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RESEARCH ARTICLE

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COMPARISION OF MECHANICAL PROPERTIES OF M_{15}, M_{20},M_{25} GRADES OF PERVIOUS CONCRETE WITH CONVENTIONAL CONCRETE

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ABSTRACT

Pervious concrete is a type of concrete with high porosity. It is used for concrete flatworks application that allow the water to pass through it, thereby reducing the runoff from a site and allowing ground water recharge. The high porosity is attained by a highly interconnected void content. Typically pervious concrete has water to cementisious material ratio of 0.28 to 0.4.The mixture is composed of cementisious materials, coarse aggregates and water with little to no fine aggregates. Addition of a small amount of fine aggregates will generally reduce the void content and increase the strength. The present project deals with the study and comparison of mechanical properties, workability and density of different grades of pervious concrete(M15,M20,M25).

Keywords: pervious concrete, no fines, hyper plasticizer

1.INTRODUCTION

Light weight concrete has become more popular in recent years and have more advantages over the conventional concrete.

Pervious concrete is nothing but no fines concrete, which is also known as porous, gap graded or permeable concrete mainly consists of normal Portland cement, CA, water. In which FA are not existent or present in very small amount i.e < 10% by weight of the total aggregates.

In general, for making porous concrete , we will use the aggregates of size which passes through 12.5mm sieve and retained on 10mm sieve. In this project we have taken single size aggregates i.e 12.5mm. the single size aggregates make a good no-fines concrete, which addition to having large voids and hence light in weight, also offers architecturally attractive look.

Fig – 1 test specimens

2.AIM AND OBJECTIVES

The aim of the research is to study the strength of pervious concrete for different grades(M15, M20, M25). The objectives include

- To study the workability of concrete.
- To study the density of concrete.
- To study the mechanical properties such as compressive, tensile and flexural strength of concrete.

3. MATERIALS

the present investigation the following materials were used:

- Ordinary Portland Cement of 53 Grade cement conforming to IS: 169-1989
- Fine aggregate and coarse aggregate conforming to IS: 2386-1963.
- Water.
- Hyperplasticizer(ECMASHP-902)

3.1CEMENT:

Ordinary Portland Cement of 53 Grade of brand name Ultra Tech Company, available in the local market was used for the investigation. Care has been taken to see that the procurement was made from single batching in air tight containers to prevent it from being effected by atmospheric conditions. The cement thus procured was tested for physical requirements in accordance with IS: 169-1989 and for chemical requirement in accordance IS: 4032-1988. The physical properties of the cement are listed in Table –

Table-1 Properties of cement

SL.NO	Properties	Test results	IS: 169-1989
1.	Normal consistency	0.32	
2.	Initial setting time	60min	Minimum of 30min
3.	Final setting time	320min	Maximum of 600min
4.	Specific gravity	3.14	

3.2 FINE AGGREGATES:

River sand locally available in the market was used in the investigation. The aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity in accordance with IS: 2386-1963.The sand was surface dried before use.

Table-2 Properties of fine aggregates

Fineness modulus	2.4
Specific Gravity of fine aggregate	2.55
Free moisture	2%

3.3 COARSE AGGREGATES:

Crushed aggregates of less than 12.5mm size produced from local crushing plants were used. The aggregate exclusively passing through 12.5mm sieve size and retained on 10mm sieve is selected. The aggregates were tested for their physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386-1963. The individual aggregates were mixed to induce the required combined grading. the particular gravity and water absorption of the mixture are given in table.

Table-3 Properties of coarse aggregates

Specific Gravity of coarse aggregate	2.60
Water absorption	1%

3.4 WATER :

Potable water fit for drinking is required to be used in the concrete and it should have pH value ranges between 6 to 9.

3.5 HYPER PLASTICIZERS

Hyper plasticizers are standard chemical admixtures for concrete employed in the reduction of water to cement quantitative relation while not moving workability, and to avoid particle saggregation within the concrete mixture. These are called high vary water reducers (HRWR), fluidifiers, and dispersants as these are capable of reducing water to cement quantitative relation by forty.0%. These chemical admixtures are additional within the concrete simply before the concrete is placed. These admixtures facilitate to enhance strength and flow characteristics of the concrete. In this project we used ECMASHP-902 as admixture with an amount of 0.2% by weight of cement.

