INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 2 ISSUE 3 (2016) PAGES 970-973
RECEIVED : 01/05/2016. PUBLISHED : 11/05/2016
May 11, 2016

# EXPERIMENTAL STUDY ON STRENGTH OPTIMIZATION OF PERVIOUS CONCRETE

Nandhini.P[1], Ms. P.Mangiyar Thilagam[2]

**Abstract:**

This paper is focused on evaluating the performance of different pervious concrete mixtures in an Endeavour to achieve an optimized mix with adequate tensile strength and porosity. In addition, a relationship was investigated between permeability and porosity of different mixtures. This is done in an attempt to use the porosity as a quick and easy quality control test for evaluating the permeability of pervious concrete. The mix design variables investigated in this study included aggregate-to - cementing materials ratio (A/CM), aggregate gradation and cementing materials blends; ternary blends of silica fume/slag and Metakaolin /Slag were examined. Single and hybrid fibre systems were also evaluated. These included Wollastonite natural fibres and polypropylene macro-fibres. Modifications to the permeability test proposed by ACI522R, "Pervious Concrete", were made to evaluate permeability of the specimen.

**Keywords** – Porosity, A/Cm, Wollastonite, Macro fibres.

## 1. INTRODUCTION

Pervious concrete is a special type of concrete with a high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass through it, thereby reducing the runoff from a site and recharging ground water levels. The void content can range from 15 to 35% with compressive strengths of 2.75 to 27.5 N/mm$^2$. The infiltration rate of pervious concrete will fall into the range of 80 to 720 litres per minute per square meter. Typically pervious concrete has little to no fine aggregate and has just enough cementations paste to coat the coarse aggregate particles while preserving the interconnectivity of the voids. Pervious concrete is traditionally used in parking areas, areas with light traffic, pedestrian walkways, and greenhouses. Pervious concrete is an important application for sustainable construction.

## PERVIOUS CONCRETE

Pervious concrete has the ability to decrease the noise emitted by vehicles on concrete pavements due to reduction of interaction noise between the tire and pavement. Pervious pavement absorbs the sound. The characteristics of pervious concrete minimize air pressure between the tire and road surface. Therefore, pervious concrete has the potential to reduce greatly the noise generated by vehicles. Construction of fences in urban areas to control road noise could prove costly. Instead, construction of pervious concrete on the road should reduce noise as well as the expense.

## SKID RESISTANCE

Pervious concrete can remove storm water more rapidly than traditional concrete due to its higher absorption capacity and more rapid infiltration of storm water into the ground. Skid resistance is dramatically increased by minimizing water on the pavement surface.

INTERNATIONAL RESEARCH JOURNAL IN ADVANCED ENGINEERING AND TECHNOLOGY (IRJAET) E - ISSN: 2454-4752 P - ISSN : 2454-4744
VOL 2 ISSUE 3 (2016) PAGES 970-973
RECEIVED : 01/05/2016. PUBLISHED : 11/05/2016
May 11, 2016

## STORM WATER RUNOFF

Reducing storm water runoff is one of the primary functions of pervious concrete. Pervious concrete contains minimum quantity of fine aggregate and contains uniformly sized coarse aggregate so that more void space exists in the matrix for holding and transporting water. Pervious concrete can substantially reduce surface runoff water in comparison to traditional concrete pavement. Thus, pervious concrete can reduce the size of necessary storm sewers.

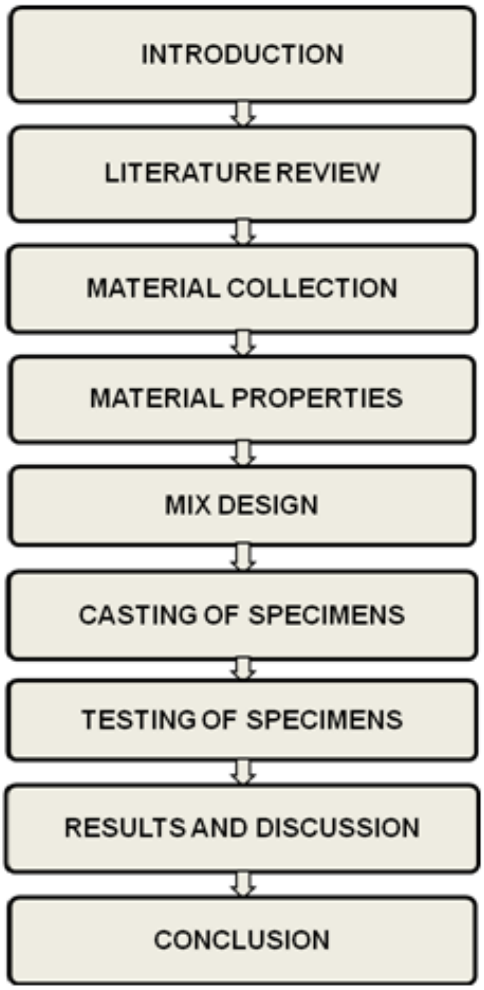


**Fig.1.Working flow chart**

## NATIVE ECOSYSTEM

Pervious concrete can filter pollutants in storm water runoff that would penetrate into the ground. As pervious concrete absorbs runoff water, it conserves this natural resource plants and for ground water recharge. Pervious Pervious concrete can filter pollutants in storm water runoff that would penetrate into the ground. As pervious concrete absorbs runoff water, it conserves this natural resource plants and for ground water recharge. Pervious concrete helps to direct runoff into the soil. This helps to conserve this precious natural resource.

