sand with some percentage compare both the results. With different aggregate/cement ratio 4:1 and 5:1 and two sizes of coarse aggregate were used, namely 10 mm and 20 mm with constant water/cement ratio 0.35 to determine compressive strength and permeability of pervious concrete and compare properties with 20% fly ash replacement of cement and 15% sand in replacement of coarse aggregate used in pervious concrete.*

Keywords- Pervious concrete, Compressive strength, Aggregate size effect, Permeability, Environmental

I. INTRODUCTION

Pervious concrete is also known as porous concrete, no-fines concrete. Conventional Portland cement concrete is commonly used for construction of pavement surface. The impervious nature of concrete surface leads to increase water runoff in rainy season and cause excessive flooding in built-up areas. Generally pervious concrete has high water permeability compared to normal concrete. Day by day concrete used in construction industries more and more which leads to hazardous for environmental because of conventional concrete has no self-purifying capacity. To use with pervious concrete in construction industries which give us better alternatives. Pervious concrete developed for draining water from the ground.

In construction industries required improvement of performance regarding reduced noise, vibration resistance in structure increasing. So we can improve strength properties with better permeability capacity of pervious concrete. Air content is important factor for strength of any type of concrete. Generally in pervious concrete has more void content then conventional concrete so it directly affect on its strength properties of pervious concrete. This study aimed to investigate to improve the compressive strength using compression test machine (CTM) and determine permeability of pervious concrete using with falling head test method.

II. LITERATURE REVIEW

2.1 Materials for pervious concrete

For pervious concrete, Ordinary Portland cement of 53 grade is used for experimental investigation. NRMCA recommended the cement content for pervious concrete Between 275 to 420. The compressive strength increases with increase in cement content. From the literature review the volume of cement paste between aggregate particles controls bonding so that volume of cement paste strongly influences the compressive strength of pervious concrete. Rounded gravel and angular crushed stone or crushed limestone are used as coarse aggregate for pervious concrete. The average size of coarse aggregate used 5-10 mm and 10-20 mm. some research also used aggregate of sizes greater than 20 mm size. Generally in pervious concrete fine aggregate is used but some amount of fines added for increase the compressive strength of the pervious concrete mix.

2.2 Properties of Pervious concrete

According to literature review strength and permeability of the pervious concrete is generally inversely to each other.

2.2.1 Strength

The disadvantage of pervious concrete is due to lower strength and durability which causes service life is shorter than that of the designed life. Pervious concrete might be utilized for different application; its essential burden is low compressive strength. Since the paste layer between aggregate is thin, it cannot give sufficient compressive strength contrasted and conventional concrete. Therefore, use of pervious concrete in high volume pavement. Generally pervious concrete mixture achieved compressive strength in the range of 3.5 Mpa to 28 Mpa. Typically this value is about 17 Mpa.

Lowest compressive strength of pervious concrete is 2.5 Mpa and average compressive strength is around 20 Mpa. The compressive strength of pervious concrete is half or one-third that of conventional concrete. Utilizing smaller coarse aggregate and mineral admixture is proposed as a suitable intends to acquire higher strength with pervious concrete. Compressive strength of pervious concrete is identified based on some factors, such as void ratio, water-cement ratio, cementing materials, aggregate size.
The flexural strength of concrete is an important factor in structural design of concrete pavement flexural strength in pervious concrete. Flexural strength in pervious concrete generally ranges between 1 Mpa and 3.8 Mpa. Flexural strength depends on many factors such as porosity aggregate/cement ratio.

2.2.2 Permeability
A wide range of values for water permeability of pervious concrete has been reported. According to some studies water permeability of pervious concrete is 1 mm/s to 5 mm/s and some studies reported that permeability, between 20 mm/s and 45 mm/s. hence, the permeability of pervious concrete is typically between 5 mm/s. the water permeability of pervious concrete was also reported as the permeability coefficient

III. RESEARCH METHODOLOGY

To determine compressive strength of the pervious concrete use compression testing machine (CTM) and for permeability of concrete check out by constant head test method or falling head test method is used.

