

**Experimental Investigation of Mineral Admixtures in Pervious Concrete**E. Siva Subramanian¹, P. Govindarasu², P. Queen Shulamite³¹Asst Professor, Department of Civil Engineering, V.S.B Engineering College, Karur²Asst Professor, Department of Civil Engineering, V.S.B Engineering College, Karur³Asst Professor, Department of Civil Engineering, V.S.B Engineering College, Karur

Abstract - Pervious concrete is one of the most promising sustainable materials nowadays. Pervious concrete is a zero-slump, open graded material consisting of hydraulic cement, coarse aggregate, admixtures and water. Because pervious concrete contains little or no fine aggregates such as sand, it is sometimes referred to as “no-fines” concrete. It is a special type of concrete having a high void content of about 30%, is becoming popular nowadays due to its potential to reduce the runoff to the drainage systems which can provide a water flow rate around 0.34 cm/second. Pervious concrete is the mixture of cement, smaller size coarse aggregate, water and admixture. This paper illustrates the performance of pervious concrete with these sustainable materials replacing or partially replacing cement & aggregate. It is observed from the study that compressive strength and split tensile strength of pervious concrete is increasing by introducing bottom coal ash. The results indicates that the higher strength at higher percentage of admixtures.

Keywords: Pervious, coal ash, compressive strength, split tensile strength

I. INTRODUCTION

Over the last few decades increasing awareness of human being about environmental protection and preservation guides some new techniques. Pervious concrete is one these modern technologies. Pervious concrete is an innovative approach to control, manage and treat the storm water runoff. Sometimes it also known as “no-fine”, “permeable”, “porous” or “gap-graded” concrete. The rapid population over the world leads rapid urbanization and as a result the earth surface is being covered with impervious surface like buildings and pavements. Since this kind of surface does not permit storm water to percolate underground through it, the runoff is increasing these days and causing urban floods. It also affects underground water level. Pervious concrete is the special type of concrete which contains interconnected voids and these voids or pores allows storm (and rain) water to percolate underground. Thus pervious concrete is the best way to solve or minimize those problems. Pervious concrete mostly used as a paving material but it also may use for various purpose other than pavement like parking areas, tennis court, fish hatcheries, zoos, noise barriers, slope stabilization etc. Pervious concrete is a mixture of cement, water, coarse aggregate, admixture and/or supplementary materials.

Pervious concrete is a comparatively novel special type of concrete that is gaining fast popularity in many parts of the world. A porosity of 15% to 30% is typical for this material. Although the pervious concrete has high water permeability and low strength compared to conventional concrete, but it has enough strength for use in many applications. Pervious concrete has been used in a wide range of applications including: pervious pavement for parking lots, rigid drainage layers under exterior mall areas, greenhouse floors to keep the floor free of standing water, driveways, bridge embankments, swimming pool decks, beach structures, seawalls and sewage treatment plant sludge beds. The major drawback of pervious concrete is its lower compressive, low durability and flexural strength compared to conventional concrete. A small and single-sized aggregate gradation is commonly used to produce pervious concrete, which can easily achieve the required void content ($\geq 15\%$), w/c ratio between 0.27 and 0.30 are used normally and those as high as 0.34 to 0.40 have been used effectively. A mix design with little water can produce a weak binder. A mix design with excessive water can collapse the void space, making an almost impervious concrete surface.

Apparently, when compared to conventional concrete, pervious concrete has a lower compressive strength, greater permeability, and a lower unit weight (approximately 70% of conventional concrete). However, pervious concrete has a greater advantage in many regards. Nevertheless, it has its own limitations which must be put in effective consideration when planning its use. Structurally when higher permeability and low strength are required the effect of variation in aggregate size on strength and permeability for the same aggregate cement ratio need to be investigated.

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 increased the

compressive strength but also strength decreased with further increment of percentage of fine aggregates and compared to no fine aggregates in concrete, flexural strength of pervious concrete increased by 50% with addition of 10% fine aggregates (Sanket Sharma, 2012).

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 aggregates it helped to improve the significance strength of pervious concrete. SF and SP also enhanced the strength of pervious concrete. Also compressive strength of composition of these materials can be reach up to 50 MPa and it can be applied to footpath and also the low traffic vehicle road (Jing yang, 2012).

