International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 11 | Nov -2016 www.irjet.net p-ISSN: 2395-0072

Experimental Study on Strength properties of pervious concrete

[1]A.N.Swaminathen, [2]N.Saravana Kumar,

1.Assistant professor,Sree Sakthi Engineering College,Coimbatore. Tamil Nadu,India.
Email: answaminathen@gmail.com
2. Assistant Professor, Sree Sakthi Engineering College, Coimbatore, Tamil Nadu, India
Email: saravanakumar1978@gmail.com

Abstract *: Pervious concrete is a porous concrete which allows water and air to pass through it. The strength properties of pervious concrete often refer to the Compressive Strength, Flexural Strength and Split Tensile Strength. This paper mainly explains about the compressive strength of pervious concrete with different samples. The mix proportion is achieved from M15 grade of concrete in which the sand is eliminated for one sample and for other samples the sand is increased by 5%.the water cement ratio for these samples is chosen as 0.3 and OPC43 grade of cement is used. In addition with the above concrete materials a special durability admixture is used in order to increase the durability and strength of pervious concrete. The pervious concrete cube is casted with cube size of 150mm x 150mm x 150mm and they were cured in water for the period of 7, 14, 28 days. The compressive strength test is done in laboratory after curing. Then the compressive strength of pervious concrete is compared the compressive strength of M15grade of concrete.*

Keywords:*Pervious concrete,Porosity,Unit weight,Compressive Strength,Super Plastizer,etc.*

1. Introduction:

Pervious Concrete is a mixture of Cement, Coarse Aggregate and water. The pervious concrete is otherwise called as porous concrete or no fine concrete because of the absence of fine aggregate. The pervious concrete is completely different from other traditional concrete because it is only suitable for pavement purpose, it cannot be used for structural members. The strength and porosity of pervious concrete depends upon the shape and size of aggregates, and the grade of cement, and water cement ratio. The mix proportion is obtained from M15 grade of concrete which comprises of 1:2:4 ratio, and the samples are 0% of sand, 5%sand, 10%sand and 15% sand. Then the compressive strength of pervious concrete cubes is compared with the compressive strength of M15 grade of concrete cube. The compressive strength test results are compared and the charts are made to show the differences. The cement of OPC43 grade is used, and the aggregate size of 8-10mm is used for preparing the samples. Due to minimized size of coarse aggregate the workability of pervious concrete is good and the flow of concrete is also good so it does not requires high compaction. The unit weight of concrete is found before doing the compressive strength test. However pervious concrete has many advantages its durability is low in order to increase the durability of pervious concrete a Super Plasticizer of Conplast SP430 is used. In pervious concrete it is highly preferred to use irregular shape of aggregates because it gives high strength and porosity. Thus the pervious concrete possesses 15 to 25 %of air voids. The pervious concrete is only suitable for plain cement concrete. It is however cannot be used for reinforced cement concrete because due to voids the steel leads to corrode easily.

2. Materials:

2.1 Cement: OPC 43 grade, Coromandel Cement:

Ordinary Portland cement of 43-grade were used in this experimental study. The Specific gravity of the cement is 3.15. The initial setting time is 30 minutes and the final setting time is 178 minutes which has been tested in the laboratory. The consistency of the cement is 34%.

2.2. Coarse Aggregate:

Coarse Aggregate of size varying from 8mm to 10mm is used for preparing the pervious concrete cube. The aggregates of irregular shapes are used. The shape of the aggregate is angular. The specific gravity of coarse aggregate is 2.95 and the water absorption is 0.60%. The impact strength of aggregate is 17.57% which is said to be strong enough to use. The aggregate of size less than 8mm increases the strength of pervious concrete but the permeability will be very less. In other case the pervious concrete with aggregate size above 12.5mm or above 16mm decreases the strength because the cohesion between the aggregate and cement will be very less and hence it cannot be used.

2.3. Water:

Water plays a vital role in concrete while mixing; it triggers and initiates the reaction between cement and aggregate. The pure drinking water was used in the experimental work.

2.4. Super plasticizing Admixture:

The chemical admixture used in the experimental work is Sulphonated Naphthalene Formaldehyde alias Conplast SP-430.It is used to attain high degree of workability. It

facilitates production of high quality Concrete. Cohesion is improved due to dispersion of cement particles thus minimizing segregation and improving surface finish.

