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Experimental study of pervious concrete

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***Keywords*—Pervious concrete, porosity, strength, super plasticizer.**

Abstract*— *In the construction sector, concrete is a widely utilized building material. Pervious concrete is a high-porosity concrete used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, decreasing runoff and permitting groundwater recharge. The main objective is to determine the strength of pervious concrete by introducing admixture. The results of an experimental inquiry on pervious concrete are given and analysed in this overview. The amount of general-purpose water in pervious concrete has been minimized by utilizing super plasticizer to enhance the strength of pervious concrete and to develop inexpensive pervious concrete. The mix design for pervious concrete was prepared, concrete specimen samples were manufactured, and tests were performed on pervious concrete specimens to determine the strength of pervious concrete and compare it to conventional concrete.

I. INTRODUCTION

The Pervious concrete, also known as permeable or porous concrete, is characterized by high water permeability and porosity. Pervious concrete is composed of cement, aggregates, water, and admixtures (if required). Pervious concrete's high water permeability absorbs rainfall and allows it to soak into the earth. Pervious concrete has a significant impact on groundwater recharging and storm water discharge.

Other benefits of pervious concrete include reduced road puddles, improved water quality through percolation, and heat absorption. Furthermore, pervious concrete is used as a sound absorber in European nations and to safeguard river banks in Japan.

The most common applications of pervious concrete are light traffic volume highways such as parking lots, residential roads, driveways, walkways, and so on.

The frequently stated range of porosity for pervious concrete is 15 to 30%, and this relies on the compaction process used as well as the combination proportions. However, due to its porosity, the material's strength is quite poor.

Fig. 1: Pervious concrete

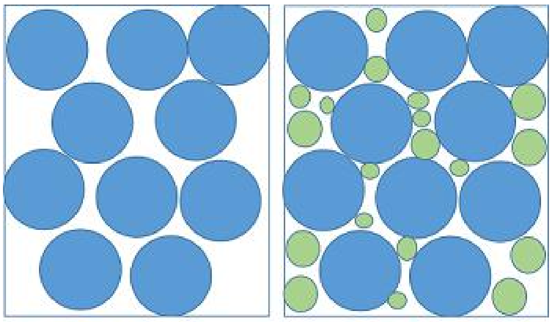

Fig. 2: Schematic representation of pervious concrete

The compressive strength of the material is just 20 to 30 MPa. Pervious concrete has a poor strength due to its large void content, which not only limits its application in cold weather zones but also causes different distresses and failures of the connected construction.

Pervious concrete pavements have grown in popularity in recent years as an efficient storm water management technology in locations that get regular and occasionally heavy rainfall.

Following are the environmental benefits of pervious concrete are as follows:-

1. Replenishes water table and aquifers.
2. Allows for more efficient land development.
3. Reduce storm water runoff.
4. Minimizes flash flooding and standing water.
5. Mitigates surface pollutants.
6. Prevents warm and polluted water from entering streams.
7. Light reflectivity is higher than asphalt surfaces, reducing any island effect.

II. METHODOLOGY

Following the acquisition of locally accessible materials, a mix design has been produced. Different material proportions were used for different mixtures, as

Specified in the experimental program Cement, sand, and aggregate were tested in laboratories. We conducted cement tests such as fineness of cement, specific gravity, and setting time. In this work, PPC 43 Grade (J K Super cement) cement was employed, as well as super plasticizer (CICO PLAST SUPER p190A) with a specific gravity of 1.20. The coarse aggregate, with a maximum size of 20mm and a specific gravity of 2.70, was procured from a local provider and certified to IS: 383. After the trial mix, the water-cement ratio is set to 0.5 to improve the overall workability of the experiment. Fresh water was acquired through a bore hole. Concrete cubes were cast and cured for 7, 14, 21 and 28 days, respectively, while beams for flexural strength testing were cast and cured for 7 and 14 and 21 days, respectively.

For each hydration period (7, 14, 21 and 28 days), three cubes were evaluated for compressive strength and three beam specimens were examined for flexural strength. Following the completion of the testing and the achievement of the results, we continued through discussion and ultimately ended this work.

