

# Effect of Size of Aggregate on the Compressive Strength of Pervious Concrete

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**Abstract**—Nowa day, due to rapid urbanization, natural resources are consumed on large amount. So to protect the natural resources various measures are being investigated by engineers. However, due to increased awareness of the need for conservation of non-renewable mineral resources, increased consideration is being given to the use of pervious concrete in most countries. No fines concrete is considered as one of the alternative to the traditional concrete. Pervious concrete would be a natural choice for use in structural applications in this age of green building. It consumes fewer raw materials than normal concrete. And hence it is required to study the behavior of no fines concrete. In this paper an attempt has been made to investigate the strength of pervious concrete by conducting various laboratory tests on the pervious concrete made, using different sizes of aggregates and different voids ratio. It is concluded that gradation of aggregate has remarkable effect on the compressive strength of pervious concrete.

**Key words**-no-fines concrete, green building,pervious concrete

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## I. INTRODUCTION

Now days, due to rapid urbanization, natural resources are consumed on large scale. To reduce the consumption of natural resources and to protect them, various measures are being investigated. To cope up with this problem one of the alternative is to replace these natural resources fully or partially without compromising the quality of the concrete. No-Fines concrete is a mixture of cement, water and a coarse aggregate combined to produce a porous structural material. It has a high volume of voids, which leads to its lower strength and its lightweight nature. It has moderate strength and durability. It is economical, light weight, pervious, environment friendly and controls the storm water if used in pavement. It is innovative approach to control, manage and treat storm water run-off. Through the direct drainage of rainwater, it helps to recharge groundwater in pavement applications. It uses the land efficiently and eliminates the need for retention ponds. It provides superior insulation values when used in walls because of its porous nature. Even though, it is not yet widely used in India, pervious concrete is generally used for light-duty pavement applications, such as residential streets, parking lots, driveways, sidewalks, channel lining, retaining walls and sound walls. So it is considered as economical and environment friendly construction material.

The strength of the no fines concrete is its major drawback. Research is going on to increase its strength. The object of this research paper is to investigate the effect of aggregatesizes on the compressive strength of pervious concrete.

## II. METHODOLOGY

The aim of this study is to develop the high strength pervious concrete. For development of such concrete, parameters governing the strength of pervious concrete has to be known, such as size and shape of aggregates. In this research paper an attempt is made to study the effect of aggregate's sizes on the compressive strength of pervious concrete. For this tests were conducted on the trial mixes of pervious concrete made with different sizes of aggregates. For the research work three sizes of aggregates were chosen, i.e. 10 mm, 20 mm, and the

aggregates passing 10mm but retaining on 19 mm sieve. Trial cubes were prepared in three sets respective of the aggregate sizes considering 15 % and 20% voids ratio for each set. 28<sup>th</sup> day's compressive strengths were found out by testing the specimens and the results were drawn.

## III. MATERIALS

### A. Cement

Ordinary Portland cement confirming to IS 12269-1986 was used for mix design.

### B. Aggregates

Coarse aggregate occupies nearly 70% to 80% by volume of concrete hence their properties are vital. Type and quality of aggregates govern the plastic and hardened properties of concrete. Aggregates conforming to IS 383-1970 were used for the mix designs.

## IV. PREPARATION OF SAMPLES AND TESTING METHODS

### A. Sieve analysis of coarse aggregates

Sieve analysis is essential to find the fineness modulus of coarse aggregates. For this three standard sieves 10 mm, 16mm and 19 mm were used. The fineness modulus was found to be 1.66.