4 MIX PROPROTIONS AS PER ACI 211.1-91

Table -4 Mix proportions for M15 grade of concrete

materials	Proportions for conventional(kg/m^3)	Proportions for No fines concrete(kg/m^3)
Cement	277.7	277.7
Fine aggregates	642.04	0
Coarse aggregates	1193.94	1193.94
Water cement ratio by mass	0.3	0.3
Admixture(ml)	55.54	55.54

Table-5 Mix proportions for M20 grade of concrete

materials	Proportions for conventional(kg/m^3)	Proportions for No fines concrete(kg/m^3)
Cement	380	380
Fine aggregates	563.06	0
Coarse aggregates	1113.75	1113.75
Water cement ratio by mass	0.3	0.3
Admixture(ml)	76	76

Table-6 Mix proportions for M25 grade of concrete

materials	Proportions for conventional(kg/m^3)	Proportions for No fines concrete(kg/m^3)
Cement	452.38	452.38
Fine aggregates	503.2	0
Coarse aggregates	1113.75	1113.75
Water cement ratio by mass	0.3	0.3
Admixture(ml)	90.47	90.47

5.EXPERIMENTAL RESULTS

5.1 WORKABILTY : Results obtained from compaction factor test showing that the workability of concrete

Table-7 Compaction factor for conventional concrete and No fines concrete

GRADES OF CONCRETE	COMPACTION FACTOR	
	CONVENTIONAL CONCRETE	NO FINES CONCRETE
M15	0.8	0.85
M20	0.84	0.89
M25	0.87	0.92

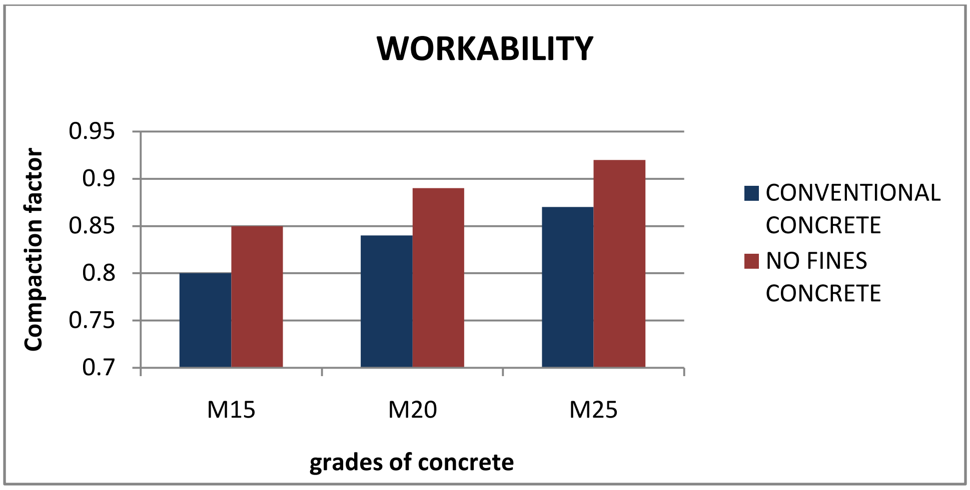

Fig – 2 Workability variation of conventional and pervious concrete for different grades

5.2 COMPRESSIVE STRENGTH:

These results are obtained by testing the total 6 specimens for 7 days and 28 days and by considering the average of the test results and that are tabulated in table

Table-8 compression strength of No fines concrete

GRADES OF CONCRETE	COMPRESSION STRENGTH(N/mm^2)	
	7 DAYS	28 DAYS
M15	11.02	16.32
M20	14.98	20.79
M25	19.86	24.4

Table-9 compression strength of conventional concrete

GRADES OF CONCRETE	COMPRESSION STRENGTH(N/mm^2)	
	7 DAYS	28 DAYS
M15	14.6	19.1
M20	17.26	25.44
M25	21.3	30.88

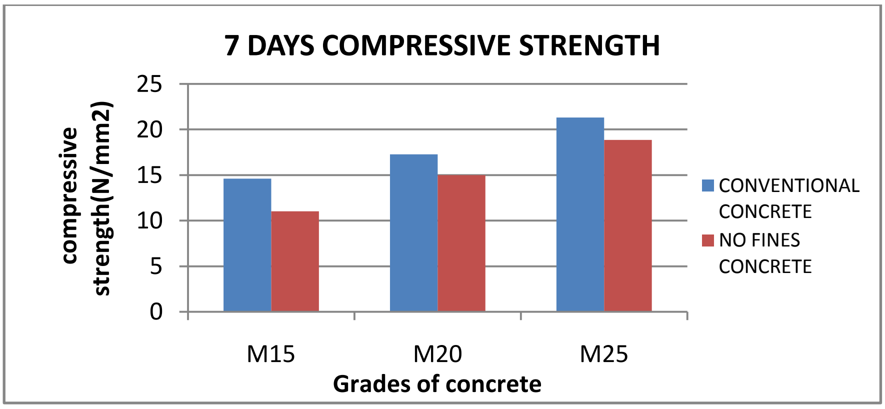

Fig-3 Seven days compressive strength variation of conventional and No fines concrete

