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DESIGN OF NO FINE CONCRETE USING POLYPROPYLENE FIBRE

[1]Suraj V. Shah, [2] Sujit R. Gadgil, [3]Digvijay D. Chougule, [4]Ranjit R. Shinde, [5]Vishwavijay T.Shendage, [6]Rohit B. Shirale

[1]Research Scholar, [2]Student, [3]Student, [4]Student, [5]Student , [6]Student
[1]Department of Civil Engineering,
[1]Nirwan University, Jaipur, India

Abstract : Pervious concrete is a special type of concrete. It contains cement , coarse aggregates, water and admixtures (if required) and other cementitious materials. The void content in pervious concrete is more which allows the water to flow through its body because of no fine aggregates used in the concrete matrix, So the pervious concrete is also called as Porous concrete or Permeable concrete. The lot of research work is going in the field of pervious concrete. The compressive strength [maximum breaking load] of pervious concrete is less compared to the conventional concrete due to its porosity and voids. Hence, the use of pervious concrete is limited to certain applications only even it has lot of advantages. If the compressive strength of pervious concrete is increased, then it will be used for more number of applications. This research paper discuss about addition of polypropylene fibre in pervious concrete increase in compressive strength of pervious concrete and its no effect on permeability and design best suitable mix ratio for pervious concrete.

***IndexTerms*– Pervious concrete, Polypropelene fibre, compressive strength, permeability**

1.INTRODUCTION

Pervious concrete which is also known as the no-fines, porous, gap-graded, and permeable concrete and Enhance porosity concrete, has little or no fine aggregate and has just enough cementitious paste to coat the coarse aggregate particles while structure with relatively large interconnected voids that confers to it acoustic characteristics, water permeability, and economy in terms of material cost, preserving the interconnectivity of the voids. From definition, pervious concrete is a mixture of gravel stone, water, cement , coarse aggregate . When pervious concrete is used for paving, the open cell structures allow water to filter through the pavement and into the underlying soils. In other words, pervious concrete protects the surface of the pavement and its environment.

In this work, no-fines concretes with three different mixtures corresponding to compressive strengths were manufactured with addition of different percentage polypropylene fiber.The best mix proportion is chosen which gives maximum compressive strength and permeability.

Pervious concrete is able to being used in many applications, although it is primary used in pavements which are in: residential roads, driveways and alleys , low volume pavements, low water crossings, pathways and sidewalks, parking areas, tennis courts, sub-base for conventional concrete pavements etc.

2. SPECIFICATION OF MATERIAL USED :

The material used consists of cement , coarse aggregate , which is of size 12.5mm to 4.75mm , polypropylene fibre for enhancing strength and some admixtures .

2.1. CEMENT :

Ordinary Portland Cement (OPC) 53 grade of cement was used for casting of cubes for all concrete mixes. The cement was uniform color i.e.grey with a light greenish shade and was free lumps. Ordinary Portland Cement (OPC) Grade 53 should complete the requirements of IS: 12269-1987 Grade.

Table 2.1 : properties of cement.

Sr.No	Property	Value
1	Specific gravity	3.15
2	Bulk density	1120 kg/m^3
3	Fineness	330 m^2/kg
4	Initial setting time	35 min
5	Final setting time	132 min

2.2 AGGREGATES :

Crushed stones from local queries were used as aggregate. The broken stones are generally used as aggregate. The aggregate where washed to removed dirt and dust and were dried to surface dry condition.The size of aggregate used is passing through 12.5 mm IS sieve and retained to 4.75 mm IS sieve.The physical properties of aggregates are mentioned below.

