EXPERIMENTAL STUDY ON PERMEABLE CONCRETE BY USING GLASS AS PARTIAL REPLACEMENT OF COARSE AGGREGATE

Aarthi M[1], Pandian S[2], Puthia Kalaimani K M[2], Tendil Vignesh M[2], *Vasanth G*[2]

[1]Asst.Prof, Department of Civil Engineering, VSB College of Engineering Technical Campus, Coimbatore
[2]Student, Department of Civil Engineering, VSB College of Engineering Technical Campus, Coimbatore

Abstract-Water is one of the most important componentsof human life. As the usage of water increases, the production of water by the nature should also be increased. But, in the modern world people goes on occupying the empty lands and using the forest land for building construction which results in deforestation. Due to this reason the climatic conditions have changed very much resulting in uneven rainfall which produces an adverse effect on human life. Now-a-days we rarely get rainfall causing water scarcity and over rainfall causing floods. Floods are occurring because rainwater do not have path to enter into the soil strata resulting in stagnant of water on the surface.The purpose of our project is to provide a permeable concrete system which is required to overcome above mentioned problems. The main objective is to find the strength and permeability of concrete which are suitable for our climatic condition which is capable of allowing water to enter into the soil strata. Our project is used to reduce the possibility of floods thereby, increasing the underground water table.

Keywords: waste materials; permeable concrete; glass waste; recycled crushed glass; Pervious concrete.

1. Introduction

Pervious concrete is a type of special concrete which is having high porosity that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. Cost efficiency was the main motivate due to a decreased amount of cement. It became popular again in the 1920s for two storey homes in Scotland and England. It became increasingly viable in Europe after WWII due to scarcity of cement. It did not become as popular in the US until the 1970s. In India it became popular in 2000.

Pervious concrete is made using large aggregates with little to no fine aggregate. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, foot bridge walkways.

Pervious concrete consists of cement, coarse aggregate and water with little to no fine aggregates. The mixture has a water cement ratio of 0.27 to 0.42 with a void content of 16 to 26 percent.

The correct quantity of water in the concrete is critical. A low water to cement ratio will increase the strength of the concrete, but too little water may cause surface failure. Aproper water content the mixture should be field checked.

In the ongoing years, not many examinations have concentrated on the concrete and solid item change with the point of utilizing waste glass, reused squashed glass (RCG), steel slag, steel fiber, tires and plastics in pervious solid (PC) to take out the removal issues and build up the PC mechanical highlights.

Since the holder reusing rate and level glass is 36% what's more, 30%, accordingly, 1.1 Mt (33%) of waste glass has been reused, when 0.73 Mt (66%) has had a place with glass holder items and 0.14 Mt (13%) is for optional total. At long last, 2.3 Mt (67%) of waste glass has been covered. The reusing marvels have served both as a recyclable waste inactive compartment and a typical reusing propensity inspiration. Glass has been reused with no item quality losing; in incredible amounts, changing the reused cullet to a glass-production plant has spared vitality and mineral assets. Squander glass (total) has not spared extraordinary vitality or then again minerals than the glass

making, notwithstanding, the shading disharmony of waste glasses has incited to discover different open doors in totals utilization. The utilization of cement reused glass has been performed by the soluble base silica response because of the receptive substance.

2. EXPERIMENTAL PROCEDURE

2.1 PROPERTIES OF MATERIALS

CEMENT :

Cement is a good binding material. The grades of the cement are Grade 33,43,53.The maximum compressive strength of the cement 53 N/mm². The fineness of the cement is 225m²/kg. The soundness of the cement is 10mm and soundness test is done in Lechatlier apparatus.

As per IS 4031-part 5 (1998)the Initial and final tests were performed for the cement and the results are tabulated.