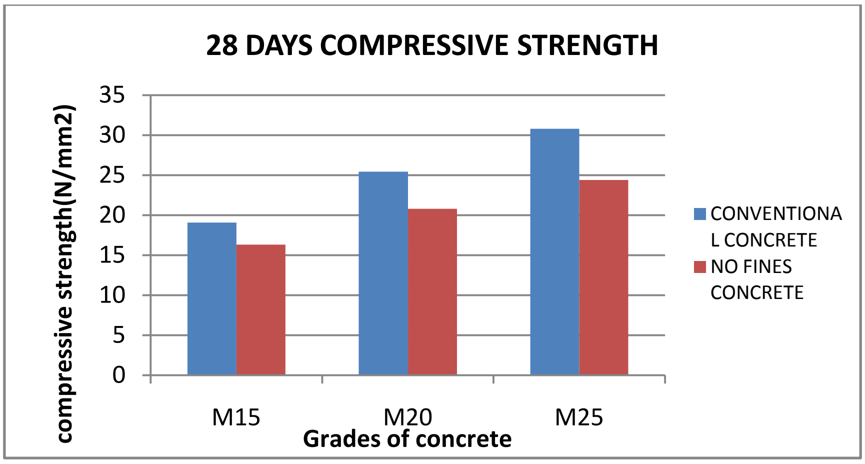

Fig-4 Twenty eight days compressive strength variation of conventional And No fines concrete

5.3 SPLIT TENSILE STRENGTH:

These results are obtained by testing the total 6 specimens for 7 days and 28 days and by considering the average of the test results that are tabulated in table

Table-10 Split tensile strength of No fines concrete

GRADES OF CONCRETE	SPLIT TENSILE STRENGTH(N/mm^2)	
	7 DAYS	28 DAYS
M15	0.98	1.22
M20	1.17	1.57
M25	1.41	2.05

Table-11 Split tensile strength of conventional concrete

GRADES OF CONCRETE	SPLIT TENSILE STRENGTH(N/mm^2)	
	7 DAYS	28 DAYS
M15	2.11	3.26
M20	3.19	4.7
M25	4.04	5.2

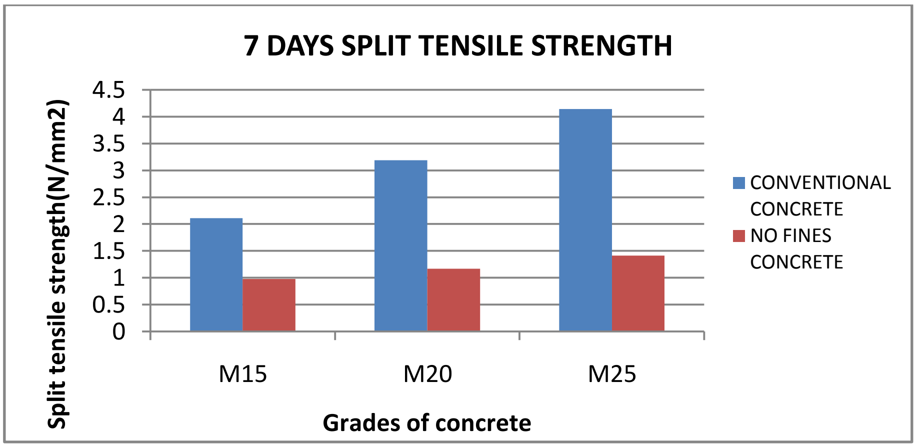

Fig-5 Seven days split tensile strength variation of conventional And No fines concrete

