

EXPERIMENTAL INVESTIGATION ON PERVIOUS CONCRETE- A REVIEW

Anuja Gangthade, Prajakta Choudhary, Naina Bhende, Pratiksha Parate, Pranit Jiwane, Harshal Khusange

Department of Civil Engineering, KDK College of Engineering, Maharashtra, India.

Abstract:-At many projects water logging at highway and parking is the major issue especially during monsoon as pavements and floors are normally impermeable. This results in considerable amount of investment in repairs and providing storm water drain systems, which may get clogged during peak over flow. Besides this, there are many other problems that arise due to the above. In such situations it is very important to think about an economical solution which helps in getting rid of all above problems. The best solution to above problem is permeable concrete. This papers summarize the various studies which have been carried out to fulfill the requirement of permeable concrete.

Key words: Permeable, Runoff, Compressive Strength, Interconnectivity.

I. INTRODUCTION

Pervious concrete is a very special type of concrete with high porosity used for flat work application basically that's allow water from precipitation and other sources to pass directly through thereby reducing the runoff from the site and allowing ground water recharge.

India is a developing country and safety of roads is still in a Pervious concrete pavement is a unique and effective means to address important environmental issues and support green, sustainable growth.

In this concrete porosity is attained by a highly interconnected void content. Also in permeable or pervious concrete has no fine aggregate and has just enough cementing paste to coarse aggregate particles while preserving the interconnectivity of the voids. Permeable or pervious concrete is traditionally used in parking area with low traffic, walkways in park and garden residential, green house, basketball court, volleyball house.

Pervious concrete is typically designed with high void content (15-25%). There is no fine aggregates in pervious concrete. The tests conducted to determine the fresh concrete properties were the slump test and compacting factor tests. These were complimented by hardened concrete tests including the following: compressive strength, indirect tensile strength. After that there is a comparisons are made between the both type of concrete.



Fig no.1.1

Pervious concrete pavement is unique and effective technique to meet the future demand. Strength of the pervious concrete is low as compared to conventional concrete it is all due to high porosity.

In pervious concrete, carefully controlled amounts of water and cement materials are used to create a paste that forms a thick coating around aggregate particles. A pervious concrete mixture contains little or no sand, creating a substantial void content. Using sufficient paste to coat and bind the aggregate particles together creates a system of highly permeable, interconnected voids that drain quickly.

II. LITERATURE REVIEW

1. T. Dharshini Priya¹ Et.Al, published research paper “Experimental Investigation on Pervious Concrete Using Special Admixtures” in March 2018

Pervious concrete acts a physical barrier to various action of any problems in the road surface. The flexural strength increases the durability and crack formation on the surface of the cracks is totally stopped by this pervious concrete enriched with PVA as the polymer enhances the flexural stability for the road. Also, the Compressive strength and crushing load helps in giving the more stability to the road. The test shows the pervious concrete is completely free from the chemical reaction induced in it and it also gives less carbonation as the cement which is major cause of CO₂ is replaced by GGBS. Hence, the two parameters shows the durability of the pavement made from Pervious concrete efficiently up to thirty years with less traffic and manageable road acquisition The Compressive strength, Flexural strength, Split tensile strength have increased by adding admixtures such as GGBS (25%) and POLYVINYL ALCOHOL (2%).

2. Sujeet Kumar Saha² Et.Al, published research paper on-“Experimental Study on behavior of Pervious Concrete in Strength and Permeability by Changing Different Parameters” in 2018

Foremost objective of this paper is to study the performance and behavior of the open structure of pervious concrete in Indian Climatic Condition, to study the strength properties of conventional concrete with pervious concrete, to study the influence of fine aggregate, w/c ratio, admixture on the properties of pervious concrete. Use of fiber, sand and changing of water-cement ratio yielded different results. Fiber content has high effect on compressive strength where as it shows an average effect on flexural & split tensile strength. i.e. with increase in 100% fiber, comp Pervious concrete with fibers is more flexible than without fiber. Compressive strength decreases by 50% & moreover coefficient of permeability also decreases. Sample M1 to M4 bearing w/c ratio of 0.32 has comparatively less strength than that of sample M5 to M8 which contain w/c ratio of 0.28. Sample M7 shows maximum compressive strength of 29.50 N/mm² but it's coefficient of permeability 0.5 cm/sec. Hence sample M5 bearing compressive strength of 28.39 N/mm² & coefficient of permeability 1.25 cm/sec.

3. Husain N Hamdulay³ Et.Al, published an experiment named “Effect of Aggregate Grading and Cementitious by Product on Performance of Pervious Concrete”, in 2015.

