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PERFORMANCE AND MANUFACTURING OF PERVIOUS CONCRETE

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Abstract-Pervious concrete which is also called permeable concrete, no fines concrete, and porous concrete is an unique type of concrete with a high porosity and it is used for concrete flatwork applications that allows water from rainfall and other sources to pass directly through and thereby reducing runoff from a site and allowing groundwater recharge. Pervious concrete is made using large coarse aggregates with little to no fine aggregates. The concrete paste then Coates the aggregates and allow the water to pass though the concrete slab.

Keywords- PC, RHA, PCP, EPA

I. INTRODUCTION

Concrete permeable sometimes referred to as non - fines, permeable concrete or improved porosity. Permeability of concrete is a coarse aggregate combined mixed, Pozzolona Portland cement and water. Permeable concrete differs from normal concrete containing coarse aggregate concrete.

The aggregate generally consists of a similar size and are connected together at the points of contact consisting of a mixture of cement and water. The result is a concrete with high content of voids that, when the good operation, so that the rapid percolation of water from the concrete. Concrete permeable characteristics are different from conventional concrete has a weight per unit of less than about 65% of the conventional concrete.

Pervious concrete presence in the concrete sector is growing day by the day. Factors such as the Green Building movement, the Clean (pure) Water Act and the price increase and changes in the field of asphalt will help push its growth, says Erickson. In fact, he believes that in the end will be the flooring of choice.

Pervious concrete is the fastest growing technology in the Green Building movement, according to Huffman, and sees a possibility for the future. Pervious concrete can help to realize a project

LEED credits, and Huffman believes that the commercial sector, as well as the federal government will affect the projects funded by the government.

Figure 1. Pervious concrete

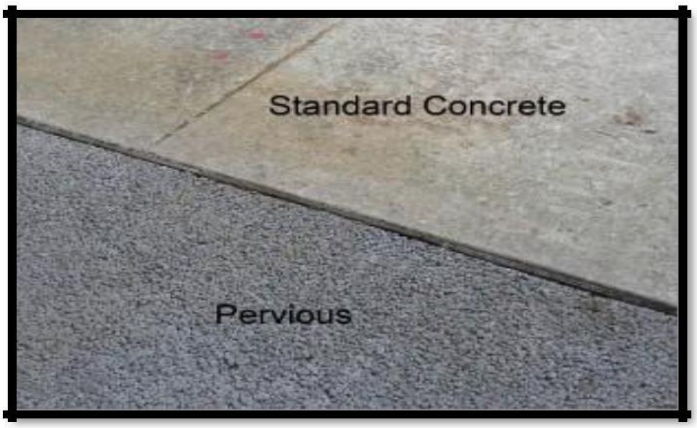

Figure 2. Comparison of normal concrete with pervious concrete

1.1 Pervious concrete applications

Parking lots Driveways Sidewalks/walkways Streets/road shoulders Other light traffic areas

Figure 3. Pervious Pavement Parking Lots

Figure 4. Pervious Pavement Walkways

1.2 Advantages of pervious concrete

- Decreasing flooding possibilities, especially in metro cities. Recharging the groundwater level
- Decrease puddles on the road.
- Improving water quality through percolation.

1.3 Disadvantages of pervious concrete

- Many engineers and contractors lack expertise with pervious concrete technology.
- Strength is less due to high porosity.
- High maintenance requirement.
- Limited use due to its low strength.

II. LITERATURE REVIEW

Yang et al. (2002) investigated that silica fume and super plasticizer in the pervious concrete can enhance the strength of pervious concrete greatly. Using smaller sized aggregate can enhance the strength of the pervious concrete.

Yukari et al. (2009) investigate the properties of pervious concrete by replacing the cement with 20% and 50% of fly ash. He concluded that compressive strength decreases with increase of the fly ash content. When fly ash content is increased up to 20% in concrete permeability is decreasing, but after that when fly ash content reach to 50% in concrete permeability is increased which is nearly similar to no fly ash pervious concrete.

Lian et al. (2010) investigated that if small amounts of super plasticiser is added to the mixtures containing silica fume, both the permeability and the compressive strength of the pervious concrete were improved.

III. MATERIALS AND METHODS

In the present study, the effects of changing the components of pervious concrete on its Compressive strength are investigated. The goal is to attain a maximum compressive Strength without hampering the permeability characteristics of the pervious concrete.

The materials used in the experimental work are:

- Cement
- Coarse Aggregate
- Water

The aggregate component of a concrete mixture at least 60 to 80 percent of the volume of cement. Coarse aggregate is dried in air to obtain dry to saturated surfaces, to ensure that the cement water is not affected. Some other characteristic of workability and aggregate bond between concrete mixes influences, such as the shape, structure, gradation and moisture. Coarse aggregate was adopted with a size of 12 mm and maximum face down. The tests were performed with coarse aggregate according to IS 2386-1963 determine the physical properties of coarse aggregate and in Table1.

Mixing of aggregate cement and rice husk ash are mixed together. Hand mixing was used with 0.50 water cement ration.