III. EXPERIMENTAL PROGRAM

The compressive and flexural strengths of pervious concrete were determined through experimental investigation.

To investigate further into the main features of pervious concrete with a super plasticizer (CICO PLAST SUPER P190-A).

The exploratory approach is followed by the table below.

Table.1: Experimental Program

S. No.	Mix	W/C	Cement %	Admix -ture	Fine Aggre-gate%	Coarse Aggre-gate%
1	MIX -1	0.5	100	0%	1.6	2.84
2	MIX -2	0.5	100	1%	1.8	3.2
3	MIX -3	0.5	100	2%	2.2	3.8

Fig. 1: Super plasticizer (CICO PLAST P190-A)

The Concrete mixtures were developed. For the compressive strength test, a number of typical 150mm cubes (shown in Figure) were formed in steel moulds.

Fig. 2: pervious concrete with super plasticizer

Fig. 3: A typical pervious concrete specimen used in this investigation

Fig. 3: Curing of Pervious concrete specimens

IV. RESULT & DISCUSSION

Cement, fine aggregate, and coarse aggregate were obtained locally for this project. The cement used was PPC 43 (J K Super), and the mix proportions were designed for M20 grade concrete. For this investigation, river sand with a specific gravity of 2.56 and coarse aggregates with a specific gravity of 2.70 were used. For all of the mixes in this study, tap water is utilized for mixing, and the water-cement ratio is set at 0.5. In various percentages, CICO PLAST SUPER P190-A (Super plasticizer) was utilized as an admixture. Slump test, Compressive and flexural strength tests were performed. The following tests are below-

Fig. 4: Slump cone test

Fig. 4: Compressive strength test

Fig.5: Flexural strength test

The results of the laboratory tests are listed below.

Table.2: Cement test result

Characteristics	Obtained values for cement	Requirement as per IS 1489(Part 1) :2015
Fineness	377.1	300 min.
Setting time		
Initial setting	140	30 minutes min.
Final setting	190	600 minutes max.
Specific gravity	3.10	

Table.3: Slump cone test result

S.No.	Grade	MIX	Percentage of super plasticizer	Workability (mm)
1	M20	MIX-1	0%	40
2	M20	MIX-2	1%	45
3	M20	MIX-3	2%	50

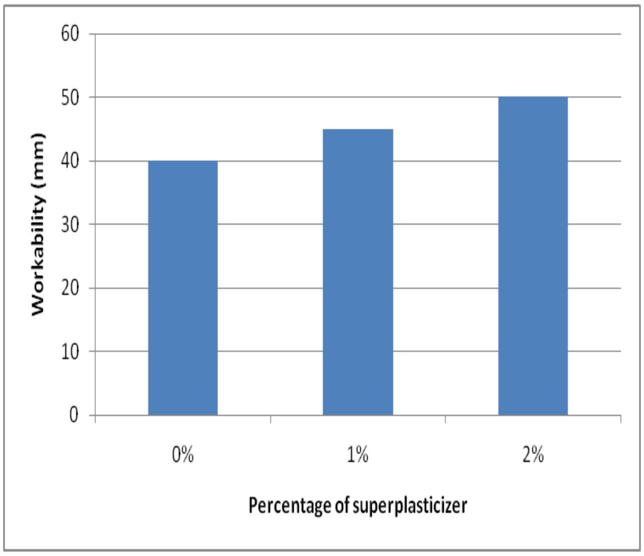

Chart.1: Slump cone test result

Table.4: Compressive strength result for MIX-1

S.No.	Grade	Percentage of super plasticizer	Curing period	Compressive strength (N/mm^2)
1	M20	0%	7 days	8.89
				8.0
				9.77
2	M20	0%	14 days	16.8
				17.7
				18.6
3	M20	0%	21 days	20
				20.5
				21.02
4	M20	0%	28 days	24
				22.22
				23.1