3. Mix Proportion:

The mix proportion of pervious concrete is made from M15 grade of concrete which possess of ratio 1:2:4; where 1 denotes the cement, 2 denotes the fine aggregate, and 4 refers to coarse aggregate; from the mix design the Cement required for $1m^3$ of M15 grade of concrete is 0.143 m^3 and the sand is 0.286 m^3 and the coarse aggregate is 0.572 m^3. In the above ratio the fine aggregate is completely eliminated and instead of fine aggregate 75% of its volume is replaced with coarse aggregate and rest 25% is replaced with Cement. Then the water cement ratio is taken as 0.3 which is chosen by experimental test values. Similarly the sand is added by 5% and the rest is filled by coarse aggregate and cement for other four samples. Totally five types of samples are casted.

4. Casting of Pervious Concrete:

The pervious concrete cubes are casted in laboratory for experimental study of strength properties of pervious concrete. The pervious concrete is casted by a cube mould of size 150mm X 150mm X 150mm as shown in the Figure 1 Totally four different samples of pervious concrete with various mix design is casted and the compression strength of the pervious concrete is compared with the compression strength of M_{15}concrete cubes of same dimensions. Pervious concrete casting is shown in figure 1

4.1. Sample 1: M15 grade of concrete

The concrete cube is casted with mix proportion 1:2:4 which belong to M15 grade of concrete. The water cement ratio is 0.3. Totally 9 cubes are casted and then allowed to cure under water. After curing of 7 day, 14 day, and 28 days the compression strength of the cube is tested by using compression strength testing machine.

4.2. Sample 2: 0% sand pervious concrete

The pervious concrete cube is casted with 0% of sand. This is achieved from M15 grade of concrete which corresponds to 1:2:4 mix proportion. From the mix proportion the sand is eliminated and 75% of its vacant is replaced with coarse aggregate of size 8mm to 10 mm and the rest of 25% is replaced with cement. The water cement ratio is 0.3 and a special durability admixture is added 2.5ml/kg of cement to increase the strength and durability. Totally 9 cubes are casted and then allowed to cure under water. After curing of 7 day, 14 day, and 28 days the compression strength of the cube is tested by using compression strength testing machine.

4.3. Sample 3:5% sand pervious concrete

The pervious concrete cube is casted with 5% of sand. This is also achieved from M15 grade of concrete which corresponds to 1:2:4 mix proportion. From the mix proportion the sand is added by 5% and the rest 95% of sand is eliminated. From that 75% of its vacant is replaced with coarse aggregate of size 8mm to 10 mm and the rest of 20% is replaced with cement. The water cement ratio is 0.3 and a special durability admixture is added 2.5ml/kg of cement to increase the strength and durability. Totally 9 cubes are casted and then allowed to cure under water. After curing of 7 day, 14 day, and 28 days the compression strength of the cube is tested by using compression strength testing machine.

4.4. Sample 4:10% sand pervious concrete

The pervious concrete cube is casted with 5% of sand. This is also achieved from M15 grade of concrete which corresponds to 1:2:4 mix proportion. From the mix proportion the sand is added by 10% and the rest 90% of sand is eliminated. From that 70% of its vacant is replaced with coarse aggregate of size 8mm to 10 mm and the rest of 20% is replaced with cement. The water cement ratio is 0.3 and a special durability admixture is added 2.5ml/kg of cement to increase the strength and durability. Totally 9 cubes are casted and then allowed to cure under water. After curing of 7 day, 14 day, and 28 days the compression strength of the cube is tested by using compression strength testing machine.

4.5. Sample 5:15% sand pervious concrete

The pervious concrete cube is casted with 5% of sand. This is also achieved from M15 grade of concrete which corresponds to 1:2:4 mix proportion. From the mix proportion the sand is added by 10% and the rest 90% of sand is eliminated. From that 70% of its vacant is replaced with coarse aggregate of size 8mm to 10 mm and the rest of 20% is replaced with cement. The water cement ratio is 0.3 and a special durability admixture is added 2.5ml/kg of cement to increase the strength and durability. Totally 9 cubes are casted and then allowed to cure under water. After curing of 7 day, 14 day, and 28 days the compression strength of the cube is tested by using compressive strength testing machine. Pervious concrete cube after curing is shown in figure 2 and 3.