Falling head test method: According to ACI recommended that falling head method developed by neithalath which could be used to determine the water permeability of pervious concrete. Falling head method in which permeability is measure the time taken by water level to fall from initial water level to fall from initial water head to final water head, and water permeability is then calculated using Darcy's first law. The equation is as follows:

$$k = \frac{A_1 l}{A_2 t} \times (log \frac{h_2}{h_1})$$

Where, k = Coefficient of water permeability, A1= specimen cross-sectional area, A2= Tube cross-sectional areas (95mm), I = length of the specimen (150 mm), t = time, h1 = the initial water head (290mm), h2 = the final water head (70 mm)

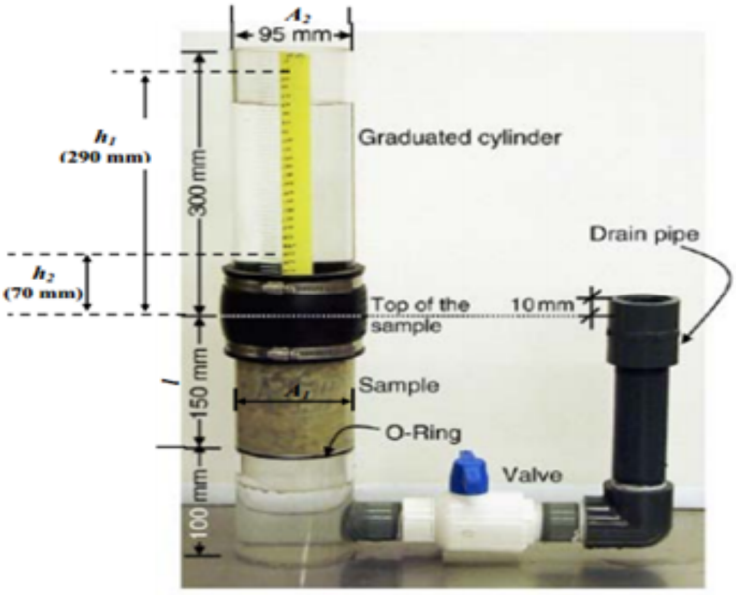

Figure 1.1: Falling head test method

Constant Head Test Method: Constant head method suggested by the Japan Concrete Institute. The method is illustrated in Figure1.2. The average water permeability of pervious concrete is 20 mm/s for 20% void content, and increased to 40 mm/s for a 30% void content. Water permeability is measure by constant head method using Darcy's First Law shown in equation.

$$k = \frac{l}{h} \times \left(\frac{Q}{A(t_2 - t_1)}\right)$$

Where, k = Coefficient of water permeability, A = specimen cross-sectional area, l = length of the specimen, t = time, h = water head, t1 = initial time.

IV. OBJECTIVE OF STUDY

1) To Develop mix design of pervious concrete with changing aggregate size with constant water to cement ratio, and investigate properties of it.

2) To develop a experimental setup to measure the permeability of pervious concrete.

3) To investigate the properties of pervious concrete with addition of sand content.

4) To investigate the property of pervious concrete with addition of supplementary cementations material.

5) To investigate the compressive strength and permeability of the pervious concrete.

V. SCOPE OF WORK

1) A number of combinations of concrete mixes are produced with different sizes of aggregate (6-10mm and 10-20mm) and different w/c ratio (0.35) to develop the mix design for pervious concrete. The main properties are to be studied include compressive strength and permeability.

2) Strength of concrete with partial replacement of sand in percentage (15%) of coarse aggregate is to be done. Properties are to be studied include compressive strength, permeability and density.

3) Supplementary cementations material like fly ash is added in 20% in cement and it is to be compared with the other property determined for the pervious concrete.

4) For the mix design from the above exercise are to be tested for flexural and split tensile strength

VI. REFERENCES

[1] ACI, Pervious concrete ACI 522R-06, 2006: 25.

[2] Yang, J., and Jiang, G. (2003), "Experimental study on properties of pervious concrete pavement materials", Int. Journal of Cement and Concrete Research, Vol.33, No.3, pp.381-386.

[3] Neithalath, N., J. Weiss, and J. Olek, Characterizing enhanced porosity concrete using electrical impedance to predict acoustic and hydraulic performance. Cement and Concrete Research, 2006: 36(11): p. 2074-2085.

[4] A.K. Jain, S.S. Goliya, Dr. J.S. Chouhan, "Effect Of Shape And Size Of Aggregate On Permeability Of Pervious Concrete", Journal of Engineering Research and Studies E-ISSN0976-7916.

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

[6] Aoki, Y. and Sri Ravindrarajah, R., "Shrinkage of environmentally friendly sustainable porous concrete", Proc. of the Int. Conf. on Sustainable Concrete Construction. Ratnagiri, India, Feb. 2008.

[7] Gyanen.Takhelmayum," Evaluation Of Compressive strength Of Pervious Concrete Using RS", IJESS Volume 2, Issue 11 (November 2012) ISSN: 2249- 9482

[8] Sung-Bum Park, and Mang Tia, G.(2003), "An experimental study on the water purification properties of porous concrete", Int. Journal of Cement and Concrete Research, Vol.34, No.3, pp.177-184.

[9] JCI, A collection of standards of JCI, 2004: 575-588.

[10] NRMCA. (2004). "What, why, and how? Pervious concrete," Concrete in Practice Series. CIP 38.