"INFLUENCE OF DIFFERENT SIZE OF AGGREGATE AND WATER CEMENT RATIO ON PERVIOUS CONCRETE"

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ABSTRACT- *A study was carried out to determine the strength of Pervious concrete under the influence of different size of Aggregate and Water cement ratio. The Aggregates were selected from Ranebennur Taluk in Karnataka State, India. This study investigates the effect of water cement ratio and size of aggregates on the Property of Pervious concrete. Concrete mixes with two different water cement ratio(0.4, 0.45) and three different size aggregates(10mm,15mm,20mm) were prepared to find an optimum mix yielding the highest strength but the strength of the no fine concrete is lower that of normal concrete. It found that the compressive strength increases with increase in water cement ratio were the permeability decreases. Both the Permeability and compressive strength increases as the size of aggregate increases.*

Key Words: No-fine concrete, compressive strength, permeability, water cement ratio, different size coarse aggregate.

1. INTRODUCTION

Pervious concrete can be produced using conventional concrete-making materials, namely cement, supplementary cementitious materials, admixtures all types of coarse and fine aggregates, and water. They usually consist of single size aggregate which is bonded together at its point of contact by paste formed by the cement and water. The paste forms a thick coating around aggregate particles. Using enough paste to coat the particles maintain a system of interconnected of voids which allow water and air to pass through. The lack of sand in pervious concrete results in very harsh mix with a rough textured, and a honeycombed surface. To achieve the permeability, pervious concrete is typically designed with high void content (15%-30%).

Due to the high void content, pervious concrete has lower compressive strength and less unit weight of approximately 70% of conventional concrete (NRMCA 2004). However, pervious concrete has a greater advantage in many regards. Nevertheless, it has its own limitations which must be put in effective consideration when planning its use. In general pervious concrete automatically acts as a drainage system, thereby putting water backs where it belongs. The hydrological performance is always the "driving force" to permit pervious concrete construction. It also mitigates than urban heat island effect, quickly dissipating heat after sunset due to the large amount of surface area. In addition to decreasing the volume of runoff, Pervious concrete has some general filtration properties, reducing the impurities caused by the automobiles and other sources and enhancing the quality of storm water (kevern et al, 2005). Because the storm water is allowed to enter the ground water and recharge the qualifier, Pervious concrete reduces the overall impact that human development has on the existing ecosystem.

2. OBJECTIVES

- To evaluate the compressive strength of pervious concrete.
- To evaluate the split tensile strength of pervious concrete.
- To obtain the permeability of pervious concrete.
- Comparing result with the ACI provisions.

3. MATERIALS AND METHODOLOGY

3.1 Materials:

3.1.1 Cement

For present experimental work, OPC 43 grade with brand name Ultra tech is used for all, OPC 43 grade concrete mixes. The testing is carried as per 8112-1989. The normal consistency, specific gravity and setting times of cement were found as per IS specifications.

Table-1: Physical properties of cement

SL NO	PROPERTY	VALUES OBTAINED	REQUIREMENTS AS PER IS:8112-1989
1	Specific gravity	3.12	Not less than 2.50
2	Fineness (%)	3%	Not greater than 10%
3	Normal consistency (%)	33%	---------
4	Initial setting time (min)	45 min	Not less than 30 min
5	Final setting time (min)	370 min	Not less than 600 min

3.1.2. Coarse aggregates:

The coarse aggregate used in the experiment is 10mm, 15mm, & 20mm. the physical properties for procured aggregate have been evaluated as per IS :2386-1963.

Table-2 Physical properties of coarse aggregate

SL NO	PROPERTY	VALUES OBTAINED
1	Specific gravity	2.69
2	Water absorption (%)	0.4%
3	Bulk density (kg/m^3)	1688 m^3

3.1.3 Water

Potable water was used for experimental work. The used water is satisfying the requirements of IS: 456-2000.

