

# EXPERIMENTAL STUDY ON PERVIOUS PEBBLE CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY GGBS

GANGA V<sup>1</sup>, RAJKOHILA A<sup>2</sup>,  
H.B.MOHAMMED BILAL<sup>3</sup>, J.DORAIKANNAN<sup>4</sup>, Dr.R.MANOCHARAN<sup>5</sup>  
Assistant professor<sup>1,2,3,4</sup>, Professor<sup>5</sup>  
*Department of Civil Engineering*  
*SRM TRP ENGINEERING COLLEGE, Tiruchirappalli, Tamil Nadu, India*

## Abstract-

This paper presents an experimental investigation on pervious concrete with no fines. This aims at the study of compressive strength and permeability of pervious concrete with pebbles and partial replacement of Ground granulated blast furnace slag (GGBS). In this study three types of different specimens were prepared. Out of which one is conventional, the second one is replacement of coarse aggregate with pebbles and third is 50% replacement of cement with GGBS. The results indicated that using of pebbles as coarse aggregate shows sufficient strength, permeability. The strength parameters and permeability parameters met the requirements and pervious concrete made with pebbles as a coarse aggregate can be used for sustainable pavement construction.

Keywords – GGBS, pebbles, pervious concrete

## I. INTRODUCTION

Pervious concrete which is also known as the no-fines, porous, gap-graded, and permeable concrete and Enhance porosity concrete have been found to be a reliable storm water management tool. By definition, pervious concrete is a mixture of gravel or granite stone, cement, water, little to no sand (fine aggregate). When pervious concrete is used for paving, the open cell structures allow storm water to filter through the pavement and into the underlying soils. In other words, pervious concrete helps in protecting the surface of the pavement and its environment. Pervious concrete is also a unique and effective means to address important environmental issues and sustainable growth. When it rains, pervious concrete automatically acts as a drainage system, thereby putting water back where it belongs. Pervious concrete void structure provides pollutant captures which also add significant structural strength as well. It also results in a very high permeable concrete that drains quickly. Pervious concrete can be used in a wide range of applications, although its primary use is in pavements which are in: residential roads, alleys and driveways, low volume pavements, low water crossings, sidewalks and pathways, parking areas, tennis courts, slope stabilization, sub-base for conventional concrete pavements etc.,

## II. EXPERIMENTAL INVESTIGATION

### 2.1 Material Properties

The materials used for this research study and properties are given below.

#### 2.1.1 Cement

For the present study Ordinary portland cement(OPC) of 53 grade was used and properties are listed in the table.

Table 2.1 Properties of Cement

S.No	Property	Result
1.	Standard Consistency	32%
2.	Initial setting time	35min
3.	Final setting time	580min
4.	Specific Gravity	3.14

### 2.1.2 Pebbles

Pebbles are rocks fragments which are smaller than cobbles. They are round or elliptical in shape with the diameter ranging between 10 to 150mm. They were crushed in UTM machine and sieved through 20mm and retained in 10mm sieve. Physical properties of pebbles are furnished below



Figure 2.1 Pebbles

Table 2.2 Properties of Pebbles

S.No	Property	Result
1.	Crushing value	22.54%
2.	Impact value	18.01%
3.	Water Absorption	12%
4.	Specific Gravity	2.7
5.	Abrasion value	25.8%

### 2.1.3 Coarse Aggregate

Crushed Granite as coarse aggregate of size not greater than 20 mm was used.

Table 2.3 Properties of Coarse aggregate

S.No	Property	Result
1.	Aggregate crushing value	19.68%
2.	Aggregate impact value	14.72%
3.	Water Absorption	8%
4.	Specific Gravity	2.7
5.	Abrasion value	18.4%

### 2.1.4 Ground granulated blast furnace slag (GGBS)

GGBS as partial replacement to cement was used in present study. Ground granulated blast-furnace slag is the granular material formed when molten iron blast furnace slag is rapidly chilled (quenched) by immersion in water. It is a granular product with very limited crystal formation and is highly cementitious in nature. It is ground to cement fineness and hydrates like Portland cement.



Figure 2.2 Ground granulated blast furnace slag(GGBS)

Table 2.4 Properties of GGBS

S.No	Property	Result
1.	Fineness	384m <sup>2</sup> /Kg
2.	Specific Gravity	2.9
3.	Bulk Density	1200Kg/m <sup>3</sup>

### 2.2 Mix Proportion

To prepare the mix, cement content of 310 kg/m<sup>3</sup> and cement to aggregate ratio of 1:5 was maintained. The water cement ratio was maintained as 0.4 for entire study. Natural coarse aggregates (blue granite metal) are replaced with pebbles aggregate. Proper care was taken to maintain the workability in pervious concrete for easy and proper mixing.

Table 2.5 Mix Proportion

S.NO	Description	GGBS (%)	Mix ratio
1.	Water cement ratio	–	0.4
2.	Conventional concrete - CC	0 %	1:5
3.	Pebble concrete -PC	0 %	1:5
4.	Pebble concrete with GGBS - PCG	50 %	1:5

### 2.3 Testing Procedure

In this study 150mm size cube and 150X300mm cylindrical specimen were casted for determining Compressive strength, and permeability respectively.

## III.RESULT AND DISCUSSION

Based on the specimen test of specimens, the results are tabulated below.

