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An Experimental Investigation on Pervious Concrete Replacement with Silica

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Abstract:
Now a day's most promising and sustainable material for making pavements, garden flooring, swimming pools and parking lots is Pervious concrete. Its role becomes very important as it contains large percentage of voids i.e., 18% to 40% which is extremely helpful in draining water from surface and protecting it from damage. Pervious concrete is formed from fine aggregates in smaller amount, coarse aggregates, cement, water and other admixtures. During this experiment we had done analysis of behaviour of pervious concrete with partial replacement of fly ash and silica fume in different-different combinations. We tried three combinations. After the gap of one week, we performed test on these few properties such as split tensile strength, flexural strength and compressive strength to achieve our aim.

Key words: Coarse Aggregates, Cement, Silica Fume, Fine Aggregates.

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I. INTRODUCTION

If we go for the difference between pervious concrete and normal concrete then we will get only a small difference of percentage of fine aggregate in terms of materials used. Making process of Pervious concrete is a little bit different from normal concrete. As pervious concrete is made up of smaller or no amount of fine aggregate with cement, coarse aggregate and water. It is made by adding controlled amount of cement and water to make a thick paste to cover coarse aggregate so that it can bind. Less or no amount of fine aggregate causes the high void content.

Pervious concrete possesses large number of voids so it is helpful in recharging of ground water as water from rain falls on the pavement and passes through pervious concrete and enters the ground. It also helps in reducing the runoff water and protecting the pavements made for different purposes.

As the pervious concrete is high in void content so from many experiments it is proved that its compressive strength decreases due to no or less use of fine aggregates. So, it becomes less suitable for high traffic roads. But, it has very high application in side road pavements as it can pass water from rain to ground and helps in recharging ground water table, it also reduces surface run off.

Basic aim of pervious concrete is to increase the permeability of it by disturbing its compressibility to a little extent.

II. LITERATURE COLLECTIONS

2.1 Sanket Sharma et al (2012) concluded that if we add 5% fine aggregates of the Total aggregates then compressive strength increases but by exceeding the given amount results in decreasing of compressive strength. With the proportion of cement to total aggregates it gives maximum compressive strength at a fixed proportion, by increasing or decreasing proportion results in decreased compressive strength.
Split strength was also found to be increased in case of 10% fine aggregate to total aggregate in comparison to no fine aggregates.
2.2 V. Prakash et al (2018) concluded that pervious concrete has very low compressive strength and flexural strength so use of it is limited to parking lots, sidewalks of roads and low traffic roads. He also concluded that the durability of pervious concrete is more so it can be a useful material for new age structural buildings.
2.3 Tanvir Hossain et al (2011) used brick chips instead of coarse aggregates in pervious concrete. They burnt the clay and then crushed it then the material formed is replaced with coarse aggregate. They concluded that use

of brick chips aggregate instead of coarse aggregate results in formation of pervious concrete with more permeability than before. Hence purpose of making pervious concrete is fulfilled.

2.4 V.T. Giner et al (2011) concluded that addition of any amount of silica fume below 15% by mass of cement results in reduction in dynamic modulus of elasticity. He also got the same result in case of damping ratio as it was also decreased.

2.5 Aditya Pathak (2018) studied about the effect of fly ash and silica fume on normal concrete. He concluded that by adding any amount of fly ash and silica fume ranging from 25% to 60% of cement mass results in increase in mechanical properties of normal concrete.

III. MATERIALS USED

3.1 Cement

It is a binding material which is used in the form of paste to bind coarse aggregate and fine aggregated if present. Cement used in this experiment is OPC 53 grade confirming to IS 8112. Its specific gravity is 3.15.

3.2 Fly Ash

Fly ash can be obtained from power stations as it is the by-product of combustion of coal in these stations. It possesses pozzolanic materials. In this experiment we have used Class C fly ash.

3.3 Silica Fume

It is very fine in nature and can impact workability to a larger extent by addition of a small amount. Its Specific gravity is 2.2.

3.4 Coarse Aggregate

Coarse Aggregate used are of size 10 to 20mm in size and is obtained from local quarries easily.

3.5 Fine Aggregate

Fine Aggregates can be easily obtained from river. In this experiment we used fine aggregate of specific gravity 2.7.

3.6 Water

It is potable solvent used in the formation of pervious concrete. Its pH is 7.

