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An Experimental Study on Pervious Concrete

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Abstract: *high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. It is also called as porous concrete, permeable concrete, no fines concrete and porous pavement. Pervious concrete is made using large aggregates with little to no fine aggregates. The concrete paste then coats the aggregates and allows water to pass through the concrete slab. This type of concrete having a high void content of about 20%, 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. It is an important application for sustainable construction and is one of many low impact development techniques used by builders to protect water quality . Pervious concrete also find its effective application in low loading intensity parking pavements, footpaths, walkways and highways. The pervious concrete is considered as an Environmental Protection Agency (EPA) for providing pollution control, storm management and suitable development. It is a composite material produced by mixing cement, inert matrix of sand and gravel or crushed stone. This concrete has a light colour and open-cell structure because of which they do not absorb heat from the sun; they also do not radiate the heat back into the atmosphere, which reduces heating in the environment. Pervious concrete has low installation costs. In addition, it filters the storm water thus reducing the number of pollutants entering the rivers and ponds. Pervious concrete also improves the growth of trees. In the present study the behaviour of pervious concrete has to be studied experimentally by using Flyash, silica fume, Titanium dioxide materials. Different properties of pervious concrete e.g. compressive strength, split tensile strength, permeability test at 7 & 28 days to be studied*

Keywords: Silica Fume, Opc, fly ash, tio2 compressive Strength, split tensile Strength

I. INTRODUCTION

Construction technology has seen a rapid change over time. Many typical structures can be constructed within a month of duration using advanced construction techniques. Through it is proven that no construction can be done economically without using concrete. The word “concrete” originates from the Latin verb “concretes” which means to grow together. Concrete is a construction material that consists of cement, aggregate, and water. Concrete solidifies and hardens after mixture and placement due to a chemical process known as hydration. The water reacts with cement, which bonds the other components together and eventually creating a stone material. It is used to make pavement, architectural structure, foundation, overpasses, parking structure etc.., those concrete are rigid material with high compressive strength and weak in tensile strength. Reinforcing bars are used to improve the tensile strength. Fresh concrete is a freshly mixed material; which can be moulded into any shape, the relative quantities of cement, aggregate and water mixed together control the properties of concrete in the wet state as well as in the hardened state. The strength of concrete mainly depends on water cement ratio. If the water cement ratio increases then too much the bleeding of concrete takes place and the strength of concrete also reduced.

To conduct the tests and check the results at different dosages.

II. LITERATURE REVIEW

Ravindrarajah Sri R. and Yukari A., (2010):

They have studied the environmentally friendly pervious concrete for sustainable construction. This paper reports an experimental investigation into the, physical and engineering properties of pervious concrete having varying amount of low calcium fly ash as the cement replacement material. Various properties of pervious concrete were studied such as porosity, unit weight, and compressive strength, weight loss on drying, free drying shrinkage and water permeability under constant head. Replacement of 50% cement by fly ash had no significant effect on water permeability but it was

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noted that there is a marginal strength effect of pervious concrete. Three previous concrete mixtures were prepared by replacing 0,20 and 50% of fly ash and its properties were studied. Based on the data, it is obtained that there is a co-relation between strength and porosity and between permeability and porosity. It also found that pervious concrete maintain a porosity range of 15- 30%. Also it is assuming that replacement of 50% of cement has no significant effect on water permeability. So it is possible to prepare environment friendly pervious concrete with significantly reduced amount of Portland cement with fly ash.

Darshan S.Shah et al.(2014) :
In this studied the hardened properties of pervious concrete. Compressive strength, split Tensile Strength and flexural Strength are included in hardened properties of pervious concrete. To investigate the result of compressive strength, cubes of size 150 mm x 150 mm x 150 mm are prepared and for flexural strength, beams of size 500 mm x 100 mm x 100 mm are prepared and investigation should be carried out at a regular interval of 7,14 and 28 days . Mix design were prepared in the ratio such as 1:6, 1:8 and 1:10 with different size of gravel such as 18.75 mm and 9.375 mm should be used to check both these hardened properties of pervious concrete . Test results indicates that smaller size of gravel (9.375 mm gravel) has more Compressive Strength (12.71 N/mm2) and Flexural Strength (1.91 N/mm2) with 1:6 concrete mix proportion and for OPC 53.

