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MAKING GREEN POROUS CONCRETE FOR RAIN WATER HARVESTING AND URBAN PAVEMENTS

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ABSTRACT

Pervious concrete is one of the most widely used materials by the concrete industry for providing storm water management, pollution control, noise control and sustainable design. The increased awareness in pervious concrete is mainly due to the benefit of storm water management which leads in sustainable development. In artistic point of view, pervious concrete pavement does not appear or perform like conventional concrete pavement.

The main aim of this project was to improve the compressive strength characteristics of pervious concrete. But it can be noted that with increase in compressive strength the void ratio decreases. Hence, the improvement of strength should not affect the porosity property because it is the property which serves its purpose.

Keywords: Concrete mix, Silica Fume, Strength parameter, sustainable construction, workability

1. INTRODUCTION

Depletion of ground water and scarcity in consumption of fine aggregate in concrete construction is effectively controlled by implementing pervious concrete. Previous research on pervious concrete has focused primarily on optimizing the hydraulic properties of pervious concrete mixes. Permeability of pervious concrete is greatest concern for field application based on rainfall intensities which vary with distribution of aggregate sizes for providing adequate drainage properties.

Use of binder is vital and indispensable in any type of concrete. In pervious concrete, most of the studies are carried out using Ordinary Portland cement (OPC) as binder. However, in urbanized areas, source of the OPC binder is in short supply and may be costly. Also, necessary efforts and care should be taken to meet the expected human needs by giving importance to economy and pollution free environment to the construction industry. In order to fulfill this demand, alternate binder is preferable which should be user friendly, environment friendly and should ensure better performance. Therefore, different binders are needed in developing the applications of pervious concrete in all regions.

Consequently pozzolanic binder, fly ash based geopolymer binder are materialized to fulfill the above said needs. It can help in satisfying the demand for cement in concrete. As per the recent scenario, keen interest is shown to utilize industrial wastes in concrete among construction industry and researchers. Due to this, consumption of natural resources can be minimized and it makes environment healthy and clean and helps in minimization of waste disposal, reduction in cost of disposal and land fill

Material Used

The following materials are used during the research work-

- Cement
- Fine aggregates (Sand)
- Coarse Aggregates(10-20 mm)
- Super Plasticizer
- Water

2. METHODOLOGY

As stated earlier concrete mix design is required to be done if admixtures or additional cementing materials are added with partial replacement of cement in concrete is done. The behaviour and properties of green and hardened concrete totally depends on its ingredients ie. Cement, aggregates, cementing material and water to cement ratio. Properties of green concrete like workability and of hardened concrete like compressive strength, flexural strength, weight density etc. totally depends on the proportion of ingredients used in mix design, apart from this ratios of fine aggregate to coarse aggregate, water to cement, admixture to cement also plays and important role in different properties of concrete.. Concrete mix design is a trial and error process and its results totally depends on the lab results of its constituents thus a through and detailed lab test need to be done on ingredients before proceeding for mix design

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3. RESULTS

Table 3.1 Compressive strength of sample containing GGBFS and Fly Ash

	Using GGBFS as Cement Replacement 50 %		
S.No.	**Sample ID**	**28 days Compressive Strength in MPa**	**Water : Cement**
1	A3GS1	15.87	0.33
2	A4GS1	12.28	
3	A5GS1	8.56	
4	A6GS1	6.46	
5	A3GS2	13.73	
6	A4GS2	10.07	
7	A5GS2	6.89	
8	A6GS2	5.64	
9	A3GS3	12.44	
10	A4GS3	9.13	
11	A5GS3	6.79	
12	A6GS3	5.47	
	Using FLY ASH as Cement Replacement 50 %		
S.No.	**Sample ID**	**28 days Compressive Strength in MPa**	**Water : Cement**
1	A3FS1	11.34	0.33
2	A4FS1	9.45	
3	A5FS1	9.12	
4	A6FS1	7.50	
5	A3FS2	10.36	
6	A4FS2	9.05	
7	A5FS2	7.35	
8	A6FS2	5.23	
9	A3FS3	10.12	
10	A4FS3	9.05	
11	A5FS3	6.23	
12	A6FS3	5.00	