3.2 EXPERIMENTAL PROCEDURE

The cubes were cast in steel moulds with inner dimensions of 150* 150*150mm & cylinders in the moulds of 150mm diameter &300mm height. The cement & coarse aggregates were mixed thoroughly manually. The mix proportions adopted for all the mixes as 1:4.3:0.4 (cement: coarse aggregates: water) and also 1:6:0.45 (cement: coarse aggregates: water). For all test specimens, the concrete was poured into the moulds in three layers and compaction was provided with a 16mm tamping rod, in addition to this table vibrator was also provided. The cast specimens were kept for one day in the moulds. After 24 hours the moulds are removed and specimens are transferred to curing pond for curing and it was done for 28days. Later they are tested for their respective strengths.

TESTS TO BE CONDUCTED

3.2.1 Compressive Strength Test

The compressive strength test was conducted on cube and cylindrical specimens. The specimen is placed in the compression testing machine and the load at a constant rate of 0.14Mpa/ min till to failure the specimen.

3.2.2 Split Tensile Strength Test

To evaluate the tensile strength for all mixes of porous concrete, split tensile test was carried on cylindrical specimens. The load configuration creates a lateral tensile stress in the cylinder across the vertical plane of loading. The split tensile strength is calculated using standard formula (0.637(P/dl)).

3.2.3 Permeability Test

Permeability of porous concrete for various mixes was determine by using constant head permeability meter. The permeability meter consists of 150mm inner diameter PVC pipe with sufficient drainage facilities. Flexible sealing material (M-seal) was applied around perimeter of sample to prevent water leakage between perimeter of sample and inner surface of permeability meter. Co- efficient of permeability for each mix was determine using the following equation

$$K=QL/AHt$$

Where, K= co-efficient of permeability(cm/sec)
Q=volume of water collected in time t (sec)
H=head causing the flow (mm)
A=cross-section area of sample (cm^2)
L= height of sample (mm)
t=time in sec.

4. EXPERIMENTAL RESULTS AND DISCUSIONS

4.1 CUBE COMPRESSIVE STRENGTH

The following table presents the cube compressive strength results for the pervious concrete. From the table it is noticed that as the size of aggregates increases the compressive strength is decreasing. Further it can be inferred that the valve of compressive strength is found to be more for cubes with w/c ratio 0.45 compared to cubes with w/c ratio 0.4.

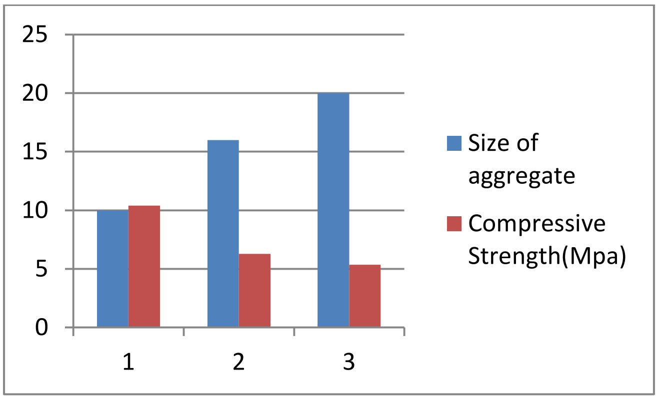
For w/c ratio 0.45, the compressive strength for 10mm aggregate is maximum (10.14Mpa) and 20mm aggregate is found to minimum (5.34Mpa). Similarly for w/c ratio 0.4, the compressive strength for 10mm aggregate is maximum (6.53Mpa) and 20mm aggregate is found to be minimum (3.51Mpa). ACI 522R-10 recommends that the compressive strength of pervious concrete should be in the range of 2.8 to 28Mpa. The obtained results are thus found to fall in the stipulated valves of ACI code.

From the case studies done by previous researchers and the results obtained from our study shows that the compressive strength is in the range of 10.14 to 3.51Mpa and this satisfies ACI recommendations.

Further it can be concluded that for w/c ratio 0.45 compressive strength is more compared to w/c ratio 0.4. Also as the size of aggregate increases its compressive strength decreases.