## RESEARCH SIGNIFICANCE

As our planet is faced with an environmentally uncertain future, a focus on green, sustainable development has become a necessity. Innovative concepts to our present infrastructure are currently being implemented, where pervious concrete is one of the important among them. Operating on a "rain and drain" philosophy, pervious concrete is able to collect the first-flush rainfall and allows it to drain immediately into the ground to recharge the water table. Due to its permeability requirement, pervious concrete is typically designed with high void content and thus suffers from significantly reduced strength.

The primary aspiration of this research project is to optimize the strength of a pervious concrete mix design without sacrificing permeability. The optimized ingredients of this concrete would improve bonding, thus reducing the effects of raveling, while maintaining adequate permeability for drainage, and thereby allow the use of this unconventional concrete in a wider range of applications. To achieve this goal, blends of supplementary cementing materials (SCM) is incorporated into the mix design to improve the properties of the Interfacial Transition Zone (ITZ) and enhance the tensile strength of the paste.

## 2. MATERIAL PROPERTIES

### GENERAL

The various strength properties of pervious concrete are dependent on cementitious content, water-cementitious material ratio (w/cm), compaction level and aggregate gradations and quality.

### MATERIALS

### CEMENT

Ordinary Portland cement was used in casting the specimens. Ordinary Portland Cement (OPC) The Specific Gravity, Fineness, Initial setting time and Consistency of the cement were tested.

### COARSE AGGREGATE

Hard granite broken stones of less than 12.5mm size were used as coarse aggregate. The Specific Gravity, Fineness modulus, Water absorption and Bulk density of the coarse aggregate were tested.

### WATER

Potable water available in laboratory with pH value of of not less than 6 and conforming to the requirement of IS 456-2000 was used for mixing concrete and curing the specimen as well.

### METAKAOLIN

Metakaolin is a cement substitute often used in concrete countertop mixes to improve the physical properties of the concrete. It is a manufactured Pozzolanic mineral admixture made by calcinizng (thermally activating) purified kaolin clay. kaolin clay has very little reactivity. But once the clay is chemically altered by heat, it reacts very aggressively with calcium hydroxide a normal cement hydration hydro product, to form additional cementitious compounds. Metakaolin is a natural white

Pozzolana made by heating kaolin clay to temperatures of 600-800 $^0$C. In addition, Metakaolin decreases porosity, increase tensile and flexural strengths, reduces drying shrinkage, and in finish ability when the countertop is troweled. Metakaolin was used as admixture in casting the specimens. 5%, 10%, 15% and 20% of cement was replaced by the Metakaolin in order to increase the strength of pervious concrete.

## CONCLUSION AND FUTURE WORK:

In phase1, the project has been thoroughly studied and methodology of executing the work is decided by studying various literature reviews related to pervious concrete.The materials used for the casting of pervious concrete specimens were collected. This project is mainly focused on evaluating the performance of different pervious concrete mixtures in an endeavour to achieve an optimized mix with adequate tensile strength and porosity characteristics. The mix design variables investigated in this study included aggregate-to -cementing materials ratio (A/CM), aggregate gradation and cementing materials blends; ternary blends of silica fume/slag and Metakaolin were examined. Single and hybrid fibre systems were also evaluated. These included Wollastonite natural fibres and polypropylene macro-fibres. In phase 2 of this project,the cube, cylinder, prism and slab specimens with the replacement of various percentages of cement by metakaolin are to be casted and should be tested and experimentally verified in order to compare the strength, young's modulus and sorptivity characteristics of pervious concrete specimens with respect to the amount of metakaolin replaced.

## REFERENCES:

1. A.R.Santakumar` (2007) Concrete technology, Oxford University press.
2. Comparison of test specimen preparation techniques for pervious concrete pavements, Construction and Building Materials 25 (2011) 3480–3485, Bradley J. Putman, Andrew I. Neptune.
3. Compressive Strength of Pervious Concrete Pavements Storm water Management, Academy University of Florida Wanielista, M, Chopra, M.
4. Compressive response of pervious concretes proportioned for desired porosities, Construction and Building Materials 25 (2011) 4181– 4189, Omkar Deo a, Narayanan Neithalath.
5. EPA (2003). Protecting Water Quality from Urban Runoff. EPA 841-F-03-003. Nonpoint Source Control Branch, US Environmental Protection Agency, Washington, DC
6. Experimental Study of Pervious Concrete Pavement on a parking lot, Geotechnical Special Publication No. 218 © ASCE 2011, Ming-Gin Lee, Yi-Shuo Huang, Tao-Kuang Chang, Chun-Hua Pao
7. Experimental Study on Properties of Pervious Concrete Pavement Materials, Science Direct: Cement and Concrete Research, Vol. 33, 2003, pp. 381-386Yang, J. and Jiang, G.