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IMPROVEMENT IN PROPERTIES OF POROUS CONCRETE USING FIBER

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Abstract - *Pervious concrete is a special type of concrete with highly porous structure 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. This porosity is attained by a highly interconnected void content. In pervious concrete, the amount of fine aggregate is little or no fine aggregate such as sand, because of that it is referred as "No fine or less fine concrete". The use of pervious concrete is significantly increasing due to reduction of road runoff and absorption of noise. This concrete is being used as paving material in the United States for the construction of parking lots, sidewalks and secondary roads. The production of better quality pervious concrete is necessary to meet specification requirements for the construction of durable pervious concrete pavements. Till now many researchers have used different materials in the pervious concrete like flyash, rice husk, geogrids etc. Fibers can also be used to strengthen the pervious concrete, so it can easily be used for higher loads.*

Key Words : Pervious concrete, Compressive strength, Permeability, Split tensile strength.

1.INTRODUCTION

Pervious concrete which is also known as the gap-graded, no-fines, permeable and porous concrete and enhance porosity concrete has been found to be a reliable storm water management tool. . Pervious concrete has become substantial popular during recent decades, because of its potential share in solving environmental issues. Pervious concrete is a highly efficient concrete which has relatively high water permeability compare to conventional concrete due to interconnected void structure. Pervious concrete is an open-graded material consisting of Portland cement, coarse aggregate, little or no fine aggregate, admixtures, and water. Typically, void percentage between 15% to 25% are achieved in the hardened concrete and flow rates for water through pervious concrete.

Massive urbanization in Indian cities is causing the ground water to go deeper and is causing water shortage. For example; Cherrapunji suffers drought while the monsoons bring flooding Chandigarh city taps ground water from deep confined aquifers which do not get naturally recharged. Further the rain water falls on the concrete and asphalt surfaces tends to carry a high level pollution and this pollution ends up in waterways ultimately .So, sustainable technologies like pervious concrete are likely to become more popular in India.

Advantages of pervious concrete are as follows-

1. Storm water runoff decreases because of high permeability

2. Increase in ground water level

3. Noise absorption

4. Less maintenance required

5. Less heat consumption due to open pore structure and high void content

2. Methodology

1. Collection and study of literature/ journals related to the pervious concrete incorporated with fibers and different materials.

2. Collection of materials for preparation of pervious concrete.

3. Material

3.1 Course aggregates - Tests for coarse aggregates were conducted as per IS : 2386- 1963 and IS : 383-1970. Sizes of crushed angular coarse aggregate with 100% passing 10mm sieve and 100% retained on 6mm sieve to be used in study.

3.2 Cement – Cement to be used for experimental investigation is 53 grade OPC

3.3 Fibers – Locally available plastic fibers (waste product)

Test to be conducted on pervious concrete are as follows-

Compressive strength test:

Compressive strength tests were conducted on a cube of size 150*150*150 mm at age of 7 days & 28 days curing. Standard testing machine with a most capability of 2000 KN was used at commonplace rate of loading as per IS 516-1959. Compressive strength,

$C = P/A.$

Split Tensile Strength test:

Tests were conducted on cylindrical specimen with diameter 100 mm & length 200 mm on a standard testing machine with a maximum capacity of 2000 KN at standard rate of loading as per IS 516-1959.

Split Tensile strength = 2P/(πDL). Its unit is N/mm2.

Permeability Test:

The coefficient of permeability was deduced from Darcy's law, which was preliminary used as a falling head test to obtain its coefficient as per ASTM D2434.

It was calculated as

$$K = QL/HAt$$

where,

Q = quantity of water collected in cm3

K = coefficient of permeability (cm/s)

L = length of specimen (cm)

T = time (sec)

A = Cross section area of specimen (cm2)

H = Water head (cm)

LITERATURE REVIEW

Anthony torres (2015) presented the use of thick cementitious paste on performance of pervious concrete and carried out the significance change in mechanical properties of pervious concrete. With the use of limestone with sizes of 9.54 mm and 6.35 mm, they thicken the cementitious paste. They minimized the other variables such as cement grades and types, w/c ratios, sample size; admixtures etc. for improving the thickness of cement paste. Based on the tests and results, they concluded that porosity of pervious concrete decreases with an increase of cementitious paste thickness. And also permeability of concrete decreases with increase of cementitious past thickness in pervious concrete. And certainly decrement in porosity and permeability, compressive strength and split tensile strength increased but it can defeat the purpose of pervious concrete if paste thickness becomes too thick.