Table 1 Physical Properties of Aggregate

Sr. No	Physical Properties	Results	Range
1	Specific Gravity	2.61	2.5-3
2	Crushing Value	19%	<30%
3	Impact Value	16%	<30%
4	Water Absorption	1.90	<10%

Table 2. Result of Aggregate Impact Value

Sr. No.	**Description**	**1**	**2**	**3**
1	Total weight of aggregate In W_1 gm	366	350	348
2	Weight of aggregate retained on 2.36mm IS sieve W_2 gm	320	303	318
3	Weight of aggregate passing through 2.36mm IS sieve $W_3=W_1-W_2$ gm	46	47	40
4	Aggregate Impact Value $(W_3/W_1)*100$ in %	12.56%	13.42%	11.49%

Table 3. Result of Los Angles Abrasion Value

Sr. No.	Description	Sample I	Sample II	Sample III
1	Weight of aggregate taken in W_1 gm	4800 20mm	3600 10mm	2500 6mm
2	Weight of aggregate passing through 1.7mm sieve W_2	985	885	599
3	Los Angles Abrasion Value $(W_2/W_1)*100$	20.53%	24.94%	23.96%

3.1 Compressive Strength

The compressive strength is the most important criterion for the structural design, the compression tests are relatively easy to carry out. The test for determining compressive strength for concrete employs a cube specimen of 150mm size and cured for 3, 7, and 28 days which is subjected to compression in a compression machine.

Figure. 5 Compression Testing Mould

Figure 6. Casting Concrete Cubes and aggregates

Figure 7. Hand Mixing of Concrete

Figure 8. Filling cube of pervious Concrete

3.2 Procedure:

- Rice Husk from local Rice Mills was burnt completely in open field condition and sieved with 150 micron IS sieve.
- Rice Husk Ash percentage was gradual increased from 5.0%, 8.0%, and 10.0%. we did this with the comparison of M_{20} grade nominal mix concrete (1 : 1.5 : 3) and cement mortar of proportion (1 : 4).
- Coarse aggregate of less than 20 mm graded nominal size, river sand zone III type and 43 grades Ordinary Portland Cement (PPC) were used for this work.
- For slump values 15 mm to 35 mm and compaction factor 0.85 to 0.90, water cement ratio for plain and RHA mixed concrete was 0.50 and 0.575 respectively.
- For casting concrete and mortar cubes, 150 mm steel cube moulds were used to carry out these tests. Each set Contained Six samples of plain concrete and six of RHA mixed.
- After 24 hours of casting, samples were opened and kept under tap water curing for 28 days.
- In order to obtain the compressive strength for 3, 7 and 28 days curing period, compression test is conducted.

- The tests are conducted on pervious concrete test specimens with different proportion of cement aggregate and rice husk ash.
- After adding rice husk ash there are phenomenal increase in the strength of pervious concrete. In these tests the water cement ratio was 0.50 and for good workability and a admixture SP430 was used. The proportion of the admixture is 0.6% by weight.
- The weight of the cube is 7.49kg. Which was almost equal to conventional concrete cube of grade M40 and that is 8.00kg .

IV. RESULTS AND DISCUSSIONS

The result of the study made on pervious concrete by optimizing on mix proportioning and their strength characteristics calculated in accordance with IS 456:2000 requirement are presented under various headings and tabulated in various tables and graphs.

4.1 When 5% RHA is added

Table 4. 5% RHA Compressive Strength

3 Days Strength (N/mm^2)		7 Days Strength (N/mm^2)		28 Days Strength (N/mm^2)	
Specimen	Average	Specimen	Average	Specimen	Average
1 7.40	7.41	13.50	13.60	26.55	26.62
2 7.33		13.60		26.70	
3 7.50		13.70		26.60	

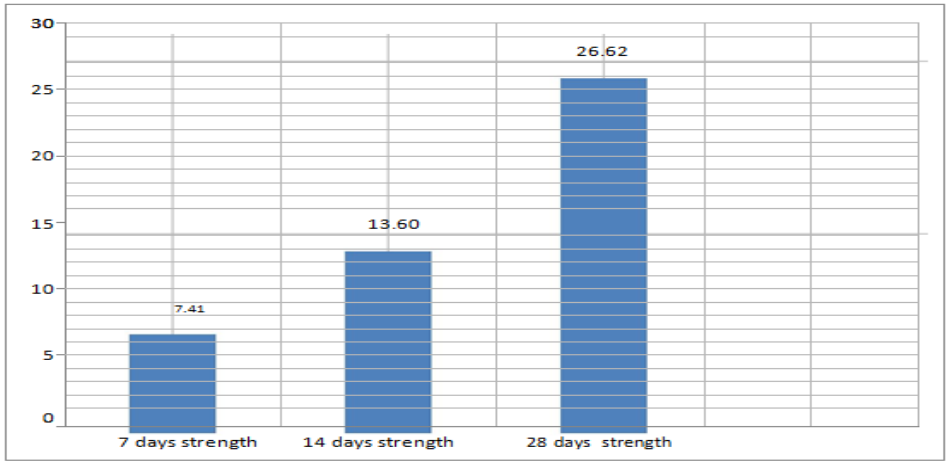

Figure 9. 5% RHA Compressive Strength

4.2 When 8% RHA is added

Table 5. 8% RHA Compressive Strength

3 Days Strength (N/mm²)		7 Days Strength (N/mm²)		28 Days Strength (N/mm²)	
Specimen	Average	Specimen	Average	Specimen	Average
1 8.30	8.24	14.70	14.43	28.50	28.62
2 8.2		14.10		28.77	
3 8.22		14.50		28.60	