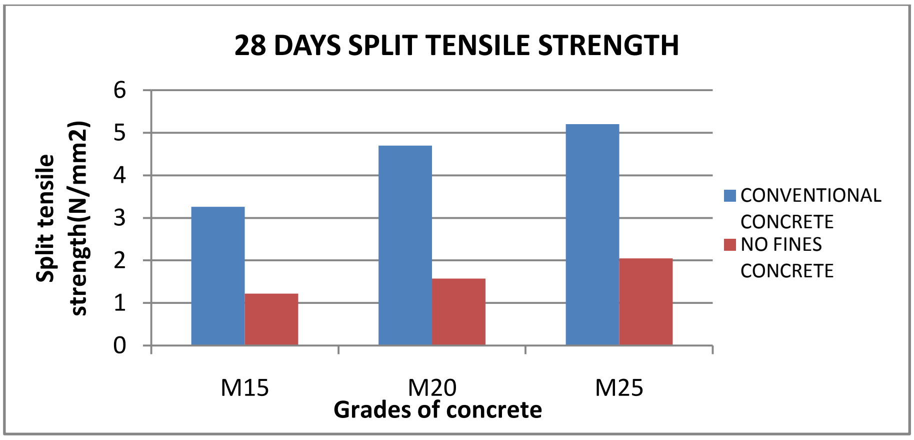

Fig-6 Twenty eight days split tensile strength variation of conventional And No fines concrete

5.4 FLEXURAL STRENGTH :

These results are obtained by testing the total 6 specimens for 7 days and 28 days and by considering the average of the test results that are tabulated in table

Table-12 Flextural strength of No fines concrete

GRADES OF CONCRETE	FLEXTURAL STRENGTH(N/mm^2)	
	7 DAYS	28 DAYS
M15	3.79	5.18
M20	6.68	7.36
M25	8.89	10.28

Table-13 Flextural strength of conventional concrete

GRADES OF CONCRETE	FLEXTURAL STRENGTH(N/mm^2)	
	7 DAYS	28 DAYS
M15	5.43	7.1
M20	8.44	10.12
M25	10.37	12.57

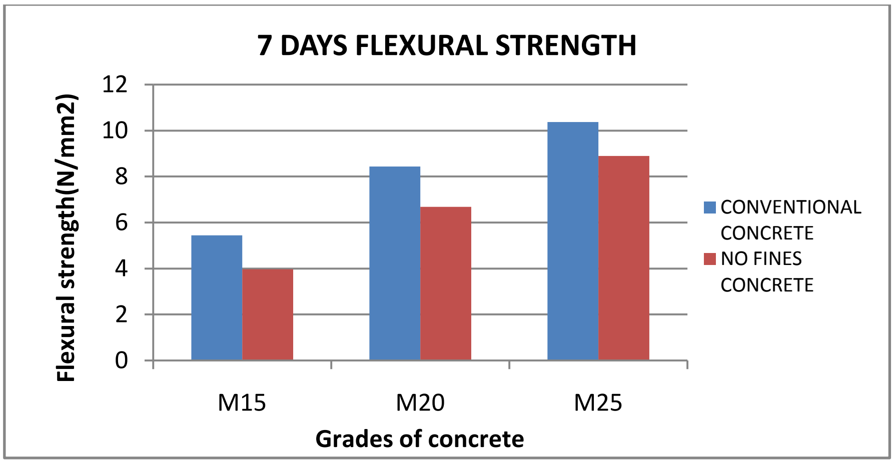

Fig-7 Seven days flextural strength variation of conventional and No fines concrete

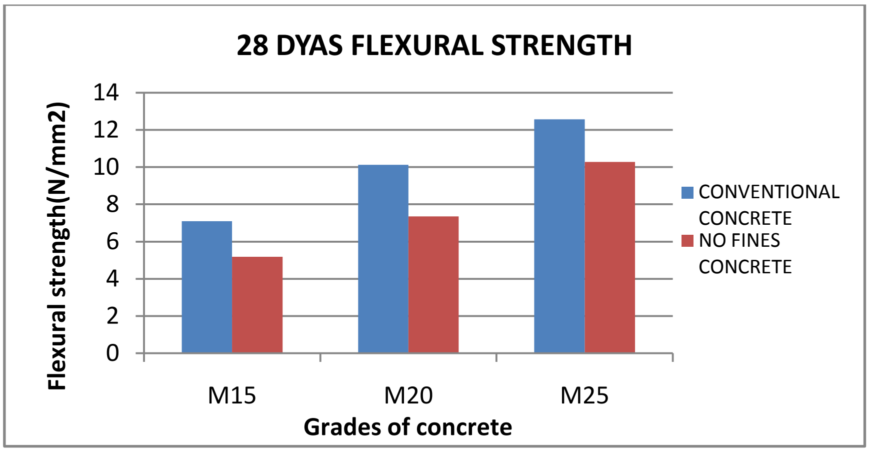

Fig-8 Twenty eight days flextural strength variation of conventional and No fines concrete

5.5 DENSITY OF CONCRETE:

The density of concrete cubes for different grades of conventional and no fines concrete are shown below.