5. Compressive Strength Test:

The compressive strength test is done to know the maximum compressive strength of pervious concrete. The compressive strength test will be carried out on the pervious concrete specimens at the end of 7, 14 and 28 days of curing. The compressive strength test procedures are as follows

- The bearing surface of the compression testing machine is cleaned and the pervious concrete cube is placed.
- Then the upper plate is moved down to touch the top face of the concrete cube.
- Then the load is allowed to apply on the pervious concrete cube placed in the compression strength testing machine.
- The load is applied without shock and gradually increased at the rate of 35 Kg/cm^2/min until the failure occurs.
- The load is noted when the dial returns backwards and the compression strength is calculated by the following formula.
- Compression strength = load (P) / area (A)
- The unit for compression strength is N/mm^2.
- The compressive strength of pervious concrete cube is determined by taking average of three values. The compressive strength test on pervious concrete specimen is shown in figure 4, 5 and 6

6. Result and Discussion:

From the above results the compressive strength of pervious concrete is similar to the strength of M15 grade of concrete. The maximum compressive strength of M15 grade of concrete is 14 N/mm^2 for 28 days. Similarly the pervious concrete also comprises of strength around 14 N/mm^2. The maximum compressive strength of pervious concrete with 0% sand is 14 N/mm^2 for 28 days. The pervious concrete with 5% of sand achieves compressive strength of 14.6 N/mm^2. The maximum compressive strength of pervious concrete with 15% of sand is 15.2 N/mm^2. From the above results we could see that the compressive strength of pervious concrete increases with increase of sand. However the strength increases with increase of sand the permeability decreases due to less percentage of voids because the sand forms dense and the voids are filled by sand. The main aim of pervious concrete is to drain rain water and storm water run-off so the pervious concrete with apt strength with apt porosity is achieved by 0% of sand usage in pervious concrete.

7. Conclusion:

From the experimental result, the pervious concrete with addition of sand increases the strength and decreases in porosity. Hence the strength and porosity is inversely proportional to each other. The pervious concrete with 0% of sand has more porosity and less strength but the pervious concrete with 15% of sand posses less porosity and high strength. However the strength of pervious concrete with 0% of sand comprises of strength equal or equal to the strength of M15 grade of concrete. Mostly M15 grade of concrete is used for pavement purpose. Thus the pervious concrete with 0% to 5% of sand is recommended to use for pavement purpose to drain rain water and storm water run off. In India pervious concrete will become more popular in future due to increased urbanization and reduced ground water level.

7. References:

[1] American Concrete Institute. 2006. "Pervious Concrete", ACI Manual of Concrete Practice, 522R-06 Committee, Farmington Hills, MI.
[2] Tennis PD, Leming ML, Akers DJ. Pervious Concrete Pavements. EB302 Portland Cement Association Skokie Illinois and National Ready Mixed Concrete Association, Maryland: Silver Spring; 2004.
[3] S.O. Ajamu, A.A. Jimoh, J.R. Oluremi "Evaluation of Structural Performance of Pervious Concrete in Construction"
[4] Darshan S. Shah , Jayeshkumar Pitroda
[5] "An experimental study on durability and water absorption properties of pervious concrete"
[6] Darshan s. Shah*Jayeshkumar pitroda* **"**An experimental study on hardened properties of pervious concrete"
[7] ACI 552R (2010): "Report on Pervious Concrete", American Concrete Institute, Farmington Hills, Michigan, **http://www.concrete.org**
[8] 7. Crouch, L. K., Pitt, J., and Hewitt, R. (2007). "Aggregate Effects on Pervious Portland Cement.
[9] Kevern.J, wang.K, Suleiman.M.T, and Schaefer.V.R,."Pervious concrete construction: Methods and Quality Control".
[10] A.K.Jain, Dr.J.S.Chouhan, S.S.Goliya "Effect of Shape and Size of Aggregate on Permeability of Pervious Concrete"
[11] Stephen A.Arhin.,RezeneMadhi.,Wasi Khan "Optical Mix Design for Pervious Concrete for an Urban Area"
[12] IS456–2000"Code of practice for plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.
[13] IS516-1959"Methods of Tests for strength of concrete", Bureau of Indian Standards, New Delhi.
[14] IS 10262-2009 "IS Method of Mix Design", Bureau of Indian Standards, New Delhi.
[15] IS 383:1970 "Specification for coarse and fine aggregates from natural source for concrete"
[16] Shetty M.S. "Concrete Technology" S.Chand& Co.Ltd, 1997.
[17] ACI Committee 522, 2006.PerviousConcrete.Report No.522R-06, American Concrete Institute. Detroit, USA, pp: 25.
[18] Eco-concrete Research Committee, 1995.Report of the eco-concrete. Japan Concrete Institute, Tokyo.
[19] Meininger, R.C., 1988.No-fines pervious concrete for paving. Concrete, 10(8):20-27.