Silica fume and ultra-fine silica powder to improve the ultra high performance pervious concrete matrix. To achieve the goal of 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 concluded 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 (Rui zhong, 2015).

The use of thick cementitious paste on performance of pervious concrete and carried out the significance change in mechanical properties of pervious concrete. To thicken the cementitious paste, they used limestone with sizes of 9.54 mm and 6.35 mm. and for improving thickness of cement paste, they minimized the other variables such as cement types, w/c ratios, sample size, admixtures etc. based on tests and results they concluded that porosity of pervious concrete decreased with an increase of cementitious paste thickness. And also permeability of concrete decreased with increase of cementitious past thickness in pervious concrete. And surely 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 (Anthony torres, 2015).

II. MATERIALS

Cementitious Materials

As in traditional concreting, Portland cements (ASTM C 150, C 1157) and blended cements (ASTM C 595, C 1157) may be used in pervious concrete. In addition, supplementary cementitious materials (SCMs) such as fly ash, pozzolans (ASTM C 618), and ground-granulated blast furnace slag (ASTM C 989) may be used. Testing materials beforehand through trial batching is strongly recommended so that properties that can be important to performance (setting time, rate of strength development, porosity, and permeability, among others) can be determined.

Aggregate

Fine aggregate content is limited in pervious concrete, and coarse aggregate is kept to a narrow gradation. Commonly-used gradations of coarse aggregate include ASTM C 33 No. 67 ($\frac{3}{4}$ in. to No. 4), No. 8 ($\frac{3}{8}$ in. to No. 16), and No. 89 ($\frac{3}{8}$ in. to No. 50) sieves [in metric units: No. 67 (19.0 to 4.75 mm), No. 8 (9.5 to 2.36 mm), and No. 89 (9.5 to 1.18 mm)]. Single-sized aggregate up to 1 inch (25 mm) has also been used. ASTM D 448 also may be used for defining grading. A narrow grading is the important characteristic. Larger aggregates provide a rougher surface. Recent uses for pervious concrete have focused on parking lots, low-traffic pavements, and pedestrian walkways. For these applications, the smallest-sized aggregate feasible is used for aesthetic reasons.

Admixtures

Chemical admixtures are used in pervious concrete to obtain special properties, as in conventional concrete. Because of the rapid setting time associated with pervious concrete, retarders or hydration-stabilizing admixtures are commonly used. Use of chemical admixtures should closely follow manufacturer's recommendations. Air-entraining admixtures can reduce freeze-thaw damage in pervious concrete, and are used where freeze-thaw is a concern. ASTM C 494 governs chemical admixtures, and ASTM C 260 governs air-entraining admixtures. Proprietary admixture products that facilitate placement and protection of pervious pavements are also used.

III. METHODOLOGY

The mix design was divided into two parts. Part I was designed to investigate the effects of aggregate size and type on the void ratio and strength of pervious concrete, and Part II was to investigate the effects of sand, latex, fiber and admixtures (AEA and HRWR) on PCPC properties.

After identification of problem and setting the objectives of the research, the research methodology has carefully design to achieve these objectives.

Collection and study of literature pertaining to the dissertation work.

- Determine the engineering properties of pervious concrete and compare them with conventional concrete.
- Cast various trial mixes with varying percentages of pervious concrete and compare for the compressive strength.
- Prepare test samples with the percentage value and test these samples for the various pavements properties.
- To comment on the suitability and limitations of pervious concrete with conventional concrete in construction of pavements.

IV. RESULTS AND DISCUSSION

Nominal mix ratio

Table - 1: Nominal mix ratio

Mix	Cement content	Fine aggregate	Coarse aggregate
Mix proportion	383.16 kg/m ³	658.24 kg/m ³	1093.44 kg/m ³
Mix ratio	1	1.72	2.85

V. CONCLUSION

For achievement of higher strength and workability in pervious concrete, it is not possible to get higher strength with conventional concrete mix. Modification is necessary in design. With use of bottom coal ash, it can be possible to increment in strength of pervious concrete. Use of silica fume in concrete gives earlier high strength but with higher replacement of cement with this material gives strength loss and also loss in workability of concrete. So for strength increment purpose, fly ash can be used as cheaper admixture with higher effects on strength of concrete.

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