Comparison of Strength & W/C Ratio for Different aggregates for the Development of Pervious Concrete

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Abstract **- Pervious concrete Consist Portland cement, coarse aggregate, water and additives with little fines or no fine aggregate. Pervious Concrete helps environment by managing storm water, reducing heat island effects and water runoff. There is no IS code for the design of pervious concrete. So, I try hit and trial method to achieve the strength with proper water cement paste. On the trial basis, the different aggregates with different shape and size are used. For the first trial mix, the water to cement ratio is 0.4 and aggregate to cement ratio is 4:1. Results show that the strength of the 10mm rounded shape aggregate has higher strength than 10mm chips shape and 10mm chips shape aggregate has higher strength than 20mm aggregate. For the second trial, the different water-cement ratio is used for the higher in the first trial mix. In the second trial mix, the water-cement ratio is 0.35 for the rounded aggregate with aggregate to cement ratio is same. The result shows that the strength is higher for the higher water-cement ratio.**

Index Terms **- Pervious Concrete, no fine Aggregates, Environmentally Friendly, Low Water Runoff, Reducing heat Island effects.**

I.INTRODUCTION

In India, the cities like Chennai, Mumbai, Bangalore and Currently Jaipur, these cities are very crowded, and have genuine problem of hot island effects, flood due to storm water runoff, less space available for the drainage of water and the ground water is also reducing in most of the cities. To overcome from these problems in cities we can apply the new concept of concrete called pervious concrete so that we can reduce all these problems.

Pervious concrete is a special type of concrete with high porosity that allows the water to percolate and other sources to pass directly through it, thereby reducing the runoff from a site and allowing ground water recharge.

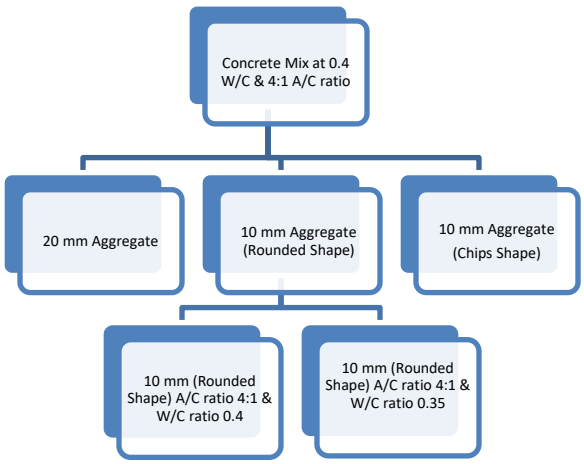
Pervious concrete is a unique and effective means of addressing a number of environmental issues and supporting sustainable development. Pervious concrete is a mixture of Portland cement, coarse aggregate, little or no fine aggregate, water, and additives. The porous structure allows both water and air to percolate into underlying layers. Apart from the above, pervious concrete when used in a pavement system has structural, economic, and road-user benefit. By capturing rainwater and allowing it to seep into the ground, pervious concrete is instrumental in recharging groundwater and reducing stormwater runoff.

Pervious concrete is also called as no fines concrete because the fine aggregate is present in little quantity or totally absent. It is also known as gap graded concrete. The permeability and strength of pervious concrete depends on the particle sizes and proportion of the constituent materials of which the concrete is made. The project describes about the effect of size of aggregates and proportions of cement, aggregates, and water.

II. OBJECTIVE

a. To obtain suitable size of aggregate, which provide the maximum strength in pervious concrete.
b. To obtain optimum paste so that the cement pastes not clogging the voids in pervious concrete.
c. To achieve optimum W/C (Water to Cement) ratio for constant A/C (Aggregate to cement ratio)

III. METHODOLOGY



3.1 EXPERIMENTAL INVESTIGATIONS TESTS ON CEMENT

a. Specific Gravity of 53 grade Cement (Ultratech Company) – 3.09, {Specific gravity test conforming the IS 4031: 1988 (part 11)}
b. The consistency of cement is 33% by weight of cement, {Test is done with conforming IS 4031:1988 (part 4)}
c. The initial and final setting time test by conforming the IS 4031:1988 (Part 5), The initial setting time of cement is 35minutes&The final setting time of cement is 9 hours.
d. Soundness test is done by conforming the IS code 4031: 1988(part 3) & soundness of Cement is 4mm.