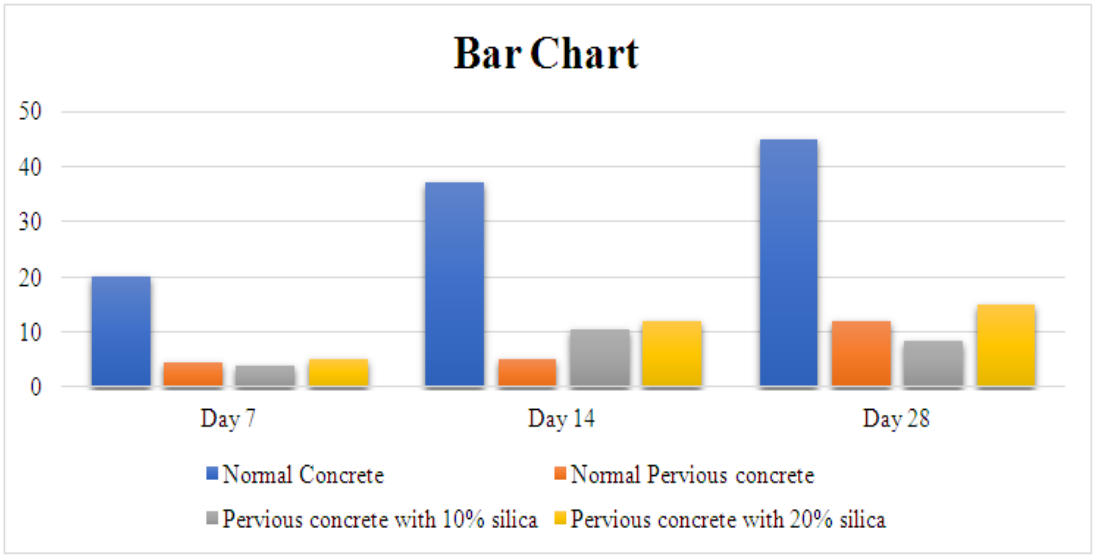
IV. METHODOLOGY

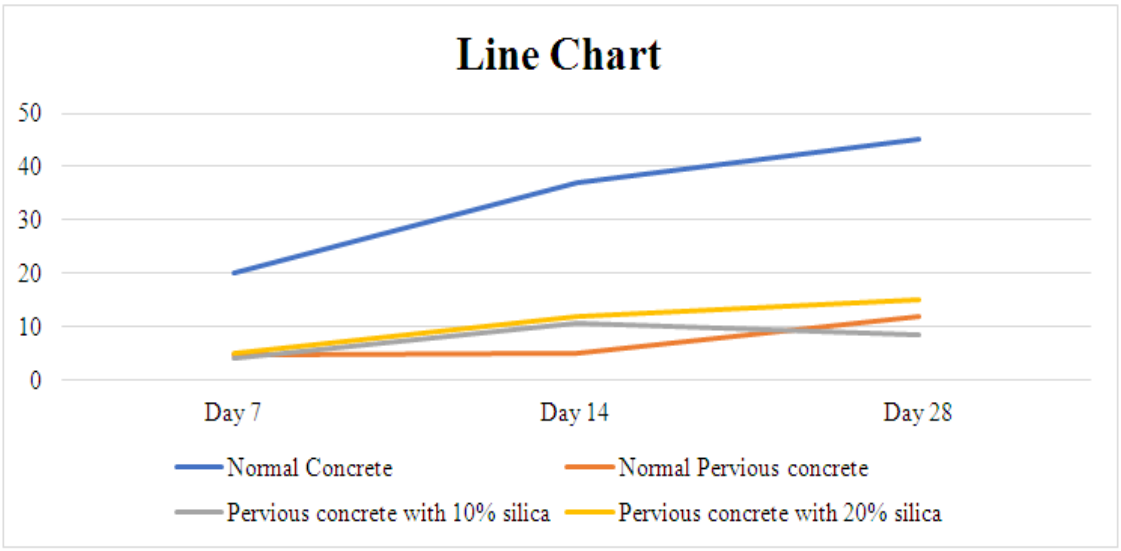
- Topic selection
- Literature collection
- Material collection
- Mix design
- Cube formation
- Test performed
- Results
- Conclusions