Table-15 Density of conventional concrete and No fines concrete

GRADE OF CONCRETE	DENSITY OF CONCRETE (kg/m^3)	
	CONVENTIONAL CONCRETE	NO FINES CONCRETE
M15	2340	1612
M20	2375	1656
M25	2394	1685

6.DISCUSSION

COMPRESSIVE STRENGTH:A decrease in the compressive strength of M_{15},M_{20} and M_{25} grades of no fines concrete by 18.2%, 14.5% and12.6% respectively is found compared to the conventional concrete.

The computed values of the compressive strength of both conventional and no fines concrete establish that compressive strength of no fines concrete is less than that of conventional concrete.

SPLIT TENSILE STRENGTH: It is evident from the study that the tensile strength of M_{15}, M20 and M25 grades of no fines concrete is decreased by 40.2%, 38.4% and 36.2% respectively in comparison with the conventional concrete.

The calculated split tensile strength values of both conventional and no fines concrete prove that the tensile strength of no fines concrete is less than that of conventional concrete.

FLEXURAL STRENGTH: Observations conclude that the flexural strength of M_{15}, M20 and M25 grades of no fines concrete is decreased by 29.9%, 27.6% and 24.6% respectively when compared to the conventional concrete.

Illustrative computation of flexural strength values of both conventional and no fines concrete prove that flexural strength of no fines concrete is less than that of conventional concrete.

DENSITY OF CONCRETE: It is observed that the density of M_{15}, M20 and M_{25} grades of no fines concrete is decreased by 31.1%, 30.2% and 29.6% as against that of conventional concrete.

The computed density of no fines concrete is noted to have decreased in comparison with that of conventional concrete.

WORKABILITY: Form the calculated workability values it is observed that for M_{15}, M_{20} and M_{25} grades of no fines concrete are increased by 5.8%, 5.6% and 5.4% respectively when compared to the conventional concrete.

CONCLUSIONS

The following conclusions are drawn based on the experimental investigations on compressive strength, split tensile and flexural, considering the considering the “environmental aspects” also:

- Pervious concrete has less strength than conventional concrete by 18.2% for M15, 14.5% for M20 and 12.6% for M25.
- Similarly the tensile and flexural strength values are also comparatively lower than the conventional concrete by 30%.
- Further, no fines concrete is an environmental friendly solution to support sustainable construction. In this project, fine aggregates as an ingredient has not been used. Presently, there is an acute shortage of natural sand all around.

By making use of FA in concrete, indirectly we may have been creating environmental problems. Elimination of fines correspondingly decreases environment related problems.

REFFERENSES

[1]. A. AGUADO (1999) he told that highly permeable materials provide drainage and noise-absorption properties that are useful in pavement top layers.

[2]. J.YANG AND G.JIANG (2003) In this paper, a pervious concrete pavement material used for roadway is introduced. Using the common material and method, the strength of the pervious concrete is low.

[3]. A.M.MULLIGAN (2005) This thesis investigated prior studies on the compressive strength on pervious concrete as it relates to water-cement ratio, aggregate-cement ratio, aggregate size, and compaction.

[4]. S.VALAVALA AND F.MONTES(2006)They concluded that Pervious concrete is an alternative paving surface that can be used to reduce the nonpoint source pollution effects of storm water runoff from paved surfaces.

[5]. M.SULEIMAN AND J.KEVERN (2007) This paper summarizes a study performed to investigate the effects of compaction energy on pervious concrete void ratio, compressive strength, tensile strength, unit weight, and freeze-thaw durability.

[6]. C.WOLFERSBERGER (2008) in this paper, Pervious concrete usually requires much less maintenance. But inspection and some attention will keep it working for many years.

[7]. K.WANG(2008) This paper describes the current state of practice in pervious concrete placement methods and presents results from a laboratory-based study to compare various placement practices and develop QA/QC criteria.

[8]. R. C.MEININGER(2009) in this paper Conclusions are drawn regarding the percentage of air voids needed for adequate permeability, the optimum water-cement ratio range, and the amounts of compaction and curing required.