Grade Cement Alicia A.L et al. (2010) :
Have carried out his experiment on optimizing strength and permeability of pervious concrete.This paper mainly focused on evaluating the performance of different pervious concrete mixture is an endeavor to achieve an optimized mix with adequate tensile strength and porosity. The mix design variables investigated in this study included aggregate to cementing materials ratio (A/C), aggregate gradation, cementing material blend, ternary blend of silica fume/slag and slag were examined. Single and hybrid fiber systems were also evaluated. These included natural fibers and polypropylene macro-fibers. From the above, the following results are comes out. An optimized pervious concrete mix was achieved using aggregate size of 10-13mm, cement to aggregate to ratio of 1:4 and a ternary cementing blend of silica fume and slag. Testing of tensile strength revealed that the addition of and polypropylene fibers improved the strength of the paste.

Harshith et.al
The work in this paper is focusing on the flexural strength, compressive strength, permeable cement and porosity of concrete substantial asphalts, as no fine totals are utilized in the strong cross segments consequently the voids are more and interconnected which permits water to go through its body. It has been seen that the pervious cement has less compressive quality stood out from customary cement. The usage of pervious cement should be obliged to zones not presented to high volume of traffic. Anyway the compressive nature of the pervious concrete is broadly not really that quite a bit of standard concrete. The sum of mixes attempted nevertheless didn't achieve compressive quality adequately ready to proceed with such high vehicle loadings.
The strength is surrendered for vulnerability anyway not to any degree which would convey the pervious concrete non reasonable.

III. MATERIALS USED

In the present investigation the following materials were used

- Ordinary Portland cement of 53 grade conforming to IS:8112.
- Coarse aggregate conforming to IS: 2386:1963.
- Water
- Silica Fume
- Fly ash
- Titanium dioxide

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A. Cement

The most popular type of concrete in common usage worldwide as a key component of cement, mortar, plasters, and the majority of non-special grout is normal Portland concrete. It was mostly started from limestone and made from various types of pressure-driven lime in Britain in the middle of the nineteenth century. When materials are heated to form clinker, a fine powder is produced. After crushing the clinker, we add a small amount of extra additives. Concretes come in a wide variety and are readily available. The OPC color is black, and white concrete can be produced by removing ferrous oxide during the mixing and assembly of concrete.

Accessible nearby is conventional Portland concrete of grade 43 from an ultra-modern company.

Table 1: Properties of cement.

S. No:			Properties
1.	Initial setting time	40 min	Greater than 30min.
2	Final setting time	480min	Not greater of 600 min
3	Specific gravity	3.14	
4.	Normal consistency	28%	

B. Coarse Aggregate

Used were stream bed boulders that had been crushed to sizes of 20 mm and 16 mm at a nearby smashing factory The totals' true requirements, such as fineness modulus, degree, explicit gravity, and mass thickness, were tested. Totals were initially thought to as cement filler to reduce the amount of concrete needed.

Table 3: properties of coarse aggregates.

Specific gravity of coarse aggregate	2.60
Impact test	3.33%
Flakiness Index	25%

C. Water

Water fit for drinking was used in the experimental investigation.

D. Silica Fume

Silica fume is a modern side-effect of silicon combinations. Silica seethe is known to work on the mechanical qualities of cement. The standard actual impact of silica rage in pervious cement is that of filler, on account of its fineness can squeeze into space between concrete grains similarly that sand fills between particles of coarse totals and concrete grains occupy the space between sand grains[10]. With respect to the compound response of silica rage, on account of high surface region and high satisfied of nebulous silica in silica seethe, the profoundly dynamic pozzolans respond more rapidly than standard pozzolans. The utilization of silica seethe in PC has designing potential and monetary benefit.

E. Fly ash

Fly ash, also known as "pulverized fuel ash", is one of the coal combustion products, composed of the fine particles that are driven out of the boiler with the flue gases. Ashthat falls in the bottom of the boiler is called bottom ash. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottomash removed from the bottom of the boiler, it is known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.

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IV. CASTING OF SPECIMENS

The compressive strength was calculated using typical cube casting moulds of size(150x150x150mm) . The standard cylinders of (300x150mm)were used to determine the split tensile strength.The samples were cured in water and latter tested for 7days and 28days for its compressive, split tensile strength as per Indian standards and the cubes are also tested for to calculate the void Content and Permeability of Pervious Concrete cubes ..

Mix -1 : Normal pervious Concrete.
Mix -2 : 10% Fly ash, 5% Silica fume, 1% Tio2.
Mix -3: 10% Fly ash, 10% Silica fume, 1% Tio2.
Mix -4: 10% Fly ash, 15% Silica fume, 1% Tio2.

Fig 1: Casting Of moulds

V. RESULTS AND DISCUSSION

A. COMPRESSIVE STRENGTH

These results are obtained by testing the total 9 specimens for 7, 28 days for Compression strength, split tensile and Permeability test.