V. RESULTS

5.1 Compressive strength test

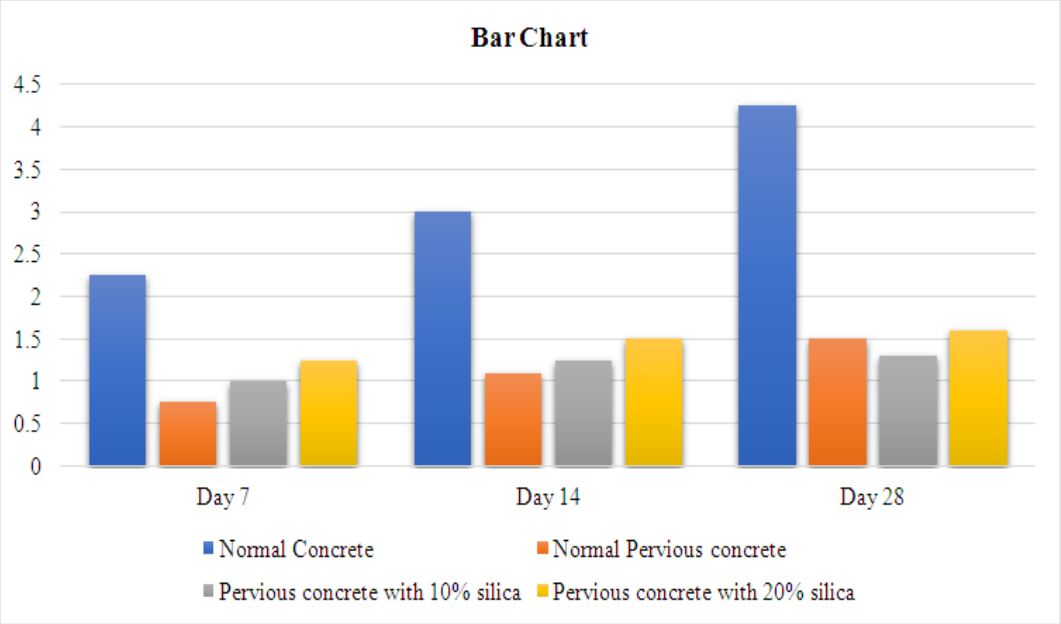
Days	Normal Concrete (N/mm^2)	Normal Pervious Concrete (N/mm^2)	Pervious Concrete with 10% Silica Fume (N/mm^2)	Pervious Concrete with 20% Silica Fume (N/mm^2)
7	20	4.5	4	5
14	37	5	10.5	12
28	45	13	8.5	15