➢ **For w/c ratio 0.45**

SL No	Aggregate size	Failure load (KN)	Compressive strength (Mpa)	% of decrease in strength
1	10mm	228	10.4	-
2	16mm	141	6.27	38.1
3	20mm	120	5.34	47.3



➢ **For w/c ratio 0.40**

SL No	Aggregate size	Failure load (KN)	Compressive strength (Mpa)	% of decrease in strength
1	10mm	147	6.53	-
2	16mm	107	4.75	27.2
3	20mm	79	3.51	46.2

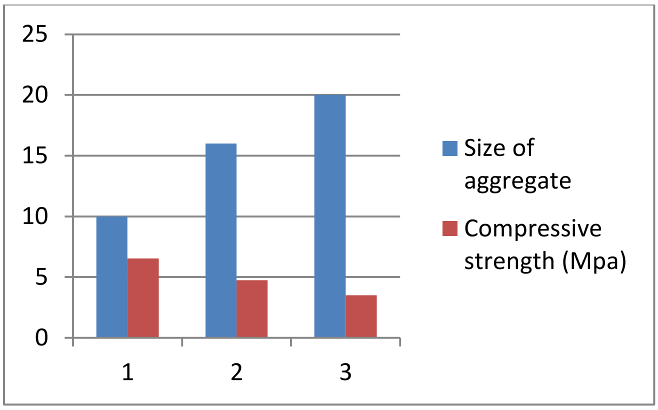
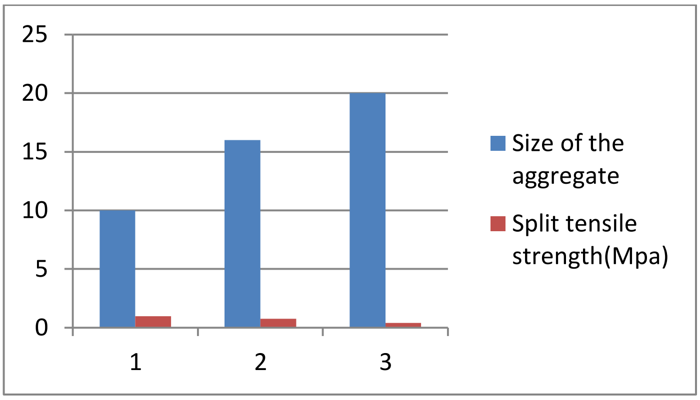


Fig 2: **Compressive Strength V/S Size of Aggregates**

4.2 SPLIT TENSILE STRENGTH OF CYLINDER

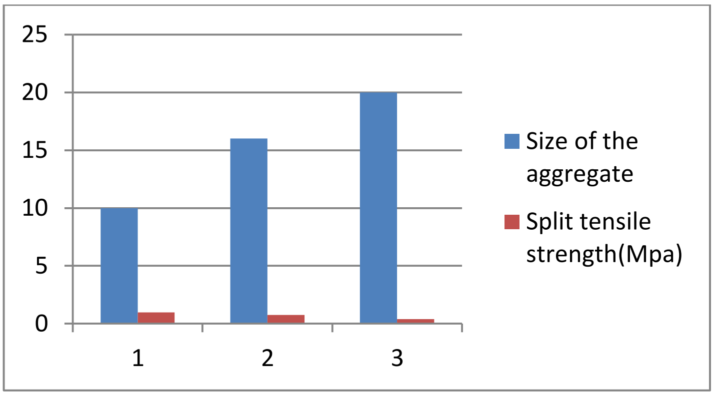
The following table represents the split tensile strength results for pervious concrete. At 28 days for w/c ratio 0.45, the split tensile strength for 10mm aggregate is maximum (1.17Mpa) and 20mm aggregate is found to be minimum (0.55Mpa). Similarly, for w/c ratio 0.45, the split tensile strength for 10mm aggregate is maximum (0.97Mpa) and 20mm aggregate is found to be minimum (0.41Mpa). From these results it is observed that the split tensile strength is decreasing as the aggregates size increases.

