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An Experimental Study on Evaluation of Properties and Structural Integrity for Pervious Concrete Pavement System

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ABSTRACT: Increased precipitation in recent years due to the effect of climate change is leading to increased surface runoff and water logging in urban areas while impervious concrete or asphalt covering of urban lands hinders groundwater recharge. However, Pervious Concrete Pavements have the capacity of functioning as a Sustainable Urban Drainage System (SUDS) by allowing surface water to infiltrate downwards through the porous structure of the pavements, thereby minimizing flooding risks, recharging ground water, reducing run off and peak flows, alleviating the precipitation load on overstressed drainage systems, and improving water quality by capturing pollutants. This research provides an overview on pervious concrete mix designs and their effect on strength and permeability. Materials of pervious concrete include those used in conventional concrete, however eliminating the fine aggregate content. Different mix designs have been prepared and tested to understand the behavior of Pervious Concrete and recommend an ideal mix.

KEYWORDS: Pervious Concrete, Mix Design, Coarse Aggregates, Grade, Compressive Strength

I. INTRODUCTION

Pervious concrete is nothing but no fines concrete, which is also known as porous, gap graded or permeable concrete mainly consists of normal Portland cement, CA, water. In which FA are not existent or present in very small amount i.e. < 10% by weight of the total aggregates. In general, for making porous concrete, we will use the aggregates of size which passes through 12.5mm sieve and retained on 10mm sieve. In this project we have taken single size aggregates i.e. 12.5mm. The single size aggregates make a good no-fines concrete, which addition to having large voids and hence light in weight, also offers architecturally attractive look. Pervious concrete pavement is a unique effective means to address the important environmental issues which support green and sustainable growth.

II. APPLICATIONS OF PERVIOUS CONCRETE

1. Pervious Concrete as a Road pavement (Foot path, Parking area)
2. Residential roads and driveways
3. Parking lots
4. Noise barriers
5. Slope stabilization

1. METHODOLOGY

The methodology adopted and material characterization and design mix is carried out is presented in the Form of flow chart and parameters studied.

- Collection Of Materials
- Physical Test on Materials
- Casting Of Sample
- Test For Fresh and Harden Concrete
- Fresh Concrete Test
 - Slump Cone Test
- Harden Concrete Tests
 - Compressive Strength (For 7, 14, 28 Days)
 - Permeability Test

III. EXPERIMENTAL RESULTS

All of the mixing, ratios, calculations, and testing culminate into the final experiment, compression testing.

Compressive Strength:

Compressive strength is dependent on size of coarse aggregate, void ratio, bond between mortar and coarse aggregate. In 7 days cubes of permeable concrete gain 30% of its strength, in 21 days of permeable concrete gain 70% of its strength, and for 28 days it gains 95% strength.