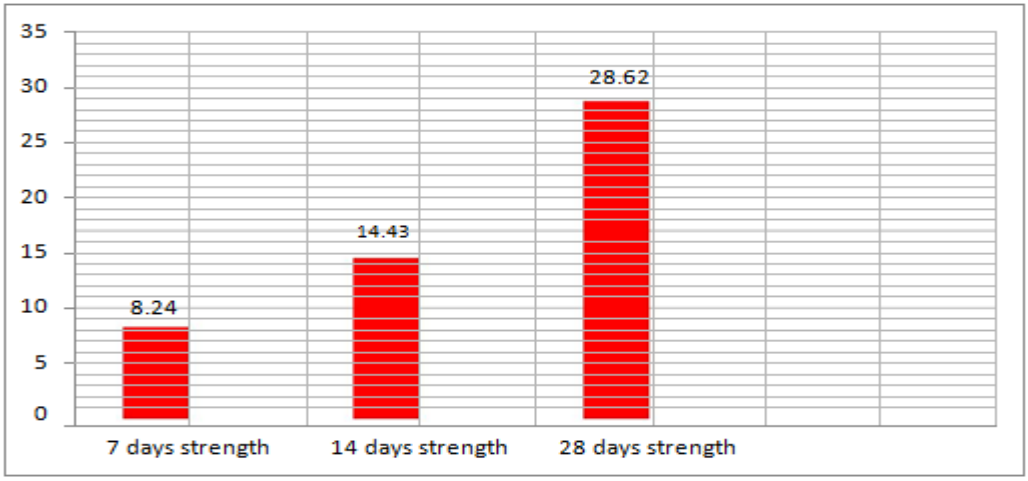

Figure 10. 8% RHA Compressive Strength

4.2 10% RHA is added

Table 6. 10% RHA Compressive Strength

3 Days Strength (N/mm^2)		7 Days Strength (N/mm^2)		28 Days Strength (N/mm^2)	
Specimen	Average	Specimen	Average	Specimen	Average
1 1010	10.18	17.30	17.50	29.61	29.5
2 10.22		17.65		28.55	
3 10.35		17.55		29.70	

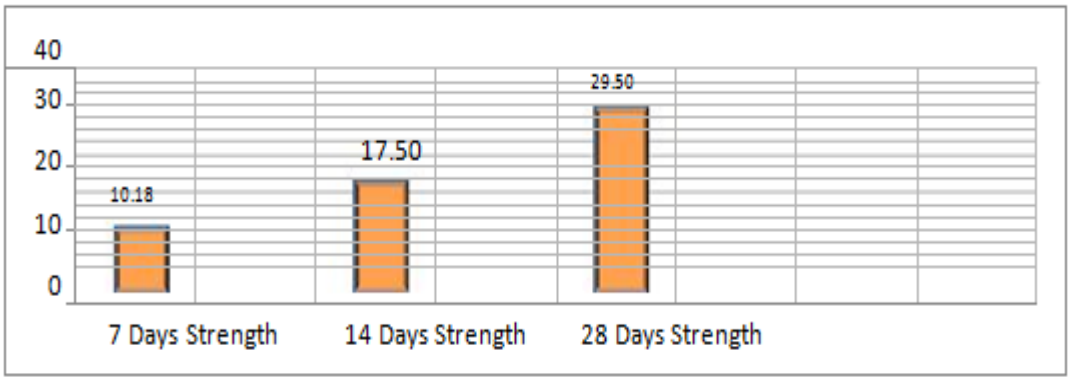

Figure 11: 10% RHA Compressive Strength

Figure 12. Pervious Concrete

V. CONCLUSIONS

- As there was no such ratio of ingredient mixing describe hence the pervious concrete mix proportion was obtained after the trial mix
- Workability was showing decreasing Pattern as adding the rice husk ash
- Compressive strength of pervious concrete is 26.62 for the 5% addition of rice husk ash, with the ratio of 1:0.05:4
- Compressive strength of pervious concrete is 28.62 for the 8% addition of rice husk ash, with the ratio of 1:0.08
- Compressive strength of pervious concrete is 28.95 N/mm2 for for the 10% addition of rice husk ash ,with the ratio of 1:0.1:4
- Permeability of pervious concrete is decreased with the increased the quantity of Rice Husk Ash
- For Ratio 1:0.05:4 it was observed 90% percolation instead of 82% percolation and 70% percolation for the ratio of 1:0.08:4 and 1:0.1:4 respectively
- To achieve the almost 90 to 95% percolation of rain water, storm water and other impurities, it was observed experimentally that 1:0.05:4 is the best ratio which was developed by the addition of 5% Rice husk ash.

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