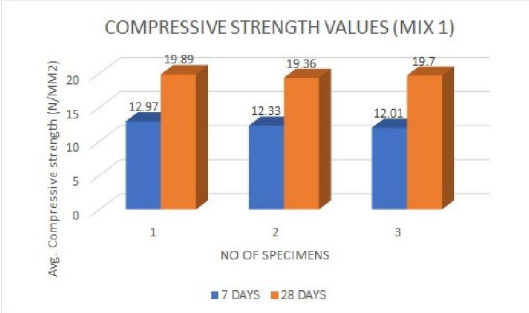

Fig 2: compressive strength of concrete

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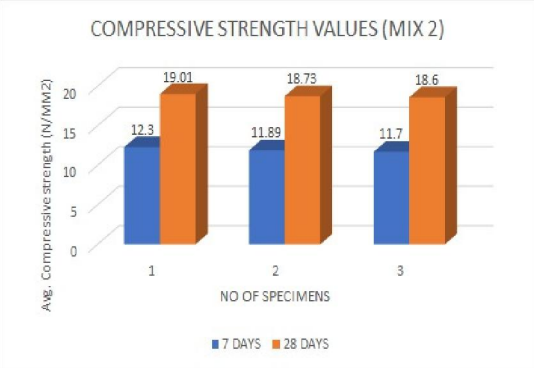

Fig 3: compressive strength of concrete.(5& S.F)

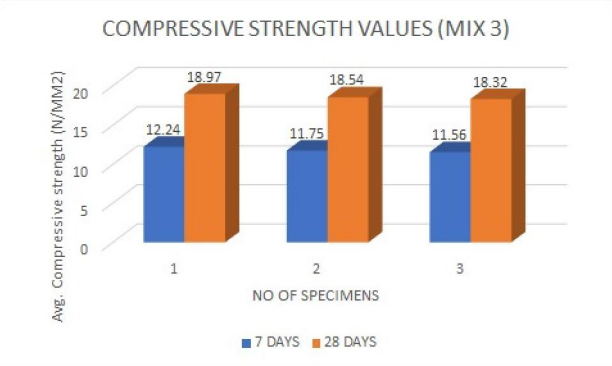

Fig 4: compressive strength of concrete (10%S.F)

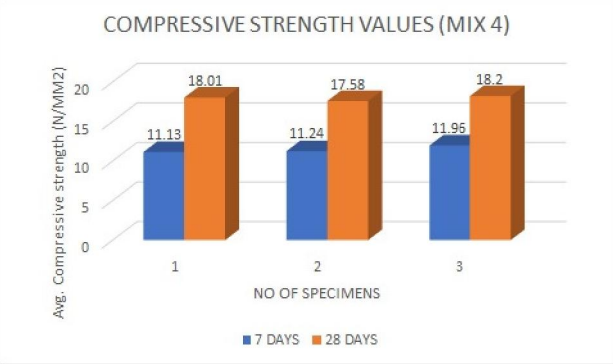

Fig 5: compressive strength of Concrete(15%S.F)

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B. Split Tensile Strength Of Concrete

The results are obtained by testing the total 9 specimens for 7 and 28 days.