Table 2.2 : Physical properties of aggregates

Sr.No	Physical Properties	Value
1	Bulk density	1600 kg/m3
3	Specific gravity	2.65

2.3 POLYPROPYLENE FIBER :

Polypropylene Fibre is a light weight synthetic fibre. The raw material of polypropylene is derived from monomeric C3H6 which is purely hydrocarbon. Its mode of polymerization, its high molecular weight and the way it is processed into fibres combine to give polypropylene fibers. The properties of fibres are mentioned below :

Table 2.3: Properties of Polypropylene fiber

Fibre Properties	Test Data
Diameter (D)	0.5 mm
Length (L)	50 mm
Aspect ratio (L/D)	100
Specific gravity	0.90 – 0.91 gm/cm^3

2.4 SUPER PLASTICIZRES :

ALGI-TECH superplasticizer admixture based on selected sulphonated napthalene polymers. This solution is brown in colour which instantly disperses in water. It is water reducing agent.

3. MIX DESIGN

Pervious concrete includes the same basic ingredients as the common conventional concrete contains i.e. Aggregate, cement, water, and some admixtures. The mixing proportion of ingredients is quite different. Also, the requirement of material is quite different. The other difference is it requires the more void space within the pervious concrete. The permeability of the pavement is directly related to the amount of void space .The conventional design of concrete needs to be adjusted accordingly to the need for void space within the mix design with low water to cement ratio. Ranges of materials are listed below. These ranges are based on research.

1. Design void content: 15% to 25%
2. Water to cement ratio: 0.35 to 0.45

The goal is to achieve a final mix design with addition of some percentage of Polypropylene fibre which provides a strong, durable pervious concrete design which allowed for reducing drainage of rainwater from the parking lot.

4. METHODOLOGY

Prepare several cubes for testing the compressive strength. A pervious concrete mixture proportioning by trial batch mixture proportion method using volumetric considerations and make the necessary calculations for production batches when mixture proportions are finalized after trial batch evaluations. Trial batches are prepared to find out mix characteristics of pervious concrete mixture.

4.1 BATCHING :

Batching is the process of measuring the quantity of ingredients and combining them in a definite proportion. The procedure was adopted in the batching, mixing and casting operations must be precise and careful. For compressive strength with water cement ratio 0.40 and 0.8% percentage of admixtures by weight of concrete.

4.1.1. Dosage of fibres and their calculation:

Calculation :

Steps for calculation of cement , aggregate and polypropylene fibre for X:Y proportion where X is cement and Y is aggregate.

Step 1 : Volume of Container in m^3

Step 2 : Dry Volume of container

= Volume of Container × 1.54

Step 3 : Volume of cement

= Dry volume of Container × X / [X +Y]

Step 4 : Weight Of Cement

= Volume Of Cement × Bulk Density of Cement

Step 5 : Volume Of Aggregate

= Volume of Container × Y / [X +Y]

Step 6 : Weight Of Aggregate

= Volume Of Aggregate × Bulk Density Of Aggregate

Step 7 : Weight Of Polypropylene

= [Cement + Aggregate] × 0.25 / 100 Or

=[Cement + Aggregate] × 0.50 / 100

Table 4 : Mix Proportion Details

Mix Design Ratio	Cement (Kg)	Aggregate (Kg)	Water (Lit)	Polypropylene Fibre (gm)
1:4	1.49	6.87	0.597	22
1:4	1.49	6.87	0.597	44
1:7	0.932	7.52	0.375	21
1:7	0.932	7.52	0.375	43
1:4	1.49	6.87	0.597	0

4.2 CURING :

The concrete were allowed to remain in quadrilateral cubic mould for 24 hours under normal condition. After that, these cubes were remoulded with care so that no edges were broken and then were placed in curing tank at ambient temperature for curing. The ambient temperature for curing was 27+2 degree calicoes or 27-2 degree calicoes.