SL No	Aggregate size	Failure load(KN)	Split tensile strength (Mpa)	% of decreases in strength
1	10mm	8.5	1.17	-
2	16mm	6	0.83	29.06
3	20mm	4	0.55	53



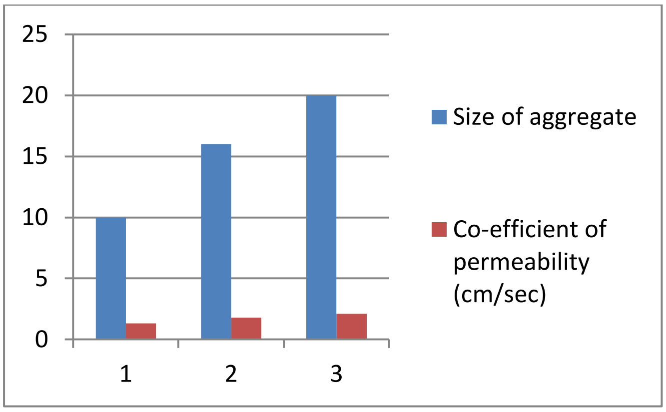
For w/c ratio 0.40

SL No	Aggregate size	Failure load(KN)	Split tensile strength (Mpa)	% of decreases in strength
1	10mm	7.0	0.97	-
2	16mm	5.5	0.76	21.64
3	20mm	3.0	0.41	57.73

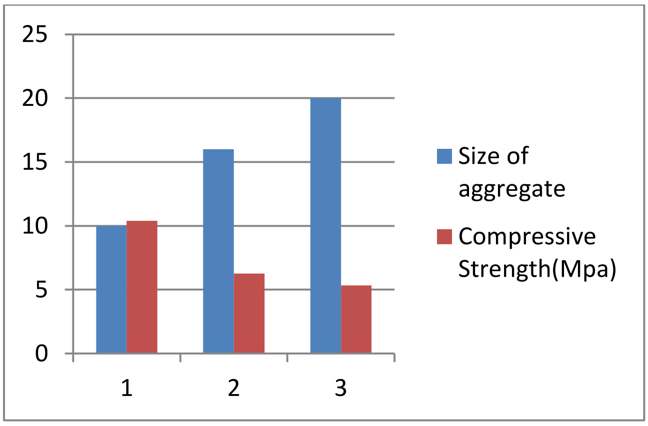


4.3PERMEABILITY TEST

Permeability values obtained for the various mix can be seen in the following table. From the table it can be noticed that as the size of aggregate increasing the permeability goes on increasing. The permeability for various mixes increasing due to the allocation of aggregate in the concrete mix and the corresponding mix having its own void ratio. In general as the % of void ratio increase the permeability is increases but in the other senses the compressive and tensile strengths were decreased. This was proven in the present experimental work. As the size of aggregate increased in the concrete mix, the permeability increased and the strengths were decreased. The designer has to take the decision for choosing the previous concrete with the consideration of strengths and permeability.



SL No	Aggregate size	Co-efficient of permeability(cm/sec)
1	10mm	1.11
2	16mm	1.42
3	20mm	1.91



For w/c ratio 0.40

SL No	Aggregate size	Co-efficient of permeability (cm/sec)
1	10mm	1.33
2	16mm	1.80
3	20mm	2.12

CONCLUSION

1. The studies indicate the viability of using different size of aggregate with different w/c ratios in the preparation of porous concrete for construction works.

2. As the size of aggregate increases in the concrete mix the compressive strength were decreased. As the size of aggregate increases in the concrete mix the split tensile strengths were decreased.

3. As the size of aggregate increases, the permeability was increased. The compressive strength was found to be decreased for w/c ratio 0.4 when compared to previous concrete of w/c ratio 0.45.

4.The split tensile strength was found to be increased for w/c ratio 0.45 when compared to previous concrete of w/c ratio 0.40.

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