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Experimental Investigation of Pervious Concrete

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Abstract: ***the paper provides technical information on pervious concrete's application, design methods, mixture proportioning and inspection. The term "pervious concrete" typically describes a near-zero-slump, open-graded material consisting of Portland cement, coarse aggregate, little or no fine aggregate and water. The combination of these ingredients will produce a hardened material with connected pores, ranging in size from 6.3 to 10mm.That allow water to pass through easily. The void content can range from 15 to 35%, with typical compressive strengths of 2.8 to 28 MPa. The drainage rate of pervious concrete pavement will vary with aggregate size and density of the mixture, but will generally fall into the range of 81 to 730 L/min/m2. Pervious concrete is widely recognized as a sustainable building material, as it reduces storm water runoff, improves storm water quality, may recharge groundwater supplies, and can reduce the impact of the urban heat island effect.***
Keywords: ***pervious concrete, study of concrete, mix design, water ratio, concrete strength***

I. INTRODUCTION

Pervious concrete is a porous concrete paving material with a high porosity which permits water to percolate through it, made by using large aggregates with little or no fine aggregates. Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. It became popular again in the 1920s for two story homes in Scotland and England. It became increasingly viable in Europe after the Second World War due to the scarcity of cement. It did not become as popular in the US until the 1970s. In India it becomes popular in 2000. Pervious concrete is made by eliminating most or all fine aggregates from the concrete mix. Its internal interconnected void space allows storm water to percolate and thus to reduce the amount of run-off. The permeability or the saturated hydraulic conductivity of the pervious concrete signifies its capacity to drain the ponding water from the concrete surface. It quantifies the resistance of the medium to flow and depends only on the characteristics of the porous medium.

A. Pervious Concrete Pavement, an Emerging Green Technology

Pervious concrete pavements are an innovative concrete technology intended to reduce the impact of the roadway footprint and benefit the growing urban environment. They create pavement surfaces useful for many low-traffic applications, including parking lots and walkways that are more environmentally friendly than conventional impermeable surfaces. Pervious concrete is a low slump, open-graded mix composed of Portland cement, supplementary cementing materials, coarse aggregate with little or no fines, admixtures and water. The high void content (15% to 25%) and the presence of inter-connected pores result in a free-draining pavement layer that allows water to drain directly into the sub-grade, recharging the groundwater and providing an opportunity to eliminate or reduce storm water management devices such as ponds and swales.

II. MIX DESIGN

A. Target Strength for Mix Proportioning

Target Mean Strength for specified characteristic strength of cube is f'ck = fck +1.65S

Where, f'ck= target average compressive strength at 28 days

fck = Characteristic compressive strength at 28 days

S = Standard deviation

fck = 20 N/mm2

S = 1 N/mm2 …. (from table 1, IS 10262:2009)

f'ck = 7.5 + 1.65(1)

=9.15 N/mm2

Target mean strength = 9.15 N/mm^2

Characteristic strength @ 28 days = 7.5 N/mm2

B. Water Content Ratio

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Use water cement ratio in range of 0.35 to 0.5.

C. Mix Calculation

M7.5=1:3
Volume=1+3=4
Total volume ingredient for using =0.00337m^3
Volume of cement=1/4*0.00337=0.000843m^3
Volume of aggregate=3/4*0.00337=0.002527m^3
Mass of cement =0.000843*1440=1.21kg
Mass of Aggregate =0.0002527*1528=5.01kg

D. Calculation of water content

Water cement ratio = 0.35 w/1.21=0.4235lit/m^3

III.COMPRESSION TEST

TABLE.1. COMPRESSION TEST RESULTS

Sr. no.	W/C Ratio	Mix proportion	Wt. of aggregate in kg	Wt. of cement in kg	Compressive strength of 28 days in N/mm²			
					Cube1	Cube2	Cube3	Avg
1	0.35	1:3	5.01	1.21	9.2	9.4	9.2	9.2
2	0.4		5.01	1.21	10.46	10.49	10.47	10.48
3	0.45		5.01	1.21	10.70	10.68	10.69	10.69
4	0.47		5.01	1.21	10.96	10.96	10.99	10.98
5	0.5		5.01	1.21	11.37	11.35	11.34	11.94

