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AN EXPERIMENTAL INVESTIGATION ON THE ENGINEERING PROPERTIES OF PERVIOUS CONCRETE

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ABSTRACT

Now a days the urban population is increasing day by day and with that increase needs the raise in concrete jungles where almost all parts of city is covered with impermeable concrete. Due to this the recharge of ground water is decreases and in rainy seasons the water stored on the roads create nuisance to the public.In the recent past we have observed the destruction caused by the nature to a renowned city Chennai.

The answer to the above problem is pervious concrete. It consists of coarse aggregate, cement, and water. Pervious concrete is a zero slump, open graded and light weight concrete. It is also known as “no fines concrete”. It is having a high void content of about 30%. Due to this reduce the runoff to the drainage systems. Environmental protection agency (EPA) recognized that pervious concrete is a green building material for providing pollution control and storm water management. It is used for various purposes like for footpath, pavement, street road etc,.by evaluating compressive strength, split tensile strength and permeability.

The aim of this project is to design and study the effects of aggregate gradations on the permeability of pervious concrete.

Keywords: pervious concrete, green building materials, void ratio , EPA , permeability, spilt tensile strength, compressive strength.

INTRODUCTION

Pervious concrete also called permeable concrete, no fines concrete or porous concrete. It is a special type of concrete with a high porosity used for concrete flat applications. It can be allows water from precipitation and other sources to pass through directly. So that it can reduce the runoff and increase the ground water recharge.

It is a mixture of coarse aggregates, cement and water. Large size of aggregates are used for making the more voids. It can be used in numerous applications such as permeable concrete for pavement, base course, concrete bed for vegetation, thermal insulated concrete and other civil engineering applications. Aggregate is the main parts of the concrete volume. Chemical properties of pervious concrete are similar to conventional concrete.

Pervious concrete is a rough textured and has honeycombed surface. In pervious concrete sufficient paste , which is created by controlled amounts of water and cementitious materials coats and binds the aggregate particles and create well drained system and highly permeable.

In parking areas with less traffic, pedestrian walkways, residentialstreets and greenhouses Pervious concrete is used.To protect water quality it is an important application for suitable construction in one of the many low impact development techniques.

According to EPA (Environmental protection agency) nearly 90% of pollutant such as oil and other hydrocarbon can send by storm water runoff. It recharges ground water and decreases the extent of pollution and storm water runoff. It also possesses many advantages that improves city environment such as the rainwater quickly filtering into ground, so that groundwater resources can renew in time.

- In rainy seasons the no fines concrete pavement has no plash on the surface and doesn't glisten at night. This improves safety and comfort to the drives.

LITERATURE

Source taken from International Journal for Research in Applied Science & Engineering Technology

1.In 1988 Meininger studied the effect of different aggregate size (10mm and 20mm) on hardened properties of no fine concrete and the results showed that compressive strength reduces with increase in aggregate size.

2. In 2003 Jing Yang Guoliang studied that by using the common material and method, the strength of pervious concrete is low. But using smaller aggregate, silica fume and super plasticizer the strength of pervious concrete increase greatly.

3.From journal of recent activities in architectural sciences, partial replacement of cement by GGBS (Ground Granulated Blast Furnace Slag).

4.From International Journal of Engineering Trends and Technology , pervious concrete is a relatively new concept for rural road pavement, with increase into the problems in rural road as a road as a road pavement material.

METHODOLOGY

The methodology adopted,material characterization and design mix is carried out is presented in the form of flow chart and parameters studied.

- Collection of materials
- Physical test on Materials
- Casting of cubes
- Slump cone test
- Compressive strength
- Split tensile strength
- Permeability test
- Partial replacement of cement by GGBS

Sample preparation for each cube:

Sr.no	Name of material	Value in Kg
1.	Cement	1.825
2.	Coarse Aggregate	6.8167
3.	GGBS	0.0960
4.	Water	0.7435

Compressive strength test on pervious concrete

The compressive strength test was conducted in specimens on specified ages as IS 516. The dimensions of pervious concrete cubes used in this thesis were of 150 mm X 150 mm X 150 mm and the ages of testing are 7,14,28 days.

Compressive Strength = load/ surface area

Results:

<table>
<tr><td rowspan="2">sample</td><td colspan="2">Compressive strength for 7days in Mpa</td><td colspan="2">Compressive Strength for 14 days in Mpa</td><td colspan="2">Compressive Strength for 28days in Mpa</td></tr>
<tr><td>Readings</td><td>average</td><td>readings</td><td>average</td><td>readings</td><td>average</td></tr>
<tr><td>1</td><td>10.8</td><td rowspan="3">13.33</td><td>14.3</td><td rowspan="3">15.01</td><td>15.7</td><td rowspan="3">16.8</td></tr>
<tr><td>2</td><td>14.17</td><td>15.2</td><td>17.0</td></tr>
<tr><td>3</td><td>14.93</td><td>15.5</td><td>17.7</td></tr>
</table>

Split Tensile Strength of pervious concrete

Split Tensile Strength test was conducted on the specimen at 7 , 14 , 28 days as per IS 5816-1999.Three cylindrical specimens of size 150mm x 300 mm were cast. The load was applied gradually till the failure of the specimen occurs. The maximum load was then noted.

Spilt Tensile Strength =2p/πDL

Results:

sample	Spilt Tensile strength for 7days in Mpa		Spilt Tensile Strength for 14 days in Mpa		Spilt Tensile Strength for 28days in Mpa	
	Readings	average	readings	average	readings	average
1	1.5	1.69	1.61	1.80	2.29	2.56
2	1.75		1.75		2.44	
3	1.84		2.06		2.94	

Permeability test on pervious concrete

The ability of the concrete to drain runoff water is the key to the success of pervious concrete. Interconnected voids within the concrete allow the water to penetrate to the subbase and remove trace contaminants. While there is an inverse relationship between porosity and compressive strength.

Infiltration Rate

$$I = (KM) /(D^2 * t)$$

Where, I=Infiltration rate in mm/hr

M=Mass of water (18.2 Kgs)

D=Dia of the ring (300 mm)

t=12.4 sec

K=infiltration constant

Result:

Infiltration rate is 288.152 lit/min/m^2

Applications of pervious concrete

- Street roads and driveways
- Parking areas
- Foot path
- Noise barriers
- Slope stabilization
- Drainage systems

Conclusion

After conducting a detailed study on the effect of aggregate gradations on The strength and permeability characteristics of pervious concrete based on the limited laboratory and analytical results, the following can be concluded.

- All the pervious concrete mixes yielded zero or nearly zero slump. So the workability of all the pervious mixes is very low.
- Compressive strength can be increased by using proper admixtures
- By using large size aggregates we increase the permeability of the concrete
- Do to low strength of this concrete, it can be used for footpath and parking in less traffic areas
- By using this we increase the ground water recharge

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