Pervious Concrete A Novel Eco-Friendly Material

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Abstract— Pervious concrete is a very special type of concrete with high porosity, Water Absorbing pavement is a new technique in Pavement construction. Through this technique we can find a solution for the low ground water level, effective management of storm water runoff, Agricultural problems, etc. Pervious concrete can be introduced in low traffic volume areas, walk ways, sub base for concrete pavements, inter locking material, garden residential , green house, basketball court , volleyball house etc. Pervious concrete as a paving material have the ability to allow water to flow through itself to recharge ground water level and minimize surface storm water runoff. This property of porous concrete reviews its applications and engineering properties, including environmental benefits, strength and durability. By replacing a part of cement with fly ash, then it results the safe disposal of waste material. Hence it acts as an eco-friendly paving material.

Keywords: Pervious Concrete, Storm Water, Ground water Recharging, Light Weight, Waste Material Management, Strength, Durability

I. INTRODUCTION

The 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 runoff from a site and recharging ground water In pervious concrete the most important and basic principal this turns out to be different from other types of concrete like PCC and RCC because, it has no fine aggregates in it.

Permeable pavement is beneficial to the environment because it can reduce storm water volume, treat the storm water quality, and replenish the ground water supply and lower air temperatures on hot days. Due to increased void ratio, water conveyed through the surface and allowed to infiltrate and evaporate, whereas conventional surfaces will not do so. A porous pavement surface therefore becomes an active participant in hydrological cycle: rain fall and snow melt are conveyed back through soil into ground water. And also this pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices.

Pervious concrete is typically design with high void content (15-25%).There is no fine or little fine aggregates in pervious concrete. Pervious Concrete Is A Lightweight Concrete Because Of Less Amount Of Fine Aggregate. Because Of Its Porous Nature The Water Can Easily Passed Through It. Porous concrete is storm water drainage system that allow rain water and runoff to move through the pavement surface to storage layer below, with eventually seeping into the underlying soil.

A. Environmental Benefits

- Reduce the surface runoff of the storm water.
- Pervious concrete pavement reduces or eliminates runoff and permits natural treatment of runoff water.
- By collecting rainfall and allowing it to infiltrate, groundwater, aquifer recharge, water table level is increased.
- Pervious concrete is a light weight pavement material
- Effective utilization of waste material such as fly ash makes this technique more eco- friendly
- Pervious concrete pavement is ideal for protecting trees in a paved environment
- Although high-traffic pavements are not a typical use for pervious concrete, concrete surfaces also can improve safety during rainstorms by eliminating bonding.

B. What is a no-fine concrete Pervious concrete

It is a structural concrete pavement with a large volume (15 to 35percent) of interconnected voids. Like conventional concrete, it's made from a mixture of cement, coarse aggregates, and water. However, it contains little or no sand, which results in a porous open-cell structure that water passes through readily.

C. Main objective of pervious concrete are:

- To pave parking.
- Recharge ground water table.
- Reduces runoff water
- To help restore ground water supply

D. Factors to be considered for designing pervious concrete pavement:

Pervious concrete used in road pavement systems must be designed to support the intended Traffic Load and contribute positively to the site specific Storm Water Management Strategy. The designer selects the appropriate material properties, the appropriate pavement thickness, and other characteristics needed to meet the hydrological requirements (permeability, volume of voids, amount of rainfall expected, underlying soil properties) and anticipated traffic loads simultaneously.

II. MATERIALS & METHODOLOGY

A. Aggregates –

In pervious concrete generally singular size of coarse aggregates are used. For design of pervious concrete we used 16 mm of coarse aggregates as per the IS code 10262:2009 for mix design and also if coarse aggregate size decreases compressive strength increases.

B. Cementitious Material –

We used portland pozzolana cement of OPC grade-53 (Birla cement) as per the is code IS code 1489:1991

C. Admixture -

Conplast sp 500 complies with IS 9103: 1999 and BS: 5075 part 3. (Conform to ASTM-C-494 type 'G') is used as a water reducing agent in pervious concrete.

1) Properties

Specific gravity	S1.250-1.270 at 27◦c
pH at 27◦c	7.0-8.0
Chloride content	Nil to IS: 456
Air Entrainment	Approx. 1% additional air is entrained

III. EXPERIMENTAL PROGRAM

A pervious concrete is a mixture of cement, course aggregates and water. The conventional concrete is a mixture of cement paste, composed of Portland cement and water, coats the surface of fine aggregates and course aggregates. Through a chemical reaction called hydration, the paste harden and gains strength to form the rock-like mass called concrete.