Relationship Between Compressive Strength & W/C Ratio in Pervious Concrete

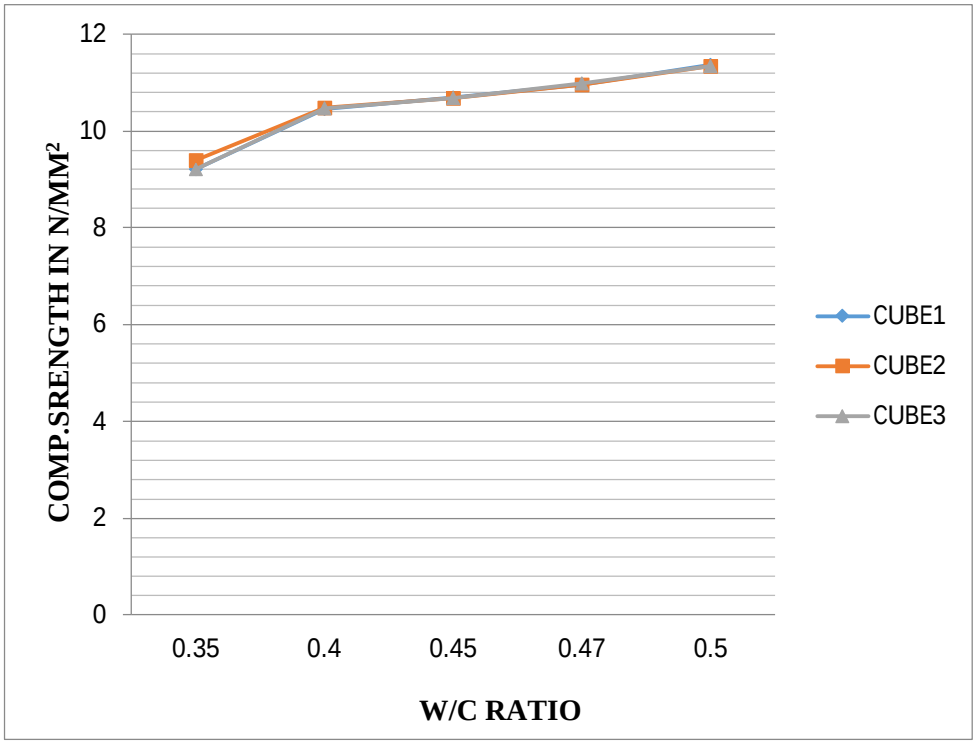

Fig III.A Relationship between Porosity & W/C Ratio in Pervious Concrete

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IV. POROSITY TEST

Table.2. Porosity test results

Sr. no.	W/C Ratio	Mix proportion	Wt. of aggregate in kg	Wt. of Cement in kg	Dry wt. Kg	Submerged wt. in kg	Porosity Void ratio in %
1	0.35	1:3	5.01	1.21	7.25	3.32	20.25
2	0.4		5.01	1.21	7.3	3.39	18.01
3	0.45		5.01	1.21	7.46	3.49	17.5
4	0.47		5.01	1.21	7.5	3.65	17.37
5	0.5		5.01	1.21	7.6	3.88	16.57

Relationship Between Porosity & W/C Ratio in Pervious Concrete

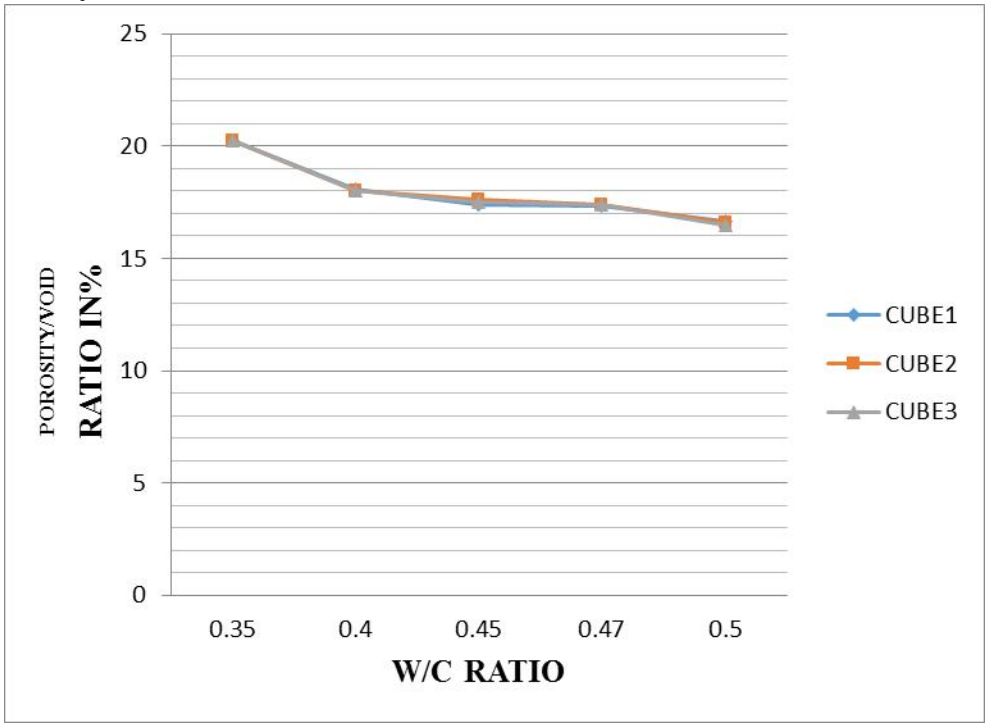

Fig 6.2 Relationship between Porosity & W/C Ratio in Pervious Concrete

V. CONCLUSION

A. Based on the experimental investigation on the pervious concrete, the following conclusions could be made:

1) Compressive strength of pervious concrete depends primarily on the porosity of concrete; A materials type and shape and size showed marginal influence on the strength of pervious concrete for a given porosity.

