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Performance Evaluation of Permeable Concrete with Partial Replacement of Cement by Fly Ash

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***Abstract*:- Pervious concrete is a special high porosity concrete used for flatwork applications that allows water from precipitation and other sources to pass through, thereby reducing the storm water runoff from a site and recharging ground water levels. In this paper the performance of permeable concrete block is study based on the properties of the block (like Compression strength, flexural strength and water absorption ratio etc.,) and comparison of properties is shown for three different water/cement ratios. Typically, pervious concrete has little or no fine aggregate and has just enough cementitious paste to coat the coarse aggregate particles while preserving the interconnectivity of the voids. This paper also provides a look to the future, for instance, that may help address the durability challenges or further enhance the environmental benefits of Permeable concrete pavement.**

1. INTRODUCTION

India is a developing country and safety of road is still in a pervious concrete pavement is a unique and effective means to address important environmental issues and support green, sustainable growth. By capturing storm water and allowing is to seep into the ground, porous concrete is instrumental in recharging ground water, reducing storm water runoff. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales and other storm water management devices. In doing so, pervious concrete has the ability to lower overall project costs on a first cost basis.

In pervious concrete, carefully controlled amounts of water and cement materials are used to create a paste that forms a thick coating around aggregate particles. A pervious concrete mixture contains little or no sand, creating a substantial void content. Using sufficient paste to coat and bind the aggregate particles together creates a system of highly permeable, interconnected voids that drain quickly. Typically between 15% and 25% voids are achieved in the hardened concrete.

Permeable concrete pavements are use mostly in rural area, this concept of pervious concrete is relatively new for rural road pavement. Pervious concrete has ability to flow water through it and this property help to recharge the ground water. Pervious concrete pavement is a unique and effective technique to meet the future demand. Strength of the pervious concrete is low as compared to conventional concrete it is all due to high porosity.

This dissertation analyses the effectiveness of permeable concrete in pavement. This was achieved by analyzing the properties and characteristics of permeable concrete. The performance of permeable concrete was compared with a concrete sample that is comparable to material used for the construction of conventional concrete road pavements.

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Pic (a)

Pic(a)-shows the pavement allows the water through it.

Permeable concrete is mostly used in non-pavements applications. This is to asses the suitability for permeable concrete to be used for the construction of road pavements.
The tests conducted to determine the fresh concrete properties were the slump test and compaction factor tests. These were complemented by hardened concrete tests including the following: compressive strength ,indirect tensile strength. After that there is a comparisons are made between the both type of concrete.

2. LITERATURE REVIEW

Malhotra (1976), found that the density of permeable concrete is generally about 70% of conventional concrete when made with similar constituents. The density of permeable concrete using conventional aggregates varies from 1602 to 1922 kg/cu.m.
Adequate vibrations is imperative for strength of conventional concrete. The use of permeable concrete is different and is a self-packing product. Malhotra (1976) suggests that the use of mechanical vibrator and ramming is not recommended with permeable concrete. A light rodding should be adequate and used to ensure that the concrete reaches all sections of the formwork. This is not problem with conventional concrete since it has greater flow ability than permeable concrete. The light rodding ensured that the concrete has penetrated all the areas impended by reinforcing steel.
Malhotra stresses that in situations where normal conditions are not achieved during placement and curing, the formwork should not be removed after 24hours as with conventional concrete. Permeable has very low cohesiveness and formwork should remain until the cement paste has hardened sufficiently to hold the aggregate particles together. However, this is more of a consideration in low temperature conditions and when used in non-pavement applications where the concrete is not sufficiently supported by the ground or other means.
Ghafoorietal (1995), undertook considerable amount of laboratory investigations to determine the effectiveness of permeable concrete as a paving material. The curing types were investigated to determine if there was any difference between wet and sealed curing. Here appeared to be only a negligible difference in strength between the different curing methods. It was clear from the test results that the strength development of permeable concrete was not dependent upon the curing conditions.
The indirect tensile test conducted by ghafoorietal found that the sample tests varied between 1.22 and 2.83mpa. The greater tensile strength was achieved with a lower aggregate cement ratio. Ghafoorietal (1995) explained the more favorable properties obtained by the lower aggregate-cement ratio by an improved mechanical interlocking behavior between the aggregate particles.
Ghafoorietal produced permeable concrete with a compressive strength in excess of 20mpa when using an aggregate-cement ratio of 4:1.

3. OBJECTIVES OF THE PROPOSED WORK

The objectives of the work would be:

- To prepare the durability, properties of permeable concrete.
- To determine the impact resistance of permeable concrete pavement.
- To compare the properties of permeable concrete with the existing concrete pavement.

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4. MIX DESIGN

The mix design in this case was the determination of the ratio aggregate, cement and water that possessed the most favorable properties. For this particular situation trail mixes were designed. The mixes were determined from pervious literature and particular mixes used by some companies. There are only three constituents of permeable concrete that can be considered and varied: aggregate, cement and water content.

5. CONVENTIONAL CONCRETE

There was no mix design undertaken for conventional concrete, since the strength of certain mixes is readily known. This meant that no trails were required to be carried out. When conducting the tests to determine the properties of a conventional concrete.

6. PERMEABLE CONCRETE

The mix design for permeable concrete were obtained from printed articles. There were a large number of different mixes that are currently being used for a whole range of applications.

Aggregate	Cement	Water
8	1	0.4
6	1	0.4
4.5	1	0.4
4.8	1	0.36

7. RESULT AND ANALYSIS

The specimen were tested for compacting factor, compressive strength and indirect tensile strength at 28days.

7.1.COMPACTING FACTOR TEST

Type	Partially compacted (m1) kilogram	Fully compacted kilogram	Compacting factor
No-fine concrete	10.815	11.332	0.90

Above table shows the compacting factor for all samples of concrete used.

7.2.COMPRESSSIVE STRENGTH TEST

Pic (b)

Pic (b)- shows the permeable concrete cube during compressive strength test.

S.no	Specimen type	Force P (KN)	Cross/sectional area (sq.m)	Compressive strength (mpa)	Average compressive strength
1	Permeable	116.3	0.0225	14.8	
2	Permeable	164.5	0.0225	13.9	14.3
3	permeable	141	0.0225	14.2	

Above table shows the force determined from the testing machine and the cube compressive strength of the test specimen.

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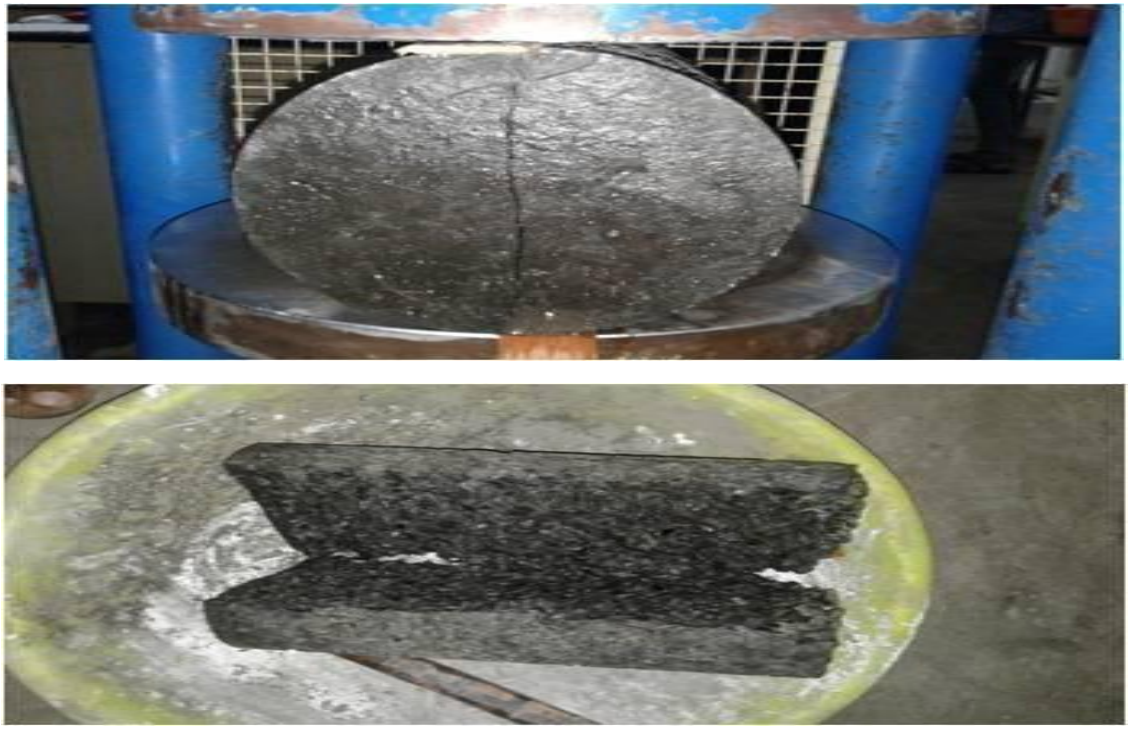
7.3.INDIRECT TENSILE STRENGTH TEST

Pic (c)



Pic (c)-shows splitting the sample of permeable concrete after tensile strength testing.

S.no	Specimen type	Force P (KN)	Length (mm)	Diameter (mm)	Indirect tensile test (mpa)	Average indirect tensile test
1	Permeable	116	300	150	1.64	
2	Permeable	150	300	150	2.12	2.14
3	Permeable	188	300	150	2.66	

Above table show the results from indirect tensile test.

The permeable concrete varied more, with tensile strength between 1.57 and 2.69. the permeable concrete did not have as much tensile strength as the conventional concrete, due to the bonding mechanism within the concrete samples.

8. CONCLUSION

We can use 13.5mm aggregate size for future study or analysis. Pervious concrete is a special type of concrete with a high porosity used for concrete pavement applications that allows water from precipitation and other sources to pass directly through it, there by reducing the runoff from a site and allowing ground water recharge.

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