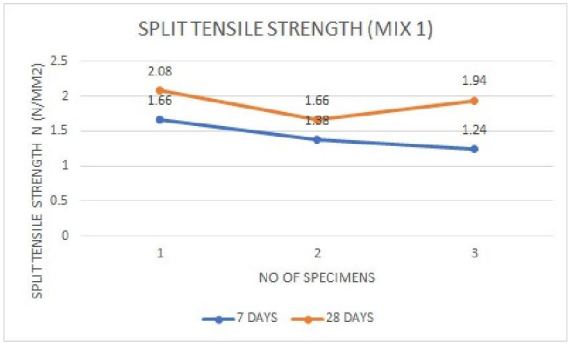

Figure 6: split tensile strength of Normal Pervious concrete

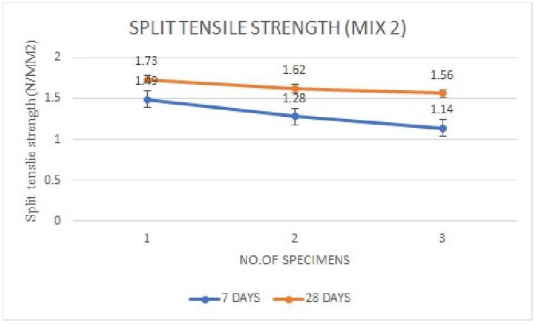

Fig 7 :split tensile strength of concrete

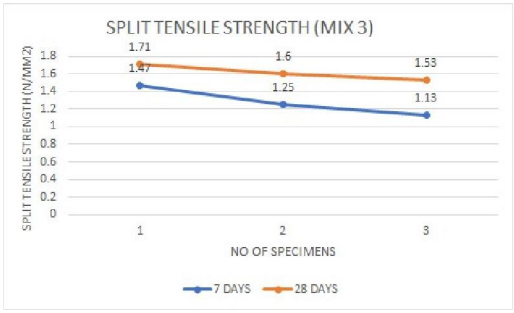

Fig 8: split tensile strength of concrete

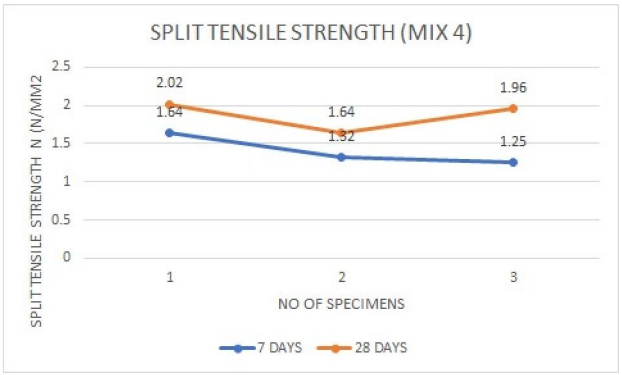

Fig 9: split tensile strength of concrete

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C. Permeability test conducted on Pervious Concrete

The cubes were tested for permeability, the amount of water passing through the cubes are observed ..by covering the cube with 4 sides using a plaster. And water is poured for 2 mins and the amount of water is Permeable is noted down.

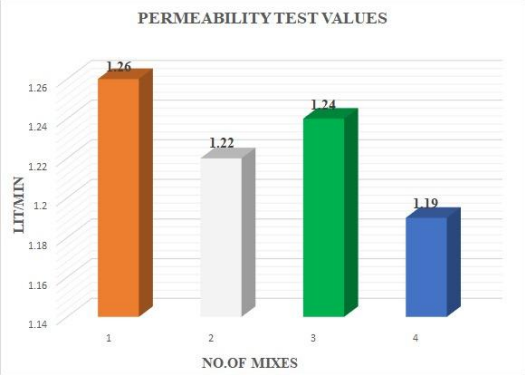

Fig-10: Permeability test results on 28 days cured Cube mixes

VI. CONCLUSION

1. This experimental study aimed to explore the feasibility and possibility of partial replacement of cement by fly ash & Silica Fume & Titanium dioxide for Pervious concrete.
2. Based on the results of this experimental investigation, following conclusions could be drawn:
3. Properties of fly ash & Silica Fume & Titanium dioxide makes it suitable ingredient for replacing in cement for production of pervious concrete.
4. The compressive strength of Normal Pervious Concrete for 7 days is 12.65 N/mm^2 & 28 days is 19.65 N/mm^2.
5. The compressive strength of 10%Fly Ash & 5% Silica Fume &1% Titanium dioxide for pervious concrete for 7 days is 11.96 N/mm^2 & 28 days is 18.78 N/mm^2.
6. The compressive strength of 10%Fly Ash & 10% Silica Fume &1% Titanium dioxide for pervious concrete for 7 days is 11.85 N/mm^2& 28 days is 18.61 N/mm^2.
7. The compressive strength of 10%Fly Ash & 15% Silica Fume &1% Titanium dioxide for pervious concrete for 7 days is 11.44N/mm^2& 28 days is 17.93N/mm^2.
8. The Split Tensile Strength of Normal Pervious Concrete for 7 days is 1.42 N/mm^2& 28 days is 1.89 N/mm^2.
9. The Split Tensile Strength of 10%Fly Ash & 5% Silica Fume &1% Titanium dioxide for pervious concrete for 7 days is 1.30 N/mm^2& 28 days is 1.63 N/mm^2.
10. The Split Tensile Strength of 10%Fly Ash & 10% Silica Fume &1% Titanium dioxide for pervious concrete for 7 days is 1.28 N/mm^2& 28 days is 1.61 N/mm^2.

REFERENCES

[1]. Darshan S.Shah etl, "Pervious Concrete: New Era for Rural Roa Pavement", International Journal of Engineering Trends and Technology, Volume 4, Issue 8, August 2013.
[2]. M. S. Shetty "Concrete Technology" S. Chand & Co.Ltd, 1997. IS 516 -1959, "Methods of Tests for strength of concrete", Bureau of Indian Standards, New Delhi.
[3]. ACI 552R (2010): "Report on Pervious Concrete", American Concrete Institute, Farmington Hills, Michigan.
[4]. Sri Ravindrarajah R. and Aoki Y. (2008),"Environmentally friendly porous concrete", Proceedings of the Second International Conference on Advances in Concrete and Construction, Hyderabad, India, Feb 2008