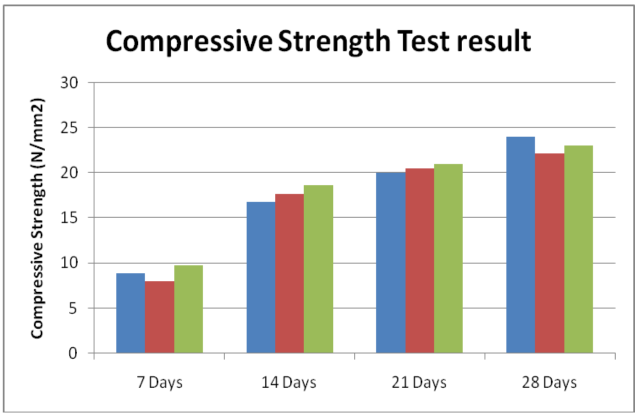

Chart2: Compressive strength test result for MIX-1

Table.5: Compressive strength result for MIX-2

S.No.	Grade	Percentage of super plasticizer	Curing period	Compressive strength (N/mm²)
1	M20	1%	7 days	10
				10.2
				10.4
2	M20	1%	14 days	18.4
				18
				18.8
3	M20	1%	21 days	19.7
				20.2
				21.8
4	M20	1%	28 days	23.5
				23.11
				24

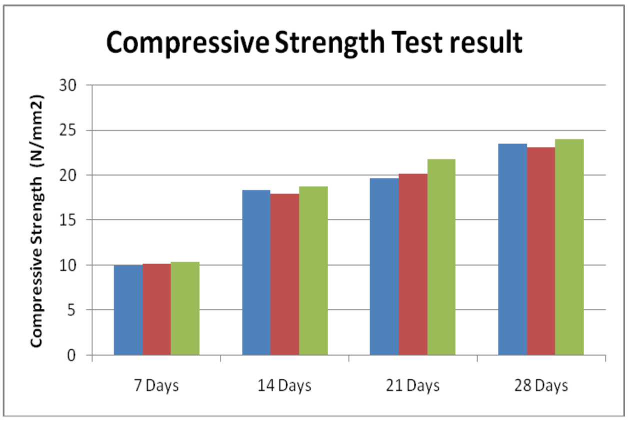

Chart3: Compressive strength test result for MIX-2

Table.6: Compressive strength result for MIX-3

S.No.	Grade	Percentage of super plasticizer	Curing period	Compressive strength (N/mm²)
1	M20	2%	7 days	11.5
				12
				11.11
2	M20	2%	14 days	19.33
				19.11
				19.5
3	M20	2%	21 days	22.4
				22
				22.9
4	M20	2%	28 days	24.2
				24
				24.4

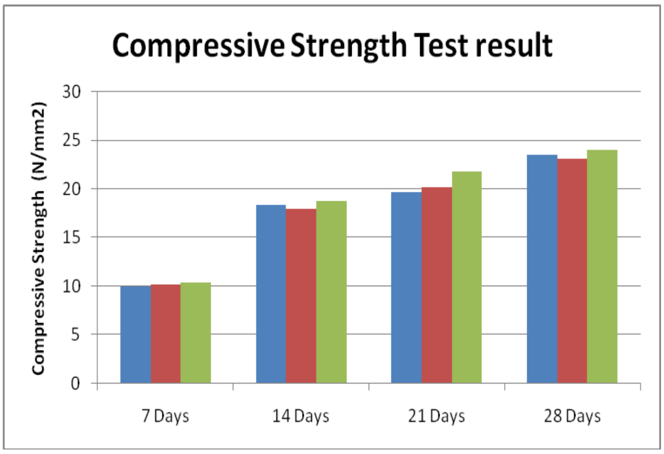

Chart4: Compressive strength test result for MIX-3

Table.7: Flexural strength result for MIX-1

S.No.	Grade	Percentage of super plasticizer	Curing period	Flexural strength (N/mm²)
1	M20	0%	7 days	1
				1.2
				1.1
2	M20	0%	14 days	1.6
				1.5
				1.8
3	M20	0%	21 days	1.8