TABLE I SIEVE ANALYSIS OF COARSE AGGREGATES

Sr. No.	Sieve size	Retain (gm)	Retain %	Cum.% Retain	Passing
1	19	495	24.75	24.75	75.25
2	16	520	26	50.75	49.25
3	10	795	39.75	90.5	9.5
4	Pan	185	9.25	99.75	0.25

**B. Mix design**

For the mix design aggregates were washed and dried to minimize the impurity. Total 18 cubes with dimensions 15cm×15cm ×15cm were casted. During casting compaction was done with the help of tamping rod. Fixed water cement ratio of 0.35 and cement content of 300 kg/m<sup>3</sup> was maintained throughout the work. Proportion for mix design is given in the table II

TABLE II CONCRETE MIX PROPORTION (KG/M<sup>3</sup>)

Sr. No.	Materials	Cement	Water	Coarse Aggregates
1	Quantity for 0.8 m <sup>3</sup>	300	106.785	1585.23
2	Quantity for 1 cube	1.27	0.45	6.687
3	Proportion	1:0.35:5.26		

TABLE III TRIAL MIX DESIGN FOR POROUS CONCRETE WITH VARYING SIZE OF COARSE AGGREGATE FROM 10 MM TO 19 MM (SAMPLE 1) (KG/M<sup>3</sup>)

Sr. No.	Voids Ratio	Cement Content (kg)	Water content (kg)	Coarse Aggregate (kg)
1	15%	1.2	0.42	6.8
2	20%	1.27	0.45	6.69

TABLE IV TRIAL MIX DESIGN FOR POROUS CONCRETE WITH SINGLE SIZE COARSE AGGREGATE OF 10 MM (SAMPLE 2) (KG/M<sup>3</sup>)

Sr. No.	Voids Ratio	Cement Content (kg)	Water content (kg)	Coarse Aggregate (kg)
1	15%	1.189	0.42	6.28
2	20%	1.2	0.436	6.68

TABLE V TRIAL MIX DESIGN FOR POROUS CONCRETE WITH SINGLE SIZE COARSE AGGREGATE OF 20 MM (SAMPLE 3) (KG/M<sup>3</sup>)

Sr. No.	Voids Ratio	Cement Content (kg)	Water content (kg)	Coarse Aggregate (kg)
1	15%	1.189	0.42	6.28
2	20%	1.2	0.436	6.86

**V. RESULTS AND DISCUSSION**

The 28<sup>th</sup> day's compressive strengths of the porous concrete blocks are given below. As illustrated in the table VI, compressive strength of the concrete with varying aggregate sizes from 10 mm to 19 mm gave more strength than the concrete with single sized aggregates irrespective of the voids ratio. Comparing the two tables VI and VII it can be said that for less voids ratio compressive strength is more.

TABLE VI 28<sup>TH</sup> DAY'S COMPRESSIVE STRENGTHS OF CUBES WITH 15% VOIDS RATIO

Sr. No.	Aggregate size	Comp. strength(N/mm <sup>2</sup> )	Mean comp. strength
1	10 mm	9.822	9.359
	pass 19	8.998	
	mm retain	9.256	
2	10 mm	8.226	8.210
		7.982	
		8.424	
3	20 mm	7.242	6.850
		6.882	
		6.426	

TABLE VII 28<sup>TH</sup> DAY'S COMPRESSIVE STRENGTHS OF CUBES WITH 20% VOIDS RATIO

Sr. No.	Aggregate size	Comp. strength (N/mm <sup>2</sup> )	Mean comp. strength
1	10 mm pass	8.202	8.685
	19 mm	9.422	
	retain	8.432	
2	10 mm	7.650	7.287
		6.988	
		7.224	
3	20 mm	6.04	5.718
		5.428	
		5.686	

**VI. CONCLUSION**

Laboratory testing has been carried out for investigating the effect of aggregate sizes on the compressive strengths of the porous concrete. Three samples of sizes of aggregates were applied, aggregates grading from 10 mm to 19 mm, 10 mm and 20 mm. From the 28<sup>th</sup> day's compressive strengths results it can be concluded that porous concrete made from single sized aggregates gives less strength than the one made with the varying sizes. Also it can be concluded that the small sized aggregates gives more strength to the porous concrete when used in it.

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