Rahul bansal (2015) studied the basic replacement of cement to fly ash. It was observed that 10% replacement of fly ash was 20% and 50% decrease the compressive strength at the age of 7 and 28 days respectively. In 20% replacement, 7% and 11% increase in compressive strength was observed at the age of 7 and 28 days respectively. In 30% replacement 23% and 19% increase the compressive strength was observed at the age of 7 and 28 days respectively. They concluded that As the fly ash content increases there was increase as well as decrease in the strength of concrete. It was also observed that with increase in age the compressive strength also increased for fly ash replaced concrete.

Amitava (2015) stated the effect of local power plant's fly ash in making of HVFA concrete with using of 5 to 10% silica fume as admixture to improve the strength parameters of HVFA concrete. Based on the experiments and results, it showed that with replacement of 50% cement to fly ash, workability of concrete improves. And it was also found out that some replacement of sand to fly ash can be used to make lower grade concrete

Rui zhong (2015) dealt with silica fume and ultra-fine silica powder to improve and advance the ultra high performance pervious concrete matrix. To achieve this goal of an ultra-high performance cement based matrix with compressive strength in excess of 150 MPa and high durability properties designed and applied to the mixture design concept of pervious concrete. They found out from the results that Based on enhanced mechanical properties as well as improved durability, high performance pervious concrete potentially allows extending the application of pervious concrete and thus carries a vital potential in effectively counteracting the growth of impervious urban areas.

Obilade (2014) concluded that when cement is partially interchanged by RHA, its content is in the range of 0 to 20% for optimum addition. Compressive strength of concrete is decreased with the increment of RHA content. He examined the effect of RHA and its fiber on mechanical properties of pervious concrete. He concluded that 8% is optimum percentage of RHA without fibers, while it is between 8 to 10% with fibers, he further added that permeability of pervious concrete by adding 12% RHA content is considerably higher than adding 10% of RHA content. It is also noted that addition of 10% RHA content gives higher compressive, tensile and flexural strength than 12% RHA content.

Rafat siddique (2013) studied the properties of self-compacting concrete (SCC) made with coal bottom ash. The mixtures were prepared with three percentages (0, 10, 20 and 30) of coal bottom ash as partial replacement of fine aggregates. Tests were conducted up to the age of 28 days & results indicated that SCC mixes developed 28-day compressive strength between 25.8 and 35.2 MPa.

Akeke (2013) examined the properties of concrete by replacing cement with 10%, 20% and 25% RHA. According to him when content of RHA increased from 10 to 25 % flexural strength and split tensile strength decreases gradually. Whereas there was not any considerable effects on compressive strength with the increase in RHA content.

Fereshteh sabet (2013) used mineral admixtures and discusses the effect of natural zeolite, silica fume and fly ash on the properties of fresh and hardened concrete. Slump flow, super plasticizer demand, compressive strength, electrical resistivity, Permeability and chloride permeability was measured for all mixes. The test results concluded that incorporation of mineral admixtures generally improve the mechanical and durability characteristics of the mixes. However, silica fume is slightly more effective than natural zeolite or fly ash in improving durability and properties of self-consolidating high performance concrete, while natural are much more cost effective.

Sanket Sharma (2012) found out the effect of percentage of fine aggregates and cement to coarse aggregate ratio, to study the mechanical properties of pervious concrete. Tests and results concluded that with addition of 5% fine aggregates in pervious concrete, it increases the compressive strength but also strength is decreased with further increment of percentage of fine aggregates. And as compared to the no fine aggregates in concrete, flexural strength of pervious concrete is increased by 50% with addition of 10% fine aggregates.

Jing yang (2012) examined the effect of smaller sized aggregates, silica fume and super plasticizer to increase the pervious concrete strength greatly. Based on results, they concluded that with use of smaller sized course aggregates it helped to improve the significant strength of pervious concrete. SF and SP also improved the strength of pervious concrete. Also compressive strength of composition of these materials can be reached up to 50 MPa and it can be applied to footpath and also the low traffic vehicle road.