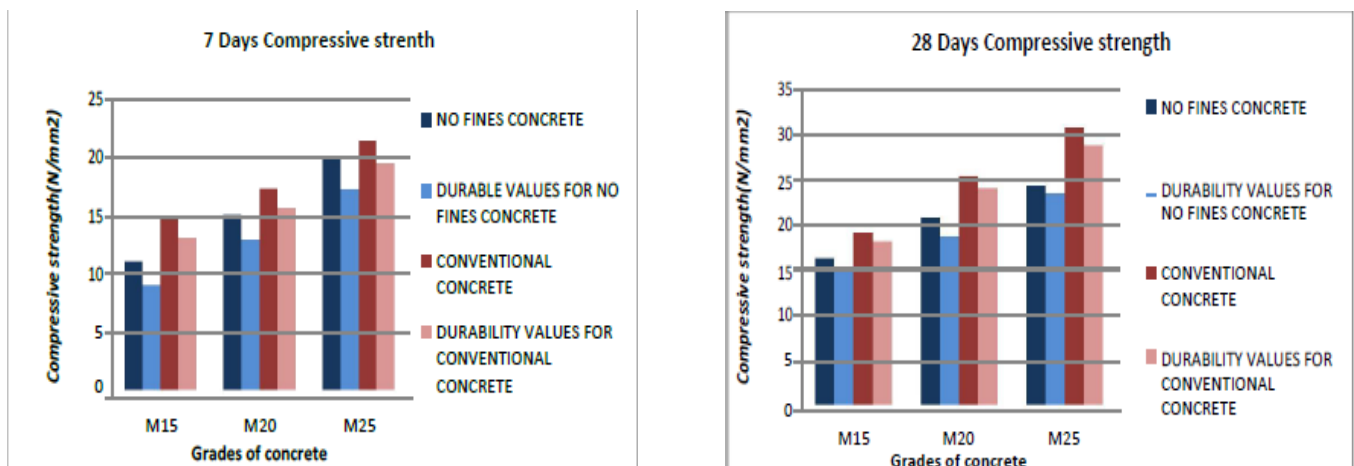


Fig. 7 & 28 Days Compressive Strength Test on Pervious Concrete

PERMEABILITY TEST:-

Permeability of the pervious concrete is determined by special arrangement of cylindrical shape bucket or specific container which should be open from both the side and has to arrange in such a way so that one side could be used for pouring of water and other resting on pervious concrete as shown in figure below.

Formula used, $I = (KM) / (D^2 \times T)$

I- Infiltration rate

M- Mass of water

K- Constant

D- Diameter

T- Time



Fig. Arrangement for Permeability Test of Pervious Concrete Specimen

PRESSURE DIFFERENCE (Pa)	PERMEABILITY OF CONVENTIONAL CONCRETE(cm/sec)			PERMEABILITY OF NO FINES CONCRETE(cm/sec)		
	M15	M20	M25	M15	M20	M25
5	5.6×10^{-14}	3.2×10^{-14}	1.39×10^{-14}	6.6×10^{-3}	1.01×10^{-3}	9.42×10^{-4}
10	1.8×10^{-14}	9.48×10^{-15}	7.47×10^{-15}	1.2×10^{-3}	8.2×10^{-4}	6.01×10^{-4}
15	8.6×10^{-15}	6.23×10^{-15}	3.25×10^{-15}	8.9×10^{-4}	5.4×10^{-4}	2.9×10^{-4}

Table of Permeability Test Result

IV. FUTURE SCOPE

- Pervious concrete can be used in building for rainwater harvesting as well as for cooling purpose by providing permeable wall.
- In the presence of clayey soil, water can be percolated through providing borehole at every 1-2km with the help of drainage system.
- Water can be filtered and stored as fresh water below the ground

V. CONCLUSION

The following conclusions are drawn based on the experimental investigations are:

1. The pervious concrete is suitable only for low volume road pavement like foot path, parking slots. Due to voids in pervious concrete it is difficult to obtain required compressive strength.
2. Using smaller size aggregate (10 mm) can enhance the compressive strength of pervious concrete than bigger size aggregate (20mm).
3. Compressive strength can be increased by using proper admixtures also.
4. Water absorption, abrasion resistance are good property of pervious concrete.
5. It is an eco-friendly concrete material.

REFERENCES

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2. J.YANG AND G.JIANG (2003) In this paper, a pervious concrete pavement material used for roadway is introduced. Using the common material and method, the strength of the pervious concrete is low.
3. A.M.MULLIGAN (2005) This thesis is investigated prior studies on the compressive strength on pervious concrete as it relates to water-cement ratio, aggregate-cement ratio, aggregate size, and compaction.
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5. **M.SULEIMAN AND J.KEVERN (2007)** This paper summarizes a study performed to investigate the effects of compaction energy on pervious concrete void ratio, compressive strength, tensile strength, unit weight, and freeze-thaw durability.
6. **C.WOLFERSBERGER (2008)** in this paper, Pervious concrete usually requires much less maintenance. But inspection and some attention will keep it working for many years.
7. **K.WANG(2008)** This paper describes the current state of practice in pervious concrete placement methods and presents results from a laboratory-based study to compare various placement practices and develop QA/QC criteria.
8. **R. C.MEININGER(2009)** in this paper Conclusions are drawn regarding the percentage of air voids needed for adequate permeability, the optimum water-cement ratio range, and the amount of compaction and curing required.



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