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Experimental Study &Analysis of Polypropylene Fiber Reinforced Pervious Concrete

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Abstract: At many projects water logging at parking and walkways is the major issue especially during monsoon as pavements and floors are normally impermeable. This results inconsiderable amount of investment in repairs and providing storm water drain systems, which may get clogged during peak over flow. Besides this there are many other problems that arise due to the above. In such situations it is very important to think about an economical solution which helps in getting rid of all above problems. The best solution to above problem is pervious concrete. When we used the polypropylene fiber in pervious concrete in various proportions 0.05%, 0.1%, 0.15%, 0.2%, 0.25% and 0.3% of volume of concrete the optimum result obtained for compressive strength at 0.2% of Polypropylene fiber. This paper discuss the art of pervious concrete; materials and possible mix proportions, properties such as compressive strength, flexural strength, shrinkage ,permeability with initial tests done at Innovation & Application and the principal advantages , major disadvantages and principal applications
Keywords: Pervious Concrete, polypropylene fiber, coefficient of Permeability, compressive strength.

I. INTRODUCTION

Pervious concrete is a composite material consisting of coarse aggregate, Portland cement, and water. It is different from conventional concrete in that it contains no fines in the initial mixture, recognizing however, that fines are introduced during the compaction process. The aggregate usually consists of a single size and is bonded together at its points of contact by a paste formed by the cement and water. The result is a concrete with a high percentage of interconnected voids that, when functioning correctly, permit the rapid percolation of water through the concrete.

Pervious concrete is a special type of concrete with high porosity. It can used for concrete flatwork application that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing ground water recharge. The concrete paste then coats the aggregates and allows water to pass through the concrete slab. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and greenhouses. It is an important application for sustainable construction and is one of many low impact development techniques used by builders to protect water quality. The pervious concrete system and its corresponding strength are as important as its permeability characteristics. The strength of the system not only relies on the compressive strength of the pervious concrete but also on the strength of the soil beneath it for support. Pervious concrete consists of cement, coarse aggregate and water with little to no fine aggregate. Water to cement ratio of 0.28 to 0.40 with a void content of 15 to 25 %. The correct quantity of water in the concrete is critical. A low water to cement ratio will increase the strength of concrete, but too little water may cause surface failure. As this concrete is sensitive to water content, the mixture should be field checked. Entrained air may be measured by a Rapid air system, where the concrete is stained black and sections are analyzed under a microscope.

A pervious concrete mixture contains little or sand (fines), 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 drains quickly. typically, between 15% and 25% voids are achieved in the hardened concrete, and flow rates for water through pervious concrete are typically around 480 in./hr (0.34 cm/s, which is 5 gal/ft2/min or 200 L/m2/min), although they can be much higher.

Both the low mortar content and high porosity also reduce strength compared to conventional concrete mixtures, but sufficient strength for many applications is readily achieved. Pervious concrete pavement is a unique and effective means to address important environment issues and support sustainable growth. By capturing rainwater and allowing it to seep into the ground, porous concrete is instrumental in recharging groundwater, reducing storm water runoff, and meeting US Environmental Protection Agency (EPA) storm water regulations. The use of pervious concrete is among the Best Management Practices (BMPs) recommended by the EPA, and by other agencies and geotechnical engineers and local basis. 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.

A. Problem Statement / need of study

Based on the literature review conducted (chapter 2), it was realized that pervious research done on pervious concrete mixtures has been focused primarily on optimizing the hydrologic properties of pervious concrete mixes. This lead to the use of singled-sized aggregates such as 10 mm and 12 mm sizes

Other porous construction materials for instance porous asphalt rely on a distribution of aggregate sizes for strength while providing adequate drainage properties. The design of each pervious concrete mixture is unique based on performance requirements. Therefore, the main objective of this study was to increase the compressive strength of pervious concrete. Result of this study would lead to better understanding of the manner in which fiber variation can be used to optimize a pervious concrete mixture depending on project site specific requirements

B. Objectives Of Study

1) To prepare block of pervious concrete.
2) Determine the structural properties of pervious block like compressive strength,.
3) Compare the properties of plain pervious concrete block and pervious concrete block with polypropylene fiber.
4) Result analysis.

II. METHODOLOGY

A. Batching

Batching is the process of measuring and combining the ingredients of concrete. It is done as perIS:516-1959page no. 5. Careful procedure was adapted in the batching, mixing and casting operations.

Fig.1 Batching Process

Fig.2 Mixing Process

B. *Concrete Mix Design (IS :13920-2009)*

Data for Mix Design for M20

1) Stipulation for proportioning
2) Grade designation : M20
3) Type & cement : OPC 53 grade conforming to IS 8112
4) Name of cement : Ultratech OPC 53 Grade
5) Maximum nominal size aggregate :20 mm
6) Minimum Cement :340 kg/cum
7) Maximum cement :450 kg/cum
8) Maximum Water Cement Ratio :0.450 we take `0.44
   0.44<0.4
9) Workability :50-75mm (slump)
10) Exposure condition : Moderate
11) Method & conc. Placing : Pouring
12) Degree & Supervision: Goo
13) Type 1 Aggregate : Crushed angular type
14) Chemical Admixture : Superplasticizer (Boxer)type. Table no 1
15) Test Data for Material. Fineness cement is less than 10%
16) Initial setting time & cement 30 min or > 30 min.
17) Final setting time of cement <600 min.
18) Compressive strength & cement
    3 days
    7 days
    28 days

C. *Sample Specimen*

At least three specimens, preferably from different batches, shall be made for testing at each selected age.

Fig.3 Sample Specimen

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D. Compressive Test

The specimen after a fixed curing period of 7 days, 14 days and 28 days were tested for compressive strength on 2000 KN compressive testing machine (**C**TM). The specimen is placed on the bearing surface of testing machine and compressive load was applied on opposites face axially and slowly. The test is carried out as per IS: 516-1959.

Fig.4 Compressive testing machine

E. Placing the Specimen in the Testing Machine

The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen which are to be In contact with the compression platens. In the case of cubes, the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast, that is not to the top and bottom. The axis of the specimen shall be carefully alignment with the centre of thrust of the spherically seated platen No packingshall be used between the faces of the test specimen and the steel platen of the testing machine As the spherically seated block is brought to bear on the specimen. The movable portion shall be rotated gentlyby hand so that uniform seating may be obtained. The load shall be applied without shock and increasedcontinuously at a rate of approximately 140 kg/cm^2/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the typeof failure shall be noted.

III. RESULTS

A. Graphical Representation Of Results

Compressive test of concrete

1) For 7 days

The Results which we get after testing the concrete cubes for 7 days with and without polypropylene fiber are as follows:

7 Days Of Compressive Strength

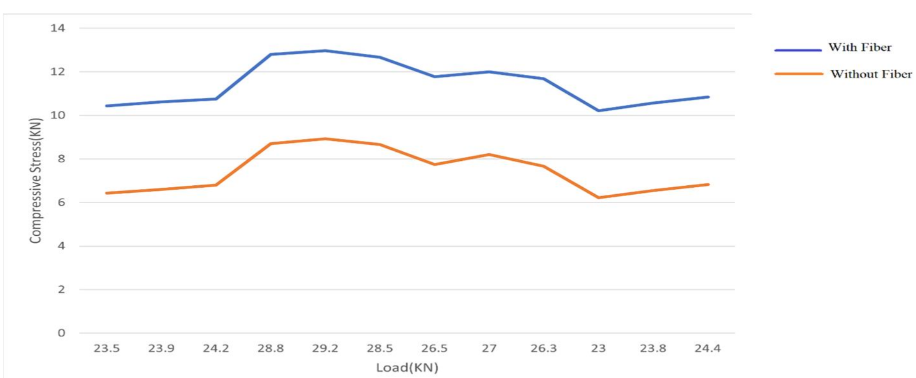

Fig. 5 7 Days Test

Conclusion: - After 7 Days of testing the Max. compressive strength of concrete with induced fiber is12.8 Mpa for 0.2% of fiber dose.

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2) For 14 days

The Results which we get after testing the concrete cubes for 14 days with and without polypropylene fiber are as

14 Days of Compressive Strength

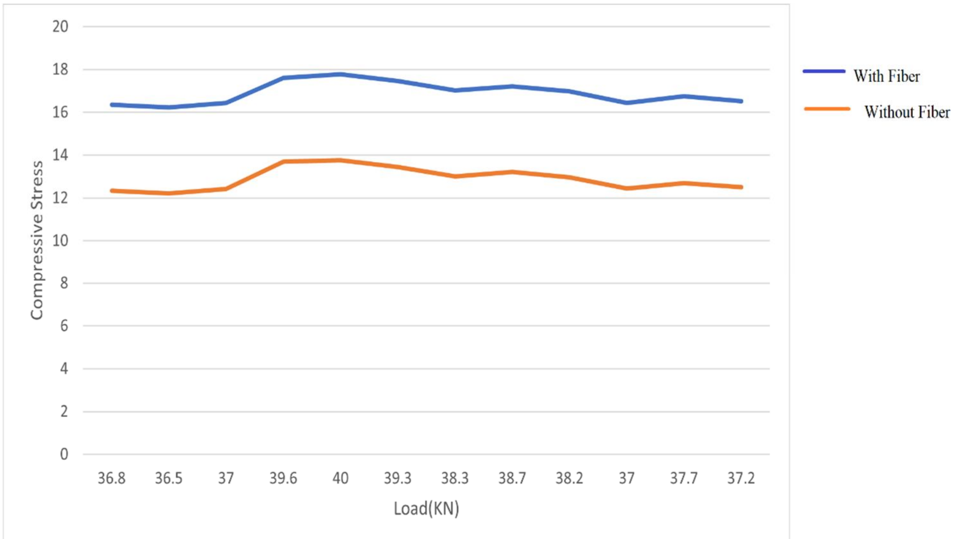

Fig. 6. 14 Days Test

Conclusion: - After 14 Days of testing the Max. compressive strength of concrete with induced fiber is 17.6 Mpa for 0.2% of fiber dose.

3) For 28 days

The Results which we get after testing the concrete cubes for 28 days with and without polypropylene fiber are as

28 Days Of Compressive Strength

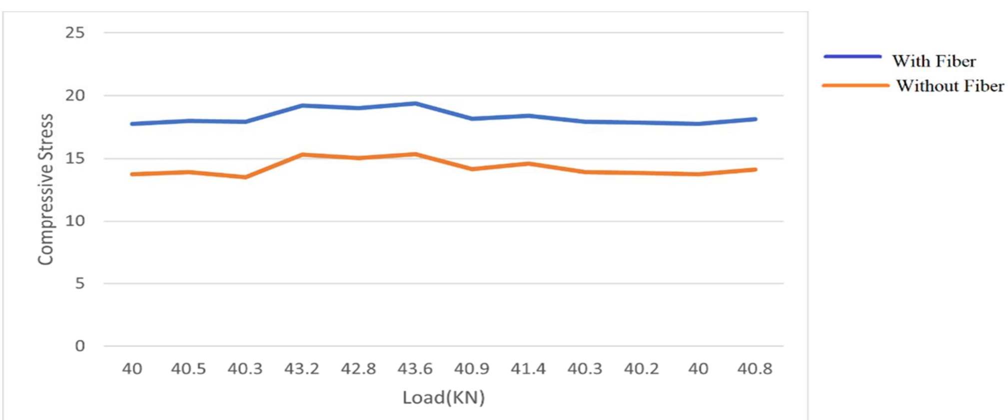

Fig. 12. 28 Days Test

Conclusion: - After 14 Days of testing the Max. compressive strength of concrete with induced fiber is 19.2 Mpa for 0.2% of fiber dose.

IV. CONCLUSION

1) When we used the polypropylene fiber in pervious concrete in various proportions 0.15%, 0.2%, 0.25%and 0.3% of volume of concrete the optimum result obtained for compressive strength at 0.2% of Polypropylene fiber.
2) Polypropylene fiber pervious concrete has high compressive strength as compared to plain pervious concrete.

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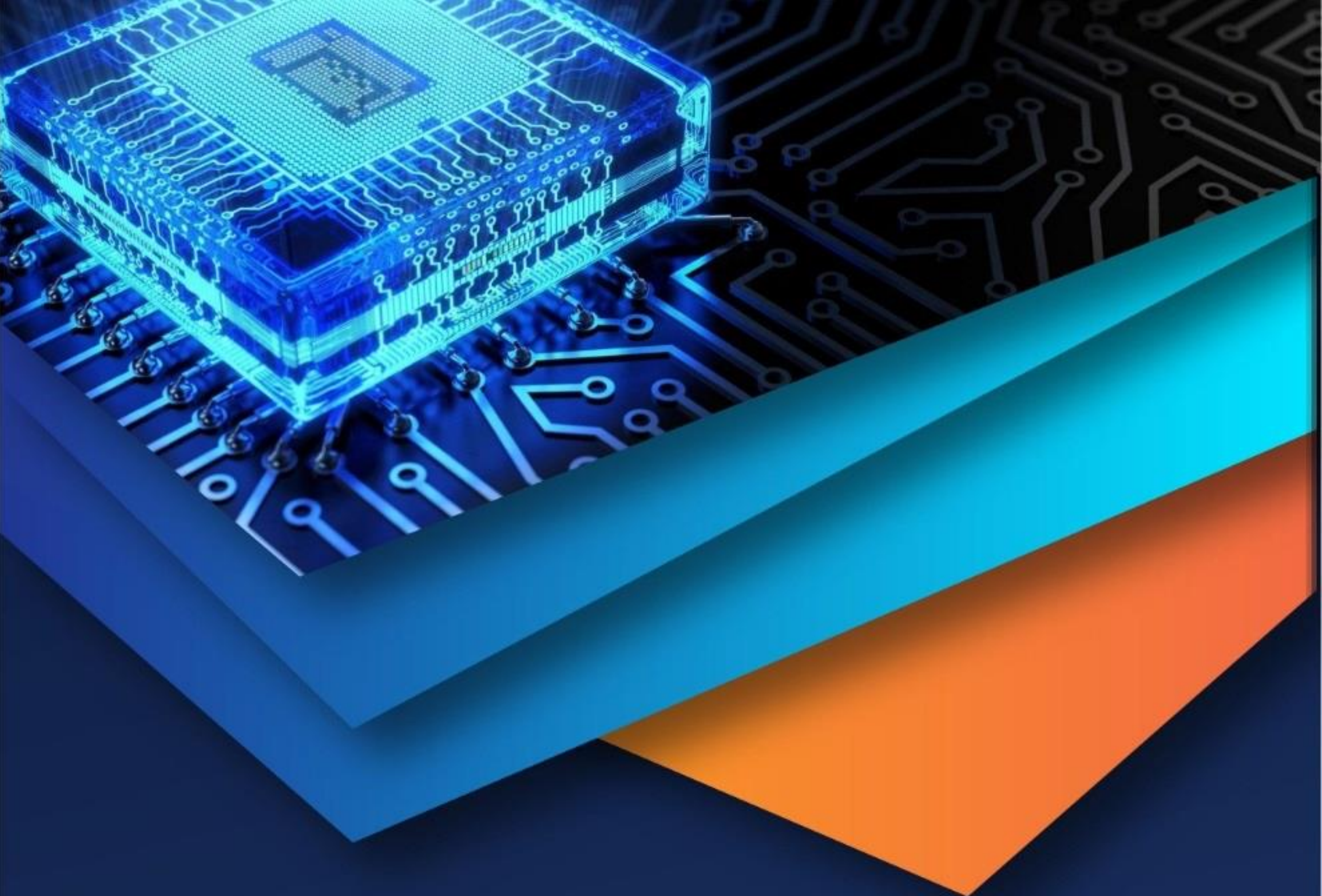

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