Test	**Permissible Value as per 1S: 8221, 1989**	**Obtained**
Initial Setting time	30 mins(max)	22 mins
Final Setting time	600 mins (max)	498 mins

Composition of ordinary Portland cement

Name of compound	**Chemical Composition**	**Abbreviation**
Tricalcium Silicate	3CaO.SiO2	C3S
Dicalcium Silicate	2CaO.SiO2	C2S
Tricalcium aluminate	3CaO.Al2O3	C3A
Tetracalciumalumino ferrite	4CaO.Al2O3.Fe2O3	C4AF

COARSE AGGREGATES:

Aggregates were first considered to simply be filler for concrete to reduce the amount of cement required. However, it is now known that the type of aggregate used for concretecan have considerable effects on the plastic and hardened state properties of concrete. Theycan form 80% of the concrete mix so their properties are crucial to the properties of concrete.Aggregates can be broadly classified into four different categories: these are heavyweight,normal weight, lightweight and ultra-lightweight aggregates. However in most concretepractices only normal weight and lightweight aggregates are used. The other types ofaggregates are for specialist uses, such as nuclear radiation shielding provided byheavyweight concrete and thermal insulation using lightweight concrete.

Coarse aggregate

GLASS:

Since the container recycling rate and flat glass is 36% and 30%, therefore, 1.1 Mt (33%) of waste glass has been recycled, when 0.73 Mt (66%) has belonged to glasscontainer products and 0.14 Mt (13%) is for secondary
aggregate. Finally, 2.3 Mt (67%) of waste glass has been buried. The recyclingphenomena have served both as a recyclable waste passivecontainer and a common recycling habit motivation. Glasshas been recycled with no product quality losing; in greatquantities, changing the recycled cullet to a glass-makingplant has saved energy and mineral resources. Waste glass (aggregate) has not saved great energyor minerals than the glass making however, the color disharmony of waste glasses hasprovoked to find diverse opportunities in aggregates usage. The use of concrete recycledglass has been performed by the alkali-silica reaction (ASR)due to the reactive content of silica in the glass (≥70%).

Crushed glass

3. MIX RATIO

Block-1 (cement + FA+CA)
Cement - 1
Fine aggregate - 1.5
Coarse aggregate - 3
Block - 2 (cement+ CA)
Cement - 1
Coarse aggregate - 3
(No fine aggregate used)
Block – 3 (cement+ CA + glass)
Cement – 1
Coarse aggregate – 3 (75% CA and 25% crushed glass will be used)
Block – 4 (cement+ CA + glass)
Cement – 1
Coarse aggregate – 3 (50% CA and 50% crushed glass will be used)

Mix preparation

4.PREPARATION OF TEST SPECIMEN

After the completion of testing the materials the concrete specimen have to be prepared. Fourdifferent concrete blocks have been prepared. The first block consists of cement, Fine Aggregate, Coarse Aggregatein the ratio of 1:1.5:3(M20 Grade).
The second block consists of cement and Coarse Aggregate in the ratio of 1:3(Fine aggregate will not be used).
The third block consists of cement, Coarse Aggregate and crushed glass in the ratio of 1:3(75%CA and 25%crushed glass will be added to the aggregate ratio3).
The fourth block consists of cement, Coarse Aggregate and crushed glass in the ratio of 1:3(50%CA and 50%crushed glass will be added to the aggregate ratio 3).