General method of curing requires 28 days to complete the process. The methods for curing are follows:

1. Covering concrete surfaces with gunny bags
2. Electrical curing
3. Membrane curing
4. Ponding method
5. Sprinkling of water
6. Steam curing

5. TESTING OF SPECIMEN :

5.1. COMPRESSIVE TEST :

The compressive strength is measured by breaking cubical specimens in compressive testing machine. The compressive strength is calculated by dividing the failure load by the cross sectional area resisting the load and reported in units Mega Pascal (N/mm^2).These results from cubes are use for quality control, acceptance of concrete or for estimating compressive strength of concrete. Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, Quality control during production of concrete etc., The specimen after a fixed curing period of 7 days, 14 days and 28 days were tested for compressive strength under compressive testing machine (UTM). The specimen is placed on the testing machine and compressive load was applied on face axially and slowly.

5.2 PERMEABILITY TEST :

The property of the concrete which permits water (fluids) to percolate through its continuously connected voids is called its permeability. In this approach, the sample is enclosed in a latex membrane to avoid water flowing along the sides of the specimen. Water is poured into graduated cylinder to fill the specimen and the draining pipe. The specimen is preconditioned by allowing water to drain out through the pipe until the level in the graduated cylinder is the same as the top of the cube. This minimizes any air pockets in the specimen and ensures that the specimen is completely saturated[1]. With the valve closed, the graduated cylinder is filled with water. The valve is then opened, and the time required for 1000 ml of water to pass from cube is find out in seconds (t).

6. RESULTS AND DISCUSSION

6.1 Results of Compressive Strength:

- Result of set of 9 cubes with proportion 1:4 (cement : coarse aggregate) with 0% polypropylene fibres. The average compressive strength after 7, 14, 28 days is found to be 8.07 N/mm2, 11.03 N/mm2 and 12.73 N/mm2 respectively.

- Result of set of 9 cubes with proportion 1:4 (cement : coarse aggregate) with 0.25% polypropylene fibres. The average compressive strength after 7, 14, 28 days is found to be 8.15 N/mm2, 10.95 N/mm2 and 13.70 N/mm2 respectively.

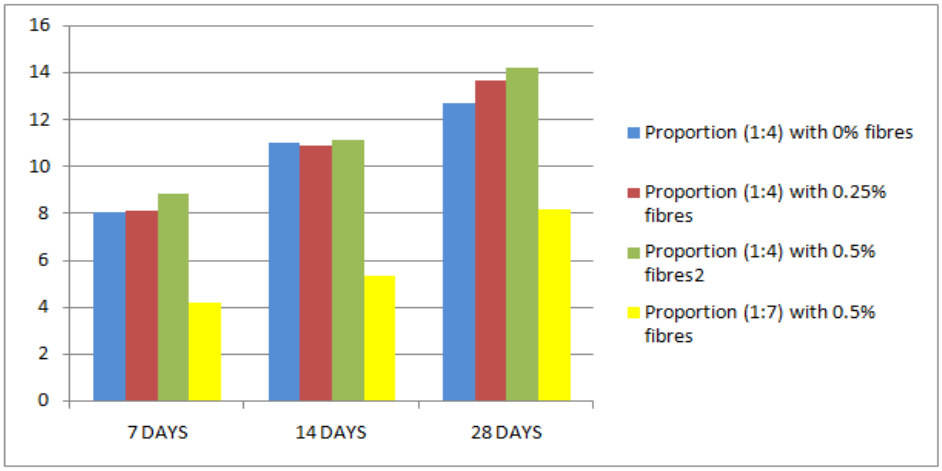
- Result of set of 9 cubes with proportion 1:4 (cement : coarse aggregate) with 0.5% polypropylene fibres. The average compressive strength after 7, 14, 28 days is found to be 8.87 N/mm2, 11.18N/mm2 and 14.22 N/mm2 respectively.

- Result of set of 9 cubes with proportion 1:7 (cement : coarse aggregates) with addition of 0.5% polypropylene fibres and cubes were tested at 7, 14, 28 days. The average compressive strength of these cubes is found to be 4.22 N/mm2, 5.40 N/mm2, 8.21N/mm2 respectively.