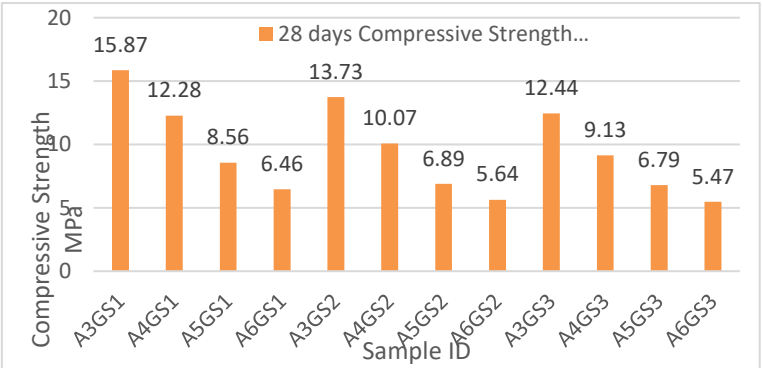

Fig. 3.1 Variation of Compressive Strength Contain of GGBFS

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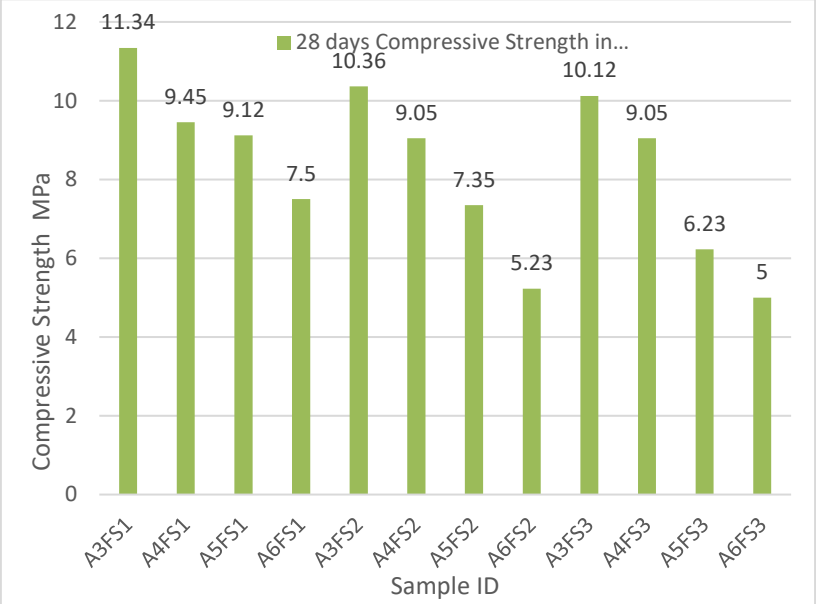

Fig. 3.2 Variation of Compressive Strength Contain of Fly Ash

The compressive strength of pervious concrete with addition of fly ash and GGBFS were measured at 28 days as shown in figures. For GGBFS mix it ranges from 15.85 MPa to 5.47 MPa with increasing aggregate to cement ratio from 3:1 to 6:1. And for FA mix it ranges from 11.34 MPa to 5 MPa with increasing aggregate to cement ratio from 3:1 to 6:1

The variation in compressive strength between small S1 and medium size S2 aggregate mix is up to 13.35 % and between S1 and bigger size S3 aggregate mix is up to 21%. Increase in compressive strength of different mix was observed by decreasing aggregate to cement ratio from 3:1 to 6:1. FLEXURAL STRENGTH TEST

Table 5.2 Flexural strength of sample containing GGBFS and Fly Ash

	Using GGBFS as Cement Replacement 50 %		
S.No.	**Sample ID**	**28 days Flexural Strength in MPa**	**Water : Cement**
1	A3GS1	3.21	0.33
2	A4GS1	2.86	
3	A5GS1	2.62	
4	A6GS1	2.22	
5	A3GS2	2.96	
6	A4GS2	2.82	
7	A5GS2	2.37	
8	A6GS2	2.02	
9	A3GS3	2.86	
10	A4GS3	2.47	
11	A5GS3	2.07	
12	A6GS3	1.83	
	Using FLY ASH as Cement Replacement 50 %		
S.No.	**Sample ID**	**28 days Flexural Strength in MPa**	**Water : Cement**
1	A3FS1	3.11	0.33
2	A4FS1	3.06	

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3	A5FS1	2.86	
4	A6FS1	2.62	
5	A3FS2	2.81	
6	A4FS2	2.56	
7	A5FS2	2.30	
8	A6FS2	1.95	
9	A3FS3	2.55	
10	A4FS3	2.20	
11	A5FS3	1.95	
12	A6FS3	1.35	

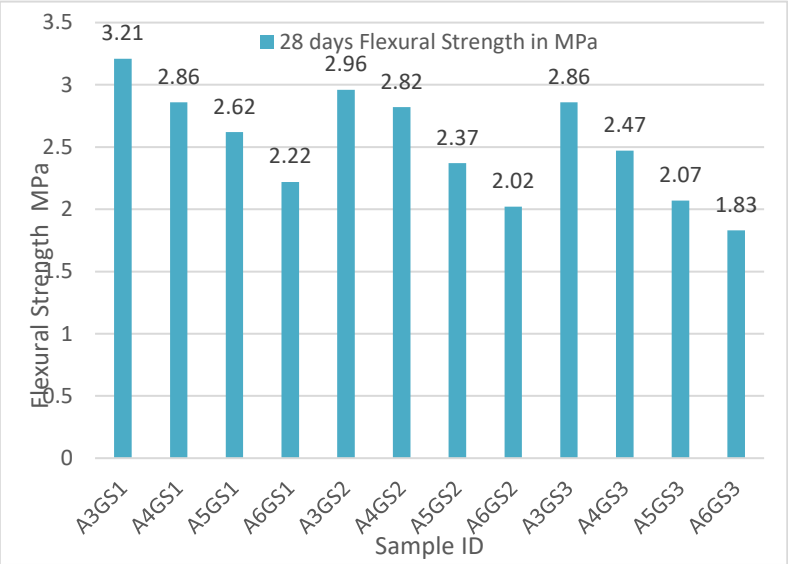

Fig. 5.3 Variation of Flexural Strength Contain of GGBFS