Table 3.1 Compressive strength of concrete

S.No	Cement %	GGBS %	Pebbles %	Compressive strength 7 days (N/mm <sup>2</sup> )	Compressive strength 28 days (N/mm <sup>2</sup> )
1.	100	0	0	6.8	12.3
2.	100	0	100	6.2	11.0
3.	50	50	100	6.5	12.14

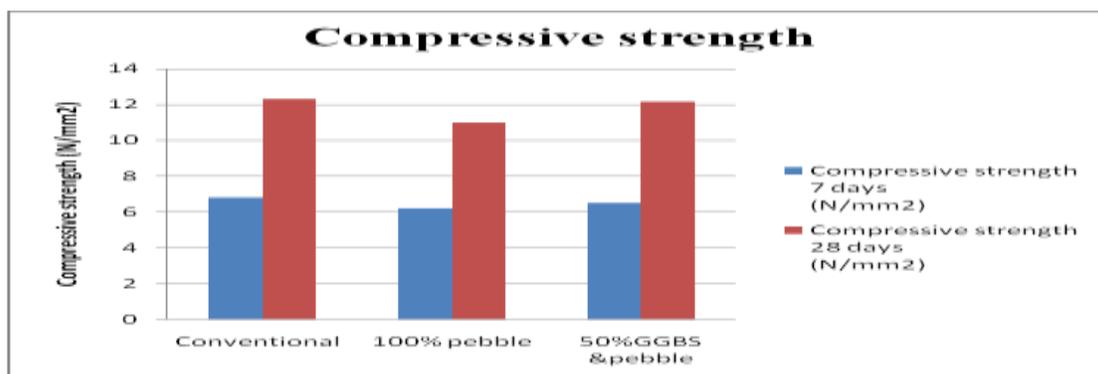


Figure 3.1 Compressive strength of concrete

Table 3.2 Permeability test

S.No	Cement %	GGBS %	Pebbles %	Permeability(cm/sec)
1.	100	0	0	1.75
2.	100	0	100	1.92
3.	50	50	100	1.9

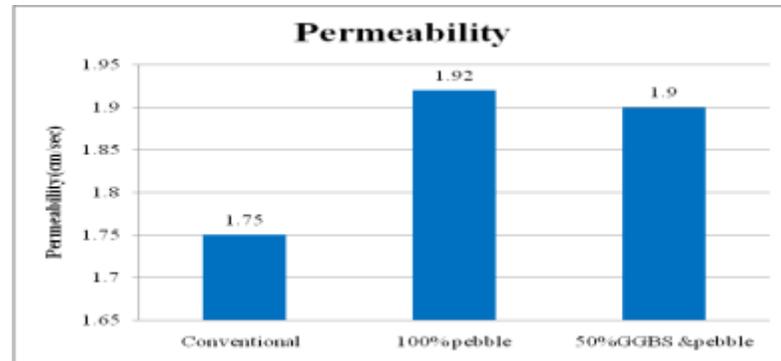


Figure 3.2 Permeability test result

#### IV.CONCLUSION

Based on the analysis of result obtained, the compressive strength of pebble pervious concrete with GGBS is more or less equal to the standard pervious concrete. It may be due to slow development of early strength due to mixing. The pervious concrete with pebbles coarse aggregates and cement replaced with 50% GGBS gives relatively equal compressive strength when compared with the conventional pervious concrete. The co-efficient of permeability is increased in pebble concrete and pebble concrete with GGBS by 9% when compared with conventional concrete. To conclude by using pervious pebble concrete with 50% GGBS, we can reduce the cost of storm water management .Hence it reduces the cost of the project and its infiltration rate is also very high, hence it reduces the time of infiltration also. It takes only few minutes to percolate all the water in soil and it avoids ponding of water in parking and gardening areas during heavy rainy season resulting in the increase of the water table level.

#### REFERENCES

- [1] ACI 552R (2010): "Report on Pervious Concrete", American Concrete Institute, Farmington Hills, Michigan
- [1] R. Nithyanandham , G. Augustine Maniraj Pandian, "study of strength characteristics of pebble concrete with partial replacement of cement by ggbs", International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 4, April 2017, pp. 1574–1579.
- [2] S. Krishna Rao, P.Sravana, T.ChandrasekharRao," Abrasion resistance and mechanical properties of Roller Compacted Concrete with GGBS", construction and building materials 114(2016) pp.925-933.
- [3] S. Divya, T.Nithyanandam, R.Ramasubramani,"Experimental Investigation of Geo Polymer Concrete with Pebbles as Coarse Aggregate", International Journal of Innovative Research in Science, Engineering and Technology, Vol.3, Issue 11, November 2014.
- [4] Karthik H. Obla, Pervious concrete – An overview, The Indian Concrete Journal, 84 p. 9-18 (2010).
- [5] Darshan S. Shah, Prof. J.R.Pitroda, "Assessment for use of Gravel in Pervious Concrete", International Journal of Engineering Trends and Technology (IJETT) ISSN No. 2231-5381, Volume: 4, Issue: 10, October 2013, Page: 4306 – 4310
- [6] IS 8112:1989. Specifications for 53grade Portland cement, New Delhi, India: Bureau of Indian Standards.
- [7] IS: 2386 (Part III) – 1963, Indian Standard, Method of Test for Aggregates for Concrete, (Part III); Specific Gravity, Density, Voids, Absorption and Bulking, (Eighth Reprint); Bureau of Indian Standard, New Delhi, India. March 1997.
- [8] IS: 2386 (Part IV) - 1963, Indian Standard, Method of Test for Aggregates for Concrete, (Part IV); Mechanical Properties, (Tenth Reprint); Bureau of Indian Standard, New Delhi, India. March 1997.