Object of the study was to replace the cement with industrial by-product such as fly ash, GGBFS which have been used successfully as supplementary Cementous material. In this study, cement of 53 grade (specific gravity 3.15), coarse aggregate (passed through 20 mm and retained on 10 mm sieve), GGBFS (specific gravity 2.88), fly ash and water are used. Now maintaining the W/C ration constant, following mix proportions are used. FA are used in 85:15 and 65:35 proportions and GGBFS are used in 75:25 and 50:50 proportion. They concluded that the compressive strength of concrete was increased by using GGBFS as supplementary material and grading of Vol-3 Issue-2 2017 IJARIE-ISSN(O)-2395-4396 4020 www.ijarie.com 198 aggregate is equally important to get strength and permeability, grater size have law compressive strength and high permeability vice versa

4. **Sukamal Kanta Ghosh⁴ Et.Al** published a review paper named “A Review of Performance of Pervious Concrete Using Waste Material” in 2015.

This review paper illustrates the performance of pervious concrete with solid waste like fly ash, furnace slag, and rice husk ash, silica fume, and solid waste (glass powder, ceramic waste, bottom ash) and its effect on

compressive strength and permeability. Fly ash (2-50%), RHA (10-30%), GGBFS (35-70), Silica fume (8-12%), Rubber waste, Glass powder (20-40%) are used replacement of cement. They conclude that the compressive strength and permeability with using waste material are as follows. Fly ash gives long term compressive strength when increase portion then compressive strength decrease. Rice husk ash gives more than 10-12% decrease compressive strength, permeability, and durability. GGBFS gives higher strength but low permeability. Silica fume increases compressive strength but no influence in permeability. Glass powder increases strength durability and workability. Ceramic powder improves durability

5. **Saeid Hesami⁵ Et.Al**, published a paper named “Effect of Rice Husk and Fibre on Mechanical Properties of Pervious Concrete Pavement” in 2014.

In this paper, glass material, steel fiber and PPS fibers and also RHA in different proportions, were used to improve the mechanical properties of pervious concrete and finding its effect on compressive strength, tensile strength, flexural strength and permeability. Coarse aggregate sized from 2.36 to 19.0 mm, RHA of 0%, 2%, 4%, 6%, 8%, 10% and 12% weight percentage as a cement replacement, PPS fiber 0.3%, steel fiber 0.5% and glass fiber 0.2% are to remain constant at 3 different w/c ratio of 0.27, 0.33 and 0.40. Outcome of Study was as described below. a) The compressive, tensile and flexural strength were found to be maximum at w/c ratio of 0.33. b) For 10% replacement of RHA and w/c ratio of 0.33, the compressive strength of pervious concrete containing fibers increases by 34%, 37% and 36% respectively for glass, steel and PPS fibers. c) For the above mentioned mix design, the tensile strength increases by 31%, 30% and 28% for glass, steel and PPS fibers respectively. d) Finally, the flexural strength undergoes a 64%, 63% and 69% increase when glass, steel and PPS fibers are used, respectively.

6. **Darshna shah⁶ Et.Al**, published a research paper “Pervious Concrete: New Era for Rural Road Pavement” in 2013.

Object of the study was to evaluate the cost effectiveness of the pervious concrete compared to normal concrete. In this study, Normal concrete was used as per IS design of M20 grade, which was constituted by 59.25 kg of cement (300rs/50kg), 88.88 kg of Fine aggregate (600rs/1 ton) and 177.8 kg of course aggregate (1000rs/1ton). Pervious concrete was used as per NRMCA guideline, which was constituted by 46.5 kg of cement (300rs/50kg) and course concrete (1000rs/1ton). They conclude that the pervious concrete reduce the storm water runoff to increase the ground level water to eliminate the costly storm water management practices. And there is considerable saving in amount about 29rs/m³ or 18rs/ft.

7. **Karthik H. Obla⁷**, Published Article in INDIAN CONCRETE JOURNAL named “Pervious Concrete- An overview” in August 2010

Investigated that Pervious concrete is a special high porosity concrete used for flatwork application that allows water from precipitation and other sources to pass through, thereby reducing the runoff from a site and recharging ground water levels. Its void content ranges from 18 to 35% with compressive strengths 28 to 281 kg/cm². The Pervious concrete will fall into the range 80 to 720 per minute per square meter. Typically, Pervious concrete has little or no fine aggregate and just enough cementitious paste to coat the coarse aggregate particles while preserving the interconnectivity of the voids.