2) Reduction in the aggregate size decreased the porosity of pervious concrete and as the consequence the strength of pervious concrete is increased.

3) Water cements ratio increases the compressive strength also increases.

4) Water cements ratio increases the porosity is decreases.

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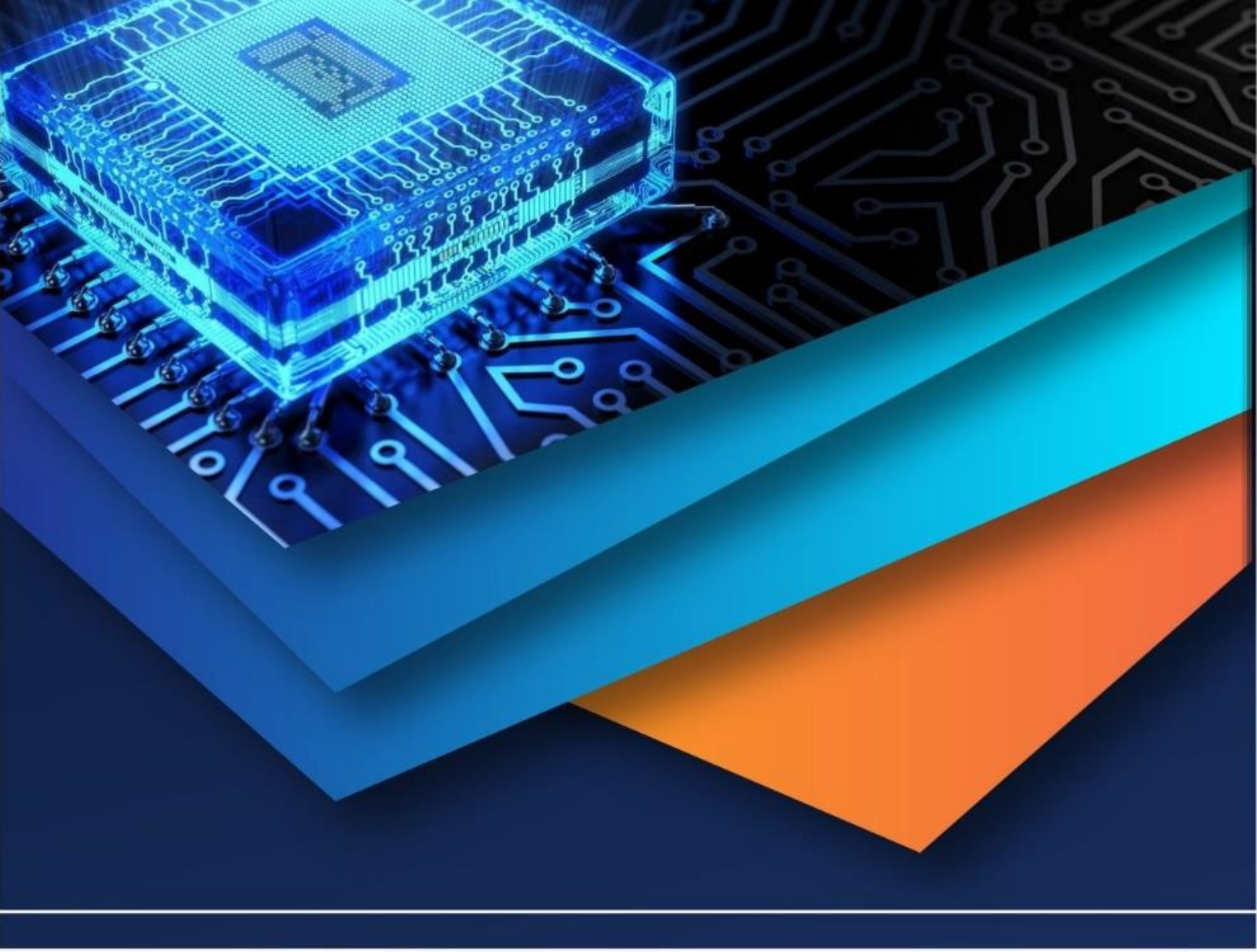

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