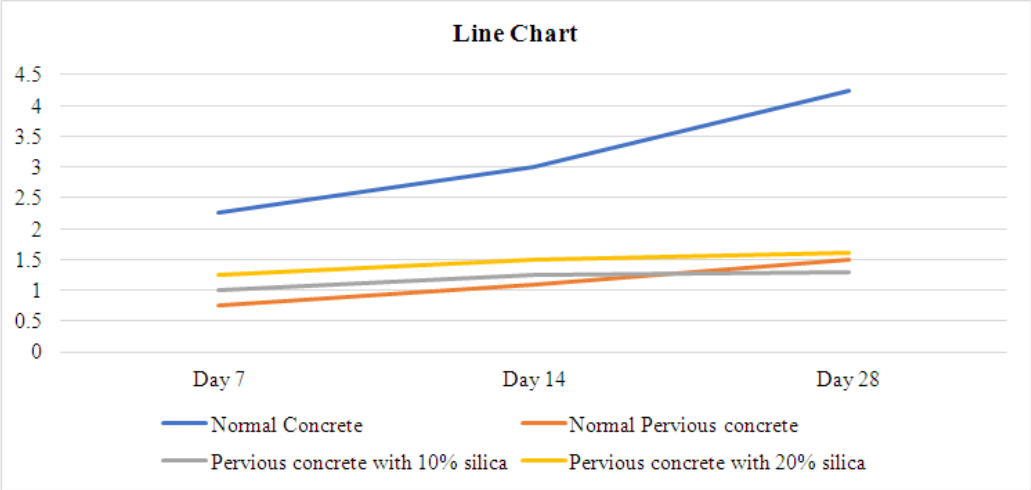




5.2 Split Strength Test

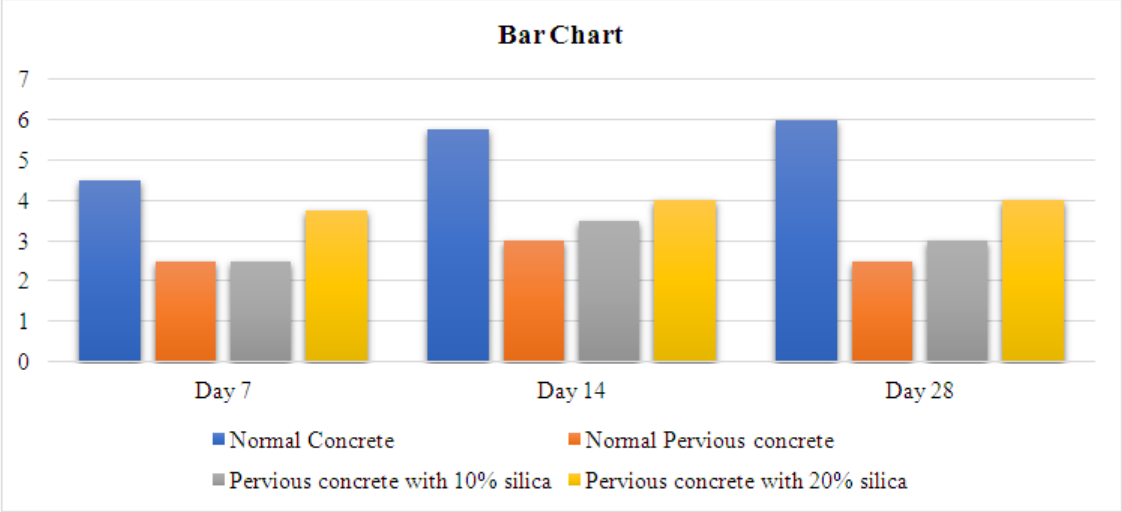
Days	Normal Concrete (N/mm^2)	Normal Pervious Concrete (N/mm^2)	Pervious Concrete with 10% Silica Fume (N/mm^2)	Pervious Concrete with 20% Silica Fume (N/mm^2)
7	2.25	0.75	1	1.25
14	3	1.1	1.25	1.5
28	4.25	1.5	1.3	1.6

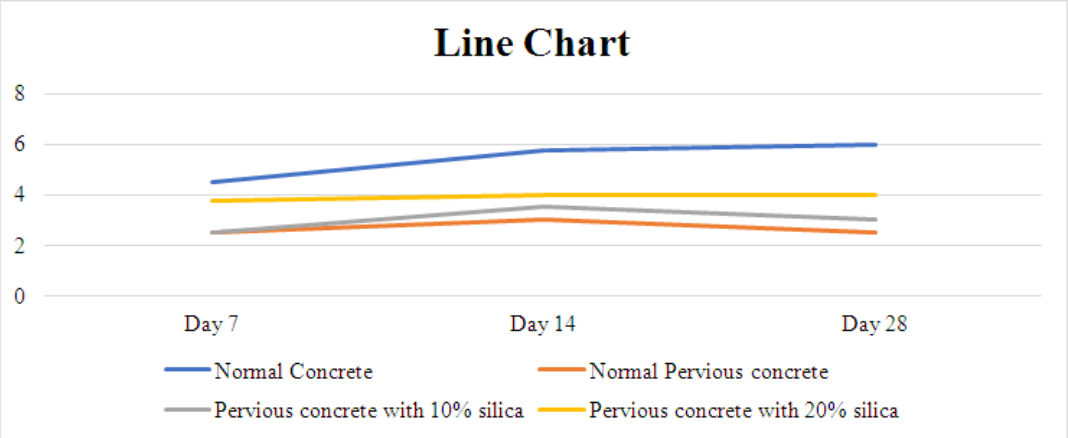




5.3 Flexural Strength Test

Days	Normal Concrete (N/mm^2)	Normal Pervious Concrete (N/mm^2)	Pervious Concrete with 10% Silica Fume (N/mm^2)	Pervious Concrete with 20% Silica Fume (N/mm^2)
7	4.5	2.5	2.5	3.75
14	5.75	3	3.5	4
28	6	2.5	3	4





VI. CONCLUSIONS

Compressive Strength of pervious concrete is found to be less than normal concrete at both 7 days and 28 days period which makes it unsuitable for bearing high loads. It has more permeability compared to normal concrete and is suitable for passing water through it which can be helpful in ground water recharge and it also reduces surface runoff.

Compressive strength, Split Strength and flexural Strength is found to be maximum when cement is replaced by 20% of silica fume than all other proportions used in pervious concrete.Split strength and Flexural strength also found to be lesser than normal concrete in all the three results.

Reason behind lesser strength than normal concrete in pervious concrete is use of less or no fine aggregate which results in void formation and decreases strength of mechanical properties.

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