8. Ajamu.S.O⁸, Et.Al -“Evaluation of Structural Performance of Pervious Concrete in Construction” November 2005

The permeability and strength of pervious concrete depends on the particle sizes and proportions of the constituent materials of which the concrete is made of. In this paper, structural property and permeability of pervious concrete made with different coarse aggregate sizes is presented. For the different aggregate/cement ratio used in this study, coarse aggregate size 9.375mm has higher compressive strength values compared to those made from 18.75mm aggregate size while 18.75mm aggregate size had higher permeability value compared to that of 9.38mm

9. Abadjieva, T & Saphiri⁹ “Investigations on Some Properties of Permeable Concrete” in 1997.

Abadjieva et al (1997), determined that the compressive strength of permeable concrete increases with age at a similar rate to conventional concrete. The permeable concrete specimens tested had aggregate-cement ratios varying from 6:1 to 10:1. The 28 day compressive strength obtained by these mixes ranged from 1.1 and 8.2 MPa, with the aggregate-cement ratio of 6:1 being the strongest. He concluded the most plausible explanation for the reduced strength was caused by the increased porosity of the concrete samples. This strength is sufficient for structural load bearing walls and associate applications.

10. Malhotra, V. M.¹⁰. “Permeable Concrete – Its Properties and Applications”, Journal of the American Concrete Institute, 1976

Malhotra (1976), found that the density of permeable concrete is generally about 70 percent of conventional concrete when made with similar constituents. The density of permeable concrete using conventional aggregates varies from 1602 to 1922 kg/m³. Adequate vibration is imperative for strength of conventional concrete. The use of permeable concrete is different and is a self-packing product. Malhotra (1976) suggests that the use of mechanical vibrators and ramming is not recommended with permeable concrete. A light rodding should be adequate and used to ensure that the concrete reaches all sections of the formwork. This is not a problem with conventional concrete since it has greater flow ability than permeable concrete. The light rodding ensures that the concrete has penetrated all the areas impeded by reinforcing steel. Malhotra stresses that in situations where normal conditions are not achieved during placement and curing, the formwork should not be removed after 24 hours as with conventional concrete. Permeable concrete has very low cohesiveness and formwork should remain until the cement paste has hardened sufficiently to hold the aggregate particles together. However, this is more of a consideration in low temperature conditions and when used in non-pavement applications where the concrete is not sufficiently supported by the ground or other means.

III. CONCLUSION

We have studied various Research papers related to our project topic which includes to learn the properties of pervious concrete such as density, Porosity, Permeability, Shrinkage, durability, etc. To deal with the economic benefit of pervious concrete and behavior of concrete with respect use of different types of admixtures and studying their results. Pervious concrete reduces the storm water runoff to increase the ground level water to eliminate the costly storm water management practices and there is considerable saving in amount. It was also

found that by using coarse aggregate of size 9.375mm gives higher compressive strength values compared to other aggregate sizes. Silica fume increases compressive strength but has no influence in permeability. In pervious concrete, mechanical vibrators and ramming is not necessary but light rodding is recommended.

REFERENCES

- [1] T. Dharshini Priya, S. B. Miruthula -“Experimental Investigation on Pervious Concrete Using Special Admixtures”, Article in International Journal of Engineering Research & Technology, March 2018.
- [2] Sujeet Kumar Saha, Dr. S.Senthil Selvan -“Experimental Study on behavior of Pervious Concrete in Strength and Permeability by Changing Different Parameters” Article in International Journal of Applied Engineering Research, 2018.
- [3] Husain N Hamdulay, Roshni J John -“Effect of Aggregate Grading and Cementitious by Product on Performance of Pervious Concrete”, Article in International Journal of Innovative Research in Science, Engineering and Technology, August 2015.
- [4] Sukamal Kanta Ghosh, Ananya Chaudhury, Rohan data and D.K.Bera “A Review of Performance of Pervious Concrete Using Waste Material” in 2015.
- [5] Saeid Hesami, Saeed Ahmadi and Mahdi Nematzadeh published a paper named “Effect of Rice Husk and Fibre on Mechanical Properties of Pervious Concrete Pavement” in 2014.
- [6] Darshna shah, Prof. Jayeshkumar Pitroda - “Pervious Concrete: New Era for Rural Road Pavement”, Article in International Journal of Engineering Trends and Technology, 2013.
- [7] Karthik H.Obla-“Pervious Concrete- An overview”, Article in Indian concrete journal, August 2010.
- [8] Ajamu.S.O, A.A.Jimoh-“Evaluation of Structural Performance of Pervious Concrete in Construction”, Article in International Journal of Engineering and Technology, November 2005.
- [9] Abadjieva, T & Sefhiri. “Investigation on some properties on Permeable Concrete” in 1997
- [10] Malhotra,V.M.1976 “Permeable concrete-its properties and applications” , Journal of the American concrete Institute Vol 73, No.11 pp 628-644.