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Mitigation of Flooding & Improvement of Ground Water Table Using Permeable Concrete

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ABSTRACT

Pervious concrete (no-fines concrete) is a concrete containing little or no fine aggregate; it consists of coarse aggregate and cement paste. It consumes less raw material than normal concrete (no sand), it provide direct drainage of rainwater, it helps recharge groundwater in pavement applications. The previous studies gives an important idea about the pervious concrete about its mixing and installation processes it also concludes that pervious concrete has a large open pore structure hence less heat storage. In our project work we adopt trial mixes which gives M20 grade concrete. Coarse aggregate with nominal size 20mm passed and 10mm retained. Fine particals are replaced by 32% of river sand. Use of river sand in small amount helps to improve strength as well as maintain the void ratio in required percentage. Main goal of our project is to achieve the maximum strength with proper drainage properties. The mix without river sand and using small aggregate give fine void ratio and compressive strength is more than the mix using large size aggregate. The concrete mix with 32% of river sand gives void ratio within permissible limit (15% - 25%) and also improves the compressive strength as compare to previous mix. Hence from this study we have concluded that use of river sand gives improves the strength without lowering the void ratio.

Keywords : No fine aggregate, void ratio, pervious concrete.

I. INTRODUCTION

In the recent year , due to urbanization in India cities, most areas are occupied with building and air proof concrete pavement rain water does not pass underground because lack of water permeability in concrete pavement. In such condition one strategy is the application of pervious concrete.Pervious concrete system has advantage over impervious concrete in that it is effective in management run-off from paved surface, control pollution in water and recharge ground water table. Pervious concrete absorbs less heat than regular concrete and asphalt, reduces the need for air conditioning. Absence of fine aggregate 15% - 30% It's volume consist of interconnected void network which allow water to pass through the concrete.

In pervious concrete there is no fine aggregate so strength of pervious concrete is less than conventional concrete because of less compressive strength which is applicable to footpath, tennis court, low traffic areas, jogging tracks,etc. In the presence of clayed soil, water can be percolated through providing borehole at 1 – 2km with the help of drainage system.

Future Scope and Objectives

By using the pervious concrete we can able to recharge the ground water table and storm water

disposed can also be done. Pervious concrete can be used in building roe rainwater harvesting as well as for cooling purpose by providing permeable wall. Flaky aggregate can be use to provide easy passes of water without extra drainage system provided. Water can filtered stored as fresh water below ground.

By providing certain angle to the flaky aggregate water will get drained to slope toward sewer line. We can also give direction to water specifically according to need. This useful where soil strata have less water absorption capacity.

Materials

Material analysis is done to test the variety of material that be used in making concrete cubes. We planned the mix proportion for the equipment and arranged the concrete cubes.

Cement

we have used ordinary Portland cement (OPC) of grade 53. It is higher strength cement to meet the needs of customer for higher strength concrete. OPC 53 grade should surpass the requirements of IS: 12269-1987 grade. Ordinary Portland cement is used throughout the experiment work.

Coarse Aggregate

Aggregate were first consider to simply be filler for concrete to reduce the amount of cement require Aggregate can be broadly classified into four different categories: these are heavyweight, normal weight, lightweight an ultra-light weight aggregates.

Physical properties of coarse aggregate:-

Sr. No.	Property	Results
1	Particle shape, size	Crushed 10mm
2	Specific gravity	2.7239
3	Water absorption	1
4	Bulk density	12.68
5	Flakiness index (%)	7.9
6	Elongation index (%)	10.6
7	Impact value	20.61

Water

As per IS-456:2000 water used for mixing and curing shall be clean and free from injurious amounts which is available from tap water is used for concreting The amount of water is critical for the formation of the voids in pervious concrete. Water to cement rations can range from 0.27 to 0.30 with as high as 0.40.

River Sand

Natural sand show a variety of mineral compositions and chemical characteristics: when sand is used in concrete aggregate, these properties may results in different concrete strength. The fineness modulus of the natural river sand is 2.44, conforming to zone II as per IS: 383-1970 was used for the experimentation after washing it with clean water. The specific gravity of the natural sand is 2.59. the water absorption and moisture content values obtained for the sand used was found to be 1.51% and 0.7% respectively.

Mix Design

The following proportioning approach can be used quickly arrive at pervious concrete proportions that would help attain void content of freshly mixed pervious concrete when measured in accordance with ASTM C1688 similar to the target value

Mix Proportion

For mix 1

Volume of concrete = 1m3

Volume of cement

= (mass of cement / specific gravity of cement) * (1/1000)

= (300 / 3.15) * (1/1000)

= 0.09523 m3

Volume of water

= (mass of water / specific gravity of water) * (1/1000)

= (220.48 / 1) * (1/1000)

= 0.220 m3

Total weight of other material except coarse aggregate

= 0.09583 + 0.220

= 0.315m3

Volume of coarse aggregate

= 1 – 0.315

= 0.6847 m3

Volume of fine aggregate

= volume of coarse aggregate * 0.33

(Assume 33% by the volume of total aggregate)