Permeable concrete cube

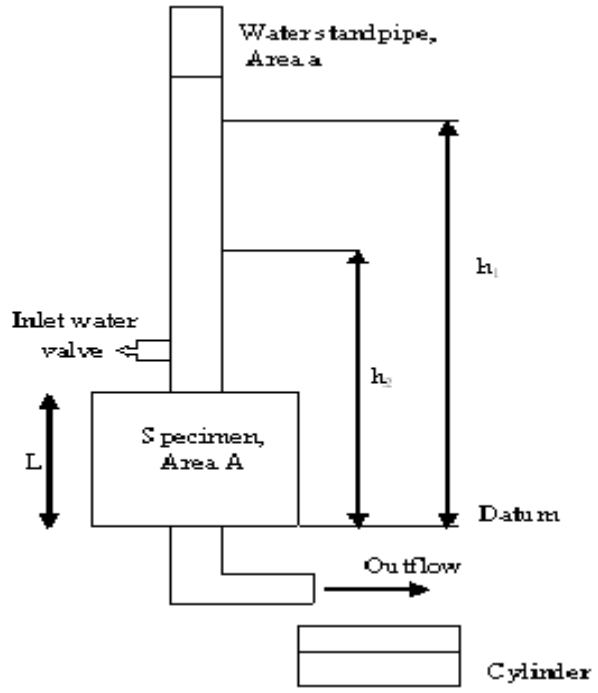
5. TESTING OF SPECIMEN

Out of many test applied to the concrete, this is the utmost important which gives anidea about all the characteristics of concrete. By this single test one judge that whetherConcreting has been done properly or not. Compressive strength of concrete depends onmany factors such as water-cement ratio, cement strength, quality of concrete material,Quality control during production of concrete etc., Test for compressive strength is carriedout either on cube or cylinder. Various standard codes recommend concrete cylinder orconcrete cube as the standard specimen for the test.
The concrete blocks of size 150mm x 150mm x 150mm have been prepared as per the mix ratio and

after the completion of curing process they have been tested in the compressive testing machine.Thecompressive test of each block is tested using compressive testing machine.

Compression testing machine

The permeability of pervious concrete was determined using a falling head permeability set up . Water was allowed to flow through the sample, through aconnected standpipe which provides the water head. Before starting the flow measurement,the samples were wrapped with polythene inside the cylinder. Then the test started byallowing water to flow through the sample until the water in the standpipe reached a givenlower level. A constant time of 5seconds was taken for the water to fall from one head toanother in the standpipe. The standpipe was refilled and the test was repeated when waterreached a lower.



Falling HeadPermeability Test Apparatus

The permeability of the pervious concrete sample can be calculated from the formula given below

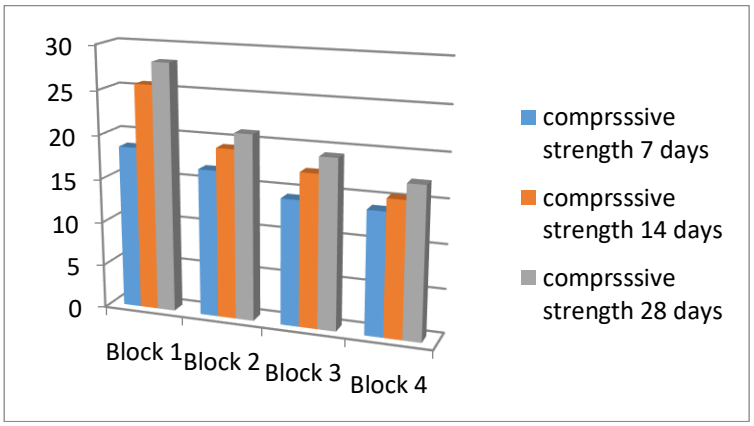
$$K=2.303\ aL/A\ (t_2-t_1)\ \log\ (h_1/h_2)$$

Where,
a = the sample cross section area
A = the cross section of the standpipe of diameter (d) = 0.95cm2
L = the height of the pervious concrete
(t_2 - t_1) = change in time for water to fall from one level to another (5secs.)
h_1= upper water level
h_2= Lower water level
D= diameter of sample (10.5cm)
d= diameter of standpipe (1.1cm)

6. RESULT

Compressive Test

Specimen	Compressive strength (N/mm^2)		
	7 days	14 days	28 days
Block 1	18.53	25.67	28.20
Block 2	16.72	19.26	21.06
Block 3	14.32	17.38	19.26
Block 4	13.98	15.41	17.20



Compressive strength chart

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