Table 6.1: Comparison of average compressive strength of pervious concrete

Sr. No	**Age of concrete (days)**	**Average Compressive Strength Of Pervious Concrete 1:4 (0% polypropylene fibre)(N/mm^2)**	**Average Compressive Strength Of Pervious Concrete 1:4 (0.25% polypropylene fibre)(N/mm^2)**	**Average Compressive Strength Of Pervious Concrete 1:4 (0.5% polypropylene fibre)(N/mm^2)**	**Average Compressive Strength Of Pervious Concrete 1:7(0.5% polypropylene fibre)(N/mm^2)**
1	7	8.07	8.15	8.87	4.22
2	14	11.03	10.95	11.18	5.40
3	28	12.73	13.70	14.22	8.21

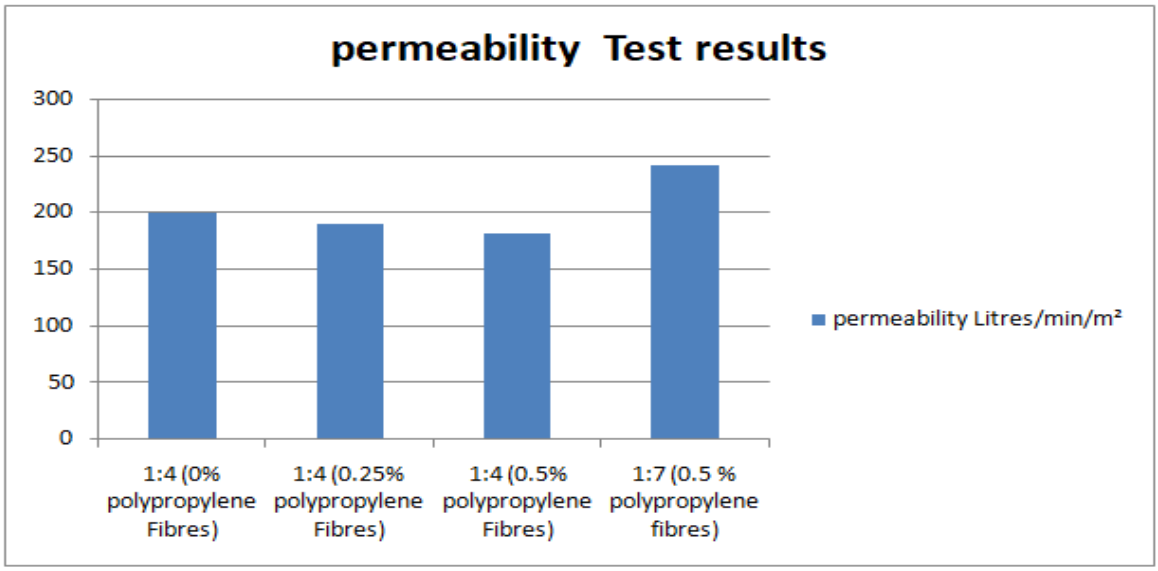
Graph 1: Comparison of compressive strength of pervious concrete



6.2 Results of Permeability Test:

1. The permeability of plain pervious concrete cube of proportion 1:4 without polypropylene fibre, 1000 ml water which is passed through the voids of the plain pervious concrete cube and the mean time taken was 13.33 second.
2. The permeability of proportion 1:4 with 0.25% of polypropylene fibre mixed pervious concrete cube, 1000 ml water which is passed through the voids of the polypropylene fibre mixed pervious concrete cube and the mean time taken was 14 second , proportion 1:4 with 0.50% of polypropylene fibre taken 14.66 seconds and proportion 1:7 with 0.50% of polypropylene fibre taken 11 seconds .
3. The permeability of pervious concrete without polypropylene fibre was little much affected. The permeability was little more than pervious concrete with polypropylene fibre.