= 0.6847 * 0.33

= 0.2259 m3

Hence,

Volume of coarse aggregate = 0.6847 – 0.2259

= 0.4587m3

Weight of coarse aggregate

= volume of coarse aggregate * specific gravity of coarse

Aggregate * 1000

= 0.4587 * 2.75 * 1000

= 1256.9 kg/m3

For mix 2

Volume of river sand

= (3 to 3.2% of weight of coarse aggregate)

= (3.2 / 100) * (1256.9)

= 40.44 kg/m3

For Mix 3

Volume of river sand

= (3 to 3.2% of weight of coarse aggregate)

= (3.2 / 100) * (1297.59)

= 41.52 kg/m3

For Mix 4

For coarse aggregate passing through 12.5mm and retained on 10mm then,

Volume of coarse aggregate = 70% of total weight of aggregate

= (70/100) * 1292.65

= 904.85 kg/m3

For coarse aggregate passing through 10mm aggregate is used for 30% of total weight of coarse aggregate then,

Volume of coarse aggregate = 30% of total weight of aggregate

= (30/100) * 1256.9

= 377.07 kg/m3

Material	Mix1 Quantities in kg/m^3	Mix 2 Quantities in kg/m^3	Mix 3 Quantities in kg/m^3	Mix 4 Quantities in kg/m^3
cement	300	300	300	300
Size of coarse aggregate	10mm	16 to 10mm	16 to 20mm	12.5 to 10mm is 70%and passing through to 10 mm is 30% used
Quantity of coarse aggregate	1256.9	1256.9	1256.9	904.85=12.5 to 10mm 377.07=passing 10mm
Water	220.48	220.48	197.16	197.16
River sand	-	40.22	41.52	-

The cube of size 150mm x 150mm x 150mm are used for casting and after demoulding cubes are taken for curing i.e 7days and 28days. After the curing the specimen are tested under the compression testing machine.

TEST CODUCTED

Void ratio:

The void content is defined as the total percentage of voids present by volume in a specimen. JCI Test method was employed to determine the total void ratio of pervious concrete on cubes (15cm x 15cm x 15cm) The void content of pervious concrete is calculates using following equation:-

Void content (%) = (T-D) / (T) *100

Where, D = (Mc-Mm)/Vm (density)

Mc = mass of measure filled with concrete

Mm = net mass of concrete by subtracting mass of measure

Vm = volume of measure

T = Ms/Vs (Theoretical density)

Ms = total mass of material batched

Vs = total absolute volume of material

Compressive Strength Test:

The test is carried out on the cube specimen 150mmx150mmx150mm. cast iron moulds are used to the cubes having leak proof metal base plate.

For the compression test, the cubes were placed in machine in such a way that the load was applied on the faces perpendicular to the direction of cast. The top surface of machine is fixed and load is applied on the bottom surface of specimen. The rate of loading was gradual and failure (crushing) load was noted and he failure pattern was also precisely observed.

$f_c = P.A$

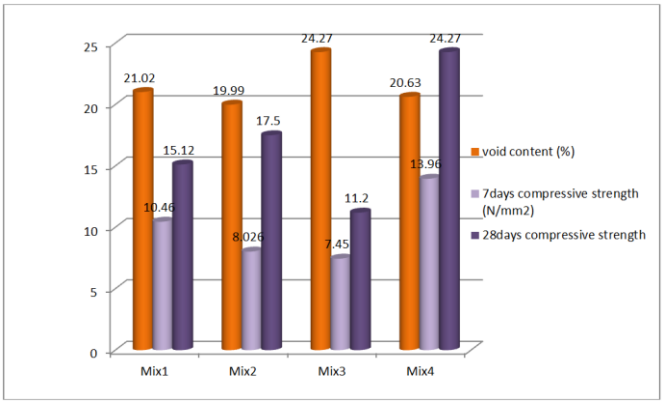
Where, P = Load at failure (KN)

A =Cross-sectional area of cube

f_C = Compressive strength (Mpa)

II. RESULT

Table shows the experimental for pervious concrete at the age of 7 and 28 days for compressive strength and void content for combination of different aggregate size respectively.



Sr. No.	Test	Mix 1	Mix 2	Mix 3	Mix4
1	Void content (%)	21.02	19.99	24.27	20.63
2	Compressive strength (N/mm^2)				
	7days	10.46	8.026	7.45	13.96
	28 days	15.12	17.50	11.2	24.27

III. CONCLUSION

From the test results it was observed that, the aggregate size of 10mm to 12.5mm gives higher compressive strength compared to 20mm size of aggregate. All this mix proportions gives satisfy the range of void content. For mix 3, it has been concluded that larger size of aggregate reduce the compressive strength of pervious concrete. For mix 4, mixing of smaller and bigger size of aggregate gives better compressive strength than the single size of aggregate. In mix aggregate smaller aggregate fill the gap between the bigger aggregate in pervious concrete and might cause the increase in compressive strength.

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