3.2 TESTS ON AGGREGATES

3.2.1 Tests On 20mm Aggregates

a. Specific Gravity of Aggregate – 2.87 {Specific Gravity test conforming IS code 2386: 1963(part 3)}
b. Water Absorption of Aggregate – 0.5% {Water Absorption Test Conforming IS Code 2386:1988 (Part 3)}
c. Table -1 Sieve Analysis for 20mm aggregate conforming IS 383:1970.

3.2.2 Tests On 10mm Chips Shape Aggregate

IS Sieve Size	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Percentage Weight Retained (gm)	Cumulative Percentage Weight Passing
12.5mm	0	0	0	100
10mm	293	293	14.65	85.35
4.75mm	1539	1832	91.6	8.4
2.36mm	148	1980	99	1
Pass	20	2000	100	0
Total	2000	-	305.25	-

a. Specific Gravity of 10mm Chips Shape Aggregate – 2.72 {Specific Gravity test conforming IS code 2386: 1988 (part 3)}
b. Water Absorption of Aggregate – 1.4% {Water Absorption Test Conforming IS Code 2386 (Part 3)}
c. Crushing Strength of Aggregate – 13.3% {Crushing Strength Test of aggregate Conforming IS code 2386: 1988 (part 4)}
d. Impact Value Test – 13.54% {Conforming IS code 2386: 1988 (part 4)}

3.3 TESTS FOR 10MM ROUNDED SHAPE AGGREGATE

a. Specific Gravity – 2.91{conforming IS code 2386 (part 3)}
b. Water Absorption – 0.2% {Conforming IS Code 2386: 1988 (Part 3)}
c. Crushing Strength – 4% {Conforming IS code 2386 (part 4)}
d. Impact Value – 6.55% {Conforming IS code 2386: 1988 (part 4)}

Table-3 Sieve Analysis for 10mm (Rounded) aggregate conforming IS 383:1970.

IS Sieve Size	Weight Retained (gm)	Cumulative Weight Retained(gm)	Cumulative Percentage Weight Retained(gm)	Cumulative Percentage Weight Passing
12.5mm	0	0	0	100
10mm	45	45	4.5	95.5
4.75mm	910	955	95.5	4.5
2.36mm	40	995	99.5	0.5
Pass	5	1000	100	0
Total	1000	-	299.5	-

IV RESULTS

4.1 Trial Mix -1

Table-4 Compare results of 10mm chips, 10mm rounded and 20mm aggregate

10mm rounded shape aggregate	Compressive Strength (MPa)	Flexural Strength (MPa)	Split Tensile Strength (MPa)	Permeability (cm /sec)	Void Ratio (%)	Density (Kg/m^3)
W/C = 0.4	16.53	4.13	1.98	0.635	9.228	2343.01
W/C = 0.35	14.31	3.57	1.71	0.682	15.48	2214.22

4.2 Trial Mix -2

Table-5 Compare results for 0.35 and 0.4 w/c ratio.

Different Aggregate	Compressive Strength (MPa)	Flexural Strength (MPa)	Split Tensile Strength (MPa)	Permeability (cm/sec)	Void Ratio (%)	Density (Kg/m^3)
20mm aggregate	7.28	1.66	0.83	-	16.48	2137.93
10mm chips shape	8.5	1.85	1	0.753	12.97	2149.21
10mm rounded shape	16.53	4.13	1.98	0.635	9.228	2343.01

V. CONCLUSION

1. For the W/C ratio is 0.4, A/C ratio is 4:1 is constant.
2. The compressive strength, flexure strength and split tensile strength of 10mm rounded shape aggregate is highly more than the 10mm chips shape aggregate and 20mm aggregate.
3. The permeability of the 20mm mix is zero because more cement paste is available for less surface area, the voids in the previous concrete clogged by cement paste.
4. The permeability is more in 10mm chips because the void ratio is more in 10mm chips aggregate mix than the 10mm rounded aggregate.
5. The density is more in 10mm rounded shape aggregate because the voids are less than the other two mixes.
6. For the W/C ratio is 0.35, A/C ratio is 4:1 is constant.
7. The W/C ratio is reduced to 0.35, by this W/C ratio the cement paste is less resulting in reducing the strength.
8. The void ratio is more in W/C = 0.35 than W/C = 0.4, because the thickness of the cement paste around the aggregate is less, resulting in reducing the density of the mix and increase in the permeability of the mix.
9. The Strength of 0.4W/C ratio is more than 0.35W/C ratio.

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