				2
				2.2
4	M20	0%	28 days	2
				2.4
				2.2

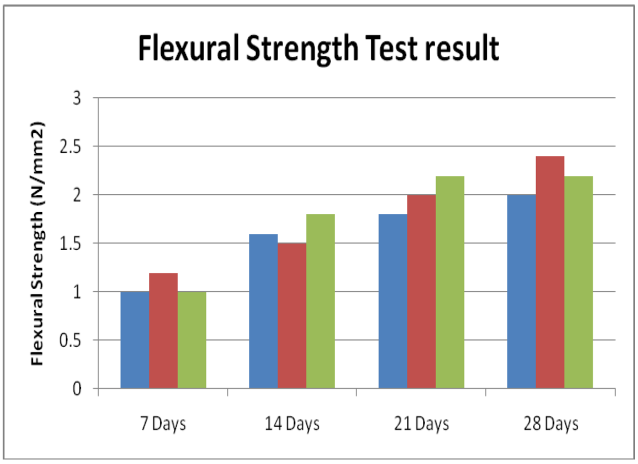

Chart5: Flexural strength test result for MIX-1

Table.8: Flexural strength result for MIX-2

S.No.	Grade	Percentage of super plasticizer	Curing period	Flexural strength (N/mm^2)
1	M20	2%	7 days	1.08
				0.9
				1.09
2	M20	2%	14 days	0.8
				1.2
				1.3
3	M20	2%	21 days	1.2
				1.3
				1.4
4	M20	2%	28 days	1.4
				1.4
				1.5

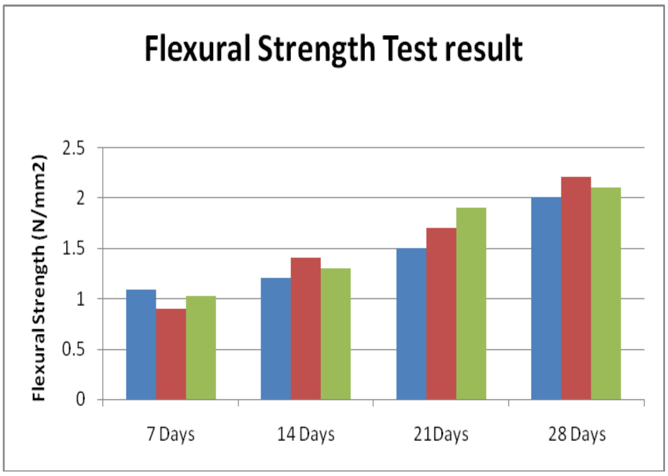

Chart6: Flexural strength test result for MIX-2

Table.9: Flexural strength result for MIX-3

S.No.	Grade	Percentage of super plasticizer	Curing period	Flexural strength (N/mm^2)
1	M20	1%	7 days	1.09
				0.9
				1.02
2	M20	1%	14 days	1.2
				1.4
				1.3
3	M20	1%	21 days	1.5
				1.7
				1.9
4	M20	1%	28 days	2
				2.2
				2.1

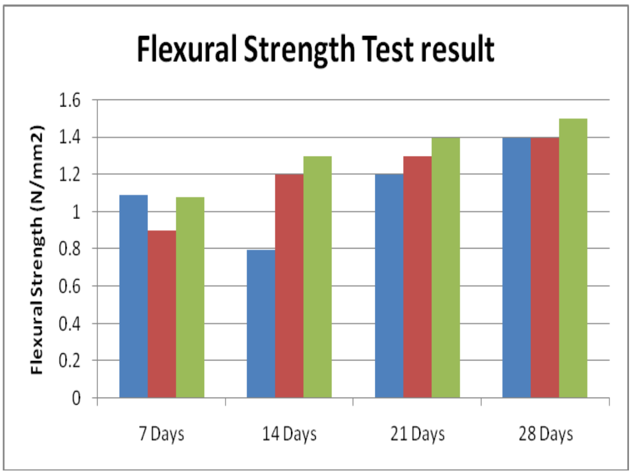

Chart7: Flexural strength test result for MIX-3

V. CONCLUSION

The compressive strength of M20 grade pervious concrete for 28 days is enhanced by adding a 2% super plasticizer and the flexural strength is lowered by adding 2% super plasticizer.

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