P.Nath (2011) determined the durability properties of high strength concrete utilizing high volume Class F fly ash sourced from Western Australia have been investigated. Concrete mixtures with fly ash content as 30% and 40% of total binder or cement were used to cast the test specimens. The 28-day compressive strength of the concrete mixtures varied from 65 to 85 MPa. The fly ash concrete samples showed less drying shrinkage than the control concrete samples when designed for the same 28-day compressive strength of the control concrete. In general, use of fly ash as partial replacement of cement improved the durability properties of concrete.

Ravindrarajah (2010) investigated the properties of pervious concrete by replacing the proportion of fly ash by 20% and 50% of cement. He determined that pervious concrete with high porosity shows high permeability and low compressive strength and .The outcomes of their investigation described that when 50% of cement was replaced by fly ash the permeability of pervious concrete was not notably affected and compressive strength will reduced with increase in content of the fly ash.

Na Jin(2010)worked on "fly ash applicability in pervious concrete" using 2% and 32% fly ash in pervious concrete. He observed that higher compressive strength can be achieved by using 2% fly ash pervious concrete than that of using fly ash content of 32% in pervious concrete. He also showed that fly ash helps to enhance long term compressive strength of pervious concrete.

Baoshan huang (2009) carried out the experiment on pervious concrete to improve the strength properties with use of latex polymer. With the use of latex, natural sand and fiber they examined the effect of polymer modification on mechanical and physical properties of PMPC. Based on results, it was possible to produce pervious concrete mixture with acceptable permeability and strength through the combination of latex and sand.

Yukari (2009) investigated on the properties of pervious concrete by interchanging the cement with fly ash content about 20% and 50%. He determined that there is decrement in compressive strength of concrete with increment of fly ash content. When fly ash proportions is increased up to 20% in concrete, decrement in permeability is observed, but after on further addition of fly ash content reached up to 50% in concrete permeability is increased which is nearly similar to no fly ash pervious concrete.

CONCLUDED REMARK

From the study of literature reviews and preliminary study of the topic some remarks are concluded as follows:-

1. The void content percentage decreases with decrease in size of coarse aggregate.

2. The compressive strength of pervious concrete decreases with increase in its size.

3. The permeability increases with increase in size of course aggregates.

4.Strength of pervious concrete can be increased by reinforcing it with fibers

REFERENCES

Siddharth talsania, jayeshkumar pitroda, prof. Chetna m. Vyas, "A Review of Pervious Concrete by Using Various Industrial Waste Materials",2015; 2(12) pp 142-151

Obilade, "Use Of Rice Husk Ash As Partial Replacement For Cement In Concrete", International Journal of Engineering and Applied Sciences, Volume 5, No 4, Sept 2014.

Saeid Hesami, Saeed Ahmadi, Mahdi Nematzadeh, Effects of rice husk ash and fibre on mechanical properties of pervious concrete pavement, Construction and Building Materials 53 (2014) 680–691.

Shihui Shen, Maria Burton, Bertram Jobson, Liv Haselbach, "Pervious Concrete With Titanium Dioxide As A Photocatalyst Compound For A Greener Urban Road Environment", Construction and Building Materials 2012;35: 874–883.

Sri Ravindrarajah, A.Yukari, "Environmentally Friendly Pervious Concrete for Sustainable Construction",35th Conference on Our World in Concrete & Structures,Singapore,25-27 August,2010.

Na Jin, M.S. Thesis "Fly Ash Applicability in Pervious Concrete", The Ohio State University,2010.

Siddharth Talsania, Jayeshkumar Pitroda, Chetna M. Vyas., Effect of rice husk ash on properties of pervious concrete, Int. J. Adv. Engg. Res. 2015; 296-299.

Karthik H . Obla., "pervious concrete – an overview," Indian Concrete Journal, August 2010 pp. 9-18.

Yukari Aoki., M.E.Thesis "Development of Pervious Concrete", Faculty of Engineering and Information Technology, University of Technology, Sydney, June 2009.

Kartini, Mahmud, Hamidah, "Strength Properties Of Grade 30 Rice Husk Ash Concrete", 31stConference on Our World In Concrete & Structures: 16 – 17 August 2006, Singapore

NRMCA, "What, Why, and How? Pervious Concrete, "Concrete in practice series, CIP 38, Silver Spring, Maryland, May 2004, 2pp.

Pervious concrete pavements, southeast Association, www.pervious.info