Typically we used one part of cement, and two part of aggregates for making of pervious concrete , and admixtures 0.5% by weight of cement, the water to cement ratio is 0.4 and 36 no. of cubes of size 150mm×150mm×150mm were made. In that nine cubes are as the conventional concrete and other are used for the pervious concrete. Before filling these cubes with concrete they were coated with oil, so that, the concrete cubes would not adhere to the mould. The compressive strength of the cube was found out using Universal Testing Machine.

IV. EXPERIMENTATION AND TESTING

A. SIEVE ANALYSIS TEST-

For the design of pervious concrete we tested the 3 different size of aggregate
- 10mm to 12.5mm
- 12.5 to 16mm
- 16mm to 20mm

B. COMPRESSIVE TEST -

Compressive strength is dependent on size of coarse aggregate, void ratio, bond between mortar and coarse aggregate.

V. RESULT AND FINDINGS

Sr. No.	Name of The test	Result
1	Fineness of cement	7.33 %
2	Specific Gravity of Cement	3.14
3	Standard Consistency	32 %
4	Setting Time of cement Initial Setting time Final Setting Time	160 min. 285 min.

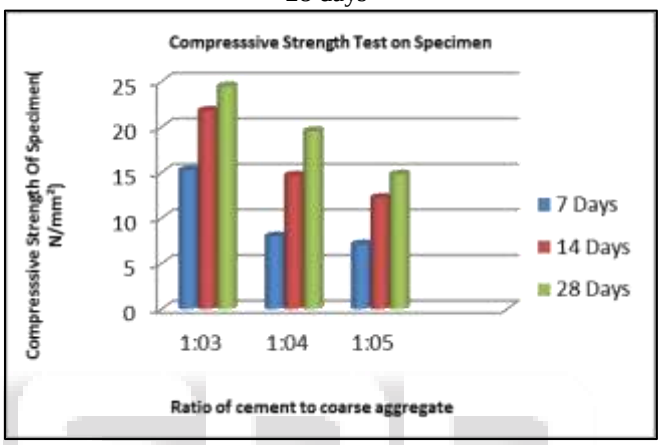
Table 1: Test result On Cement

Sr. No.	Name of The test	Result
1	Specific Gravity of Aggregate	2.82
2	Fineness Modulus of Coarse Aggregate	7.17
3	Water adsorption test	0.6%
4	Aggregate Impact value	21
5.	Aggregate crushing value	17.15 %

Table 2: Test result On Coarse Aggregate

Sr. No.	MIX	Ratio	Compressive strength (N/mm²)		
		(C/A)	7 Days	14 Days	28 Days
1	M 0	-	15.11	18.28	26.82
2	M 1	1:3	15.25	21.78	24.45
3	M 2	1:4	7.99	14.66	19.55
4	M 3	1:5	7.11	12.22	14.78

Table 3: Compressive Strength Test on Cube for 7, 14, And 28 days



VI. FUTURE SCOPE

Pervious concrete can be used in building for rainwater harvesting as well as for cooling purpose by providing permeable wall.

In the presence of clayey soil, water can be percolated through providing borehole at every 1- 2km with the help of drainage system.

Flaky aggregate can be use to provide easy passes of water without any extra drainage system provided. (Flacky aggregate have more strength).

Water can be filtered and stored as fresh water below the ground.

We can also give direction to water specifically according to need. By providing certain angle to the flaky aggregate water which gets drained will make its way to the slope going down towards the sewer line or any other drainage arrangement. This could be useful where soil strata have less water absorption capacity.

VII. MAINTENANCE

Prevent the surface from becoming clogged which reduce permeability. Most site function well without regular maintenance if protected from sand Vacuuming or power blowing may be necessary if the site become clogged.

Pressure washing pervious concrete 1-2 times a year would be necessary.

VIII. CONCLUSION

- All the experimental data shows that the concrete proportion 1:3 gives more compressive strength as compare to other two proportions i.e. 1:4 and 1:5.
- The concrete proportion 1:5 gives the maximum permeability than other two proportions, the proportion 1:4 gives moderate permeability as well as compressive strength.
- Even though the compressive strength of the pervious concrete is considerably less than that of the conventional concrete.
- Pervious concrete although not as strong as conventional concrete, provides an acceptable alternative when used in low volume and low impact areas.

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