A REVIEW ON EXPERIMENTAL INVESTIGATION OF PERVIOUS CONCRETE USING ALTERNATE MATERIALS

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ABSTRACT - Pervious concrete is different from conventional concrete as it porous, permeable and does not contain fine aggregate. The objective of this review paper is to study the effect of different alternate material used in pervious concrete. The mechanical properties such as compressive strength, permeability, flexural strength their advantages, disadvantages of pervious concrete using such materials are discussed here. Several research papers, thesis and articles have been referred to understand experimental investigation on pervious concrete with use of different alternate material such as fly ash, silica fume, brick chips and marble chips etc.

Keywords - Pervious concrete, Pozzolonic material, alternate material.

1. INTRODUCTION

1.1 Pervious Concrete:

It is said that when it rains it drains. Pervious concrete or permeable concrete acts as a filtration device for storm water and turns the entire parking area, drive ways, tennis court, green house or other civil engineering structures into a retention treatment basin. Which further flow through the subgrade beneath, taking with it pollutants that would end up in municipal storm water systems. Naturally occurring soil microbes then store and break down the pollutants, preventing aquifer pollution. Pervious concrete can be defined as an open graded or "no-fines" concrete that allows rain water to infiltrate through to the underlying sub-base (ACI Committee 522-2006). Pervious concrete is a custom-made- property concrete with high water permeability which allow the passage of water to flow through easily. Pervious concrete is a mixture of Portland cement, aggregate, and water that provide a level of porosity which allows water to percolate into the sub-grade. It differs from the conventional concrete in terms of compressive strength since it usually contains a nominal amount of fine aggregate.

1.2 Alternate materials:

Concrete is mixture of cement, aggregate water and sand. Alternate material is a material which is substitute to any of the ingredient in concrete. Mostly cement is replaced by such alternative. This material are finely grounded that replace or supplement the use of Portland cement. This material generally reduces the cost and or improves one or more technical properties of concrete. Generally pozzollonic material possesses cementitious property therefore they are partially replaced by cement. In this paper some of the alternate material such as fly ash, silica fume, brick chips and brick dust are referred.

2. LITERATURE REVIEW

2.1 Pervious concrete using alternate materials:

Tawatchai Tho-in (2012) [1] carried out experiment on pervious geo polymer concrete (GPCs) were prepared from alkali activated lignite high calcium fly ash. Different mechanical properties of pervious concrete such as permeability, compressive strength, split tensile strength etc. with the use of high calcium fly ash was determined. The test result shows compressive strengths ranges between 5.4 and 11.4 MPa and splitting tensile strengths between 0.7 and 1.4 MPa. The ratios of splitting tensile to compressive strength ranged from 10.4% to 16.3% which were slightly higher than conventional concrete. The high void content was 28.7–30.4% managed to the high water permeability coefficients between 1.92 and 5.96 cm/s. Because of the high void content, the densities of PGC were low between 1680 and1820 kg/m^3 which were approximately 30% lesser than the conventional concrete. In addition, the relationships of the density-void content, compressive strength-density, and compressive strength-void content of the PGCs were found and were similar to those of the conventional pervious concrete.

Renjith. M, Muhammed Nishab (2016) [2] determined compressive strength, splitting tensile strength, void ratio and permeability using two different sizes of coarse aggregate (crushed stone aggregate, brick aggregate and burnt clay brick aggregate) of 10mm and 20mm size in pervious concrete. Test result shows the compressive strength and splitting tensile strength was almost same of burnt brick aggregate and stone aggregate. The void ratio of brick aggregate was higher than stone aggregate.

PrakashParasivamurthy (2010) [3] conducted test on pervious concrete using recycled aggregate from crushed concrete waste. Maximum size of the aggregate was of 9.5 mm to 4.75 mm particle in the coarse aggregate of crushed concrete waste, the property of the pervious cement concrete was investigated. Pervious concrete using natural aggregates developed compressive strengths in the range of 4.5 MPa to 26 MPa compared to pervious concrete using crushed concrete waste developed compressive strengths in the range of 3.2 MPa to 18 MPa. Porosity of pervious concrete using natural aggregates is in the range of 0.22 cm/s to 0.54 cm/s. compared to pervious concrete using crushed concrete waste which was observed 0.28 cm/s to 0.64 cm/s. The porosity of pervious concrete using crushed concrete waste is slightly greater than the conventional pervious concrete made from similar

mix design. Flexural strength in pervious concretes using natural aggregates is in the range of 0.8 MPa and 3.6 MPa compared to pervious concrete using crushed concrete waste, which was observed 0.72 MPa and 2.88 MPa. The Flexural strength of pervious concrete using crushed concrete waste is slightly lower than the conventional pervious concrete made from similar mix proportions.

Tanvir Hossain (2012) [4] dealt with pervious concrete using brick chips as coarse aggregate. They concluded that brick aggregate is one of the alternative materials, and has been used widely in producing lightweight concrete, and even high strength concrete. Brick aggregate pervious concrete gives better permeability than that of stone aggregate pervious concrete. From experiments they found that strength of brick aggregate pervious concrete is less than that of stone aggregate concrete for same aggregate size. The purpose of pervious concrete is to drain off rainfall therefore permeability is of important factor which is satisfied by the use of brick aggregate.

Prof Tanveer Asif (2016) [5] used silica fume in pervious concrete and studied its properties. Compressive strength of 17.0 Mpa, 9.01 Mpa, 6.32 Mpa for the mix proportion of 1:4, 1:6 and 1:8 at 28 days of curing respectively were obtained with Silica Fume mix pervious concrete. Whereas the strength of pervious concrete for normal PPC cement concrete without mixing any admixture are 9.14 Mpa, 5.92 Mpa, 4.28 Mpa for mix proportion of 1:4, 1:6 and 1:8 at 28 days of curing respectively. The development of compressive strength with the use of silica fume mixed pervious concrete gives higher strength for all mix proportion and at all the stages of curing compared to pervious concrete without Silica Fume.

Prof. Dr K.B. Parikh, M.A.Shaikh, Adil A.Haji (2016) [6] reviewed different literatures related to pervious concrete and effects of mineral admixtures. They studied various aspects of the pervious concrete using mineral admixtures along with the basic behavior, advantages, limitations, effects & mechanical properties. They concluded that replacement of fly ash with cement up to 40% gives increment in compressive strength of concrete. Use of fine aggregate up to limit from 5% to 10% can give enough structural strength in pervious concrete. But further increment of sand reduces strength properties of pervious concrete. Use of silica fume gives earlier high strength but with higher replacement of cement with this material reduces strength.

Ahmed Ibrahim et.al. (2014) [7] experimented on the mechanical and hydrological properties of Portland cement pervious concrete. The mixtures used consist of either one or two aggregate sizes. Linear regression relationship graph were developed to establish relationships between density and porosity, compressive strength and permeability, tensile strength and permeability and compressive strength and porosity. The results showed that mechanical properties of pervious concrete such as permeability, porosity, are significantly affected by using either one or two coarse aggregate sizes in all concrete mixtures. Moreover density can be an effective factor for calculating compressive strength, and porosity. In this study, the maximum compressive strength was 6.95 MPa obtained by using one aggregate size of 9.5 mm with 250 kg/m^3 cement content. The results showed that PCPC could be produced using one or two aggregate sizes at most.

2.2 Use of brick dust as alternate materials in concrete:

Sara Rogers (2011) [8] evaluated test results on testing brick dust as pozzolonic additive to lime mortars. They concluded pozzolanicity of brick dust is a function of firing temperature, mineralogy, chemical composition, and particle size. Particle size is easily determined and, but firing temperature and mineralogy of recycled bricks is difficult almost impossible, to determine. The pozzolanicity tests evaluated in this research were all successful to some extent in determining the pozzolanicity of brick dust, particularly in situations in which the clay mineralogy and firing temperature of the brick is unknown.

Er.Ranjodh Singh (2013) [9] studied self-compacting concrete using brick dust and marble chips. They found use of brick dust and marble powder produce good quality self-compacting concrete with satisfactory slump and setting times. Under certain situations, replacement of fine aggregate by brick dust and marble powder appears to increase the strength of self-compacting concrete.

Remarks from above literature review:

- Pervious concrete with the use of fly ash geopolymer binder, were prepared from alkali activated lignite high-calcium fly ash binder and coarse aggregate. The compressive strengths obtained were between 5.4 and 11.4 MPa. The compressive strengths of Pervious Geopolymer Concrete were slightly lower than those of normal Portland cement pervious concretes. The high strength PGCs could be obtained with the use of fine fly ash. In this study, the flyash used was an as-received one and was rather coarse with the Blaine fineness of 2250 cm^2/g.[1].
- Burnt earth aggregate[2], brick chips as coarse aggregate and recycled aggregate[3] possesses relatively lower bulk density, crushing and impact values and higher water absorption as compared to natural aggregate. The compressive strength of recycled aggregate in pervious concrete is relatively lower than natural aggregate concrete but it gives higher permeability as purpose of this concrete. Therefore on other hand, higher permeability decrease the amount of compressive strength of pervious concrete than conventional concrete [2, 3, and 4].
- Partial replacement of silica fume in pervious concrete gives earlier high strength but with higher replacement of cement with this material gives strength loss [5, 6].
- Use of brick dust as additive in lime mortar can develop higher strength, but with a particle size below 75 microns had a greater impact on accelerating setting time and creating a higher strength hydraulic mortar. Also brick kiln dust and marble powder which are waste material can also to produce cost effective self-compacting concrete [7,8].

3. FINAL CONCLUSION

Normally pervious concrete can be achieved from cement, coarse aggregate and water as suggested by ACI 522.In case of pervious concrete there is correlations between compressive strength, permeability, and void content. It is concluded from above literature review that with the use of alternate material such as fly ash, silica fume, crushed concrete aggregates, brick chips etc. up to certain limit it possible to get higher strength and permeability compared to conventional concrete mix.

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