Graph 2: Permeability rate of pervious concrete



The following table provide the information of permeability rate of pervious concrete in litres/min./m^2

Table 6.2: Permeability rate

Sr. no	Proportion	Permeability Litres/min/m²
1	1:4 (0% Polypropylene fibre)	200
2	1:4 (0.25% Polypropylene fibre)	190
3	1:4 (0.5% Polypropylene fibre)	182
4	1:7 (0.5% Polypropylene fibre)	242

7 . CONCLUSION

From the test results, the following conclusions were made

- The size of coarse aggregate, water to cement ratio and aggregate to cement ratio plays a crucial role in strength of pervious concrete.
- The void ratio and unit weight are two important parameters of pervious concrete in the context of mix design.
- The compressive strength and co-efficient of permeability of pervious concrete are inversely proportional to each other.
- The addition of fibre will little much reduce the permeability capacity of pervious concrete.
- The compressive strength of pervious concrete is increased by 8% when 0.25% Polypropylene fibre were added to standard pervious concrete.
- The compressive strength of pervious concrete is increased by 12% when 0.5% Polypropylene fibre were added to standard pervious concrete.
- The permeability decreased by 5% when 0.25% fibre were added to standard pervious concrete.
- The permeability is decreased by 9% when 0.5% fibre were added to standard pervious concrete.
- The permeability increased by 21% when cement to aggregate ratio changes to 1:7.

Hence it is recommended that addition of 0.5% fibre to the pervious concrete with proportion 1:4 will satisfy both the compressive strength and permeability of pervious concrete.

REFERENCES

1. Baskar, M. Thiruvannamalai and R. Theenathayalan , 2019, Experimental study on mechanicalproperties of polypropylene fiber reinforced pervious concrete, IJCIET, 10, (2).
2. ACI 552R,(2010), Report on Pervious Concrete, American Concrete Institute, Farmington Hills, Michigan.
3. Alessandra Bonicelli, Filippogiustozzi and Maurizio Crispino, 2015, Experimental study on the effects of fine sand addition on differentially compacted pervious concrete, Construction and Building Materials , 5(1),1-16.
4. Anoop B R, Karthik H N, Bhuvan T M, Lohith Patel G N, Chethan V R., 2015, Study on fresh and hardened properties of pervious concrete, IJRTI 2(8), 45-51.

5. Anush K. Chandrappa, Krishna Prapoorna Biligiri, 2016, Pervious concrete as a sustainable pavement material , Construction and Building Materials, 11(1), 262–274.
6. Atif jawed, 2016, Experimental study on strength properties of pervious concrete, IRJET, 3(11), 311-315.
7. Dang Hanh Nguyenab, Nassim Sebaibia, Mohamed Boutouila, Lydia Leleyterb and Fabienne Baraudb, 2014, A modified method for the design of pervious concrete mix, Construction and building materials, 73, 271-282.
8. Prashant Chavana, Dipak Patareb, Manoj Wagh 2019, Enhancement of pervious concrete properties by using polypropylene fiber, IJERGS, 7(6), 17-25 .
9. Rohit Patidar, Mrs. SonamYadav, 2017, Experimental study of pervious concrete with polypropelene fibre, IRJET4(12), 442-447.
10. S. Elavarasan, K. Preetha, S. Priya, K. Ramkumar, N. Revathi 2017, Strength studies on polypropylene fibre reinforced nofine concrete pavements, IJETS, 4(4), 23-27.
11. Shamanth Kumar 2014. Pervious Concrete – an overview of mix design/ applications.
12. Sirile Eathakoti1, Navya Gundu, Markandeya Raju Ponnada, 2015, An Innovative No-Fines Concrete Pavement Model , IOSR, 12(5), 1-11.
13. Soudagar Aasif, Bagwan Irfan, Pathan Zakariya, Shaikh Mozam, Mr. Badgire 2018, Analesis of properties of pervious concrete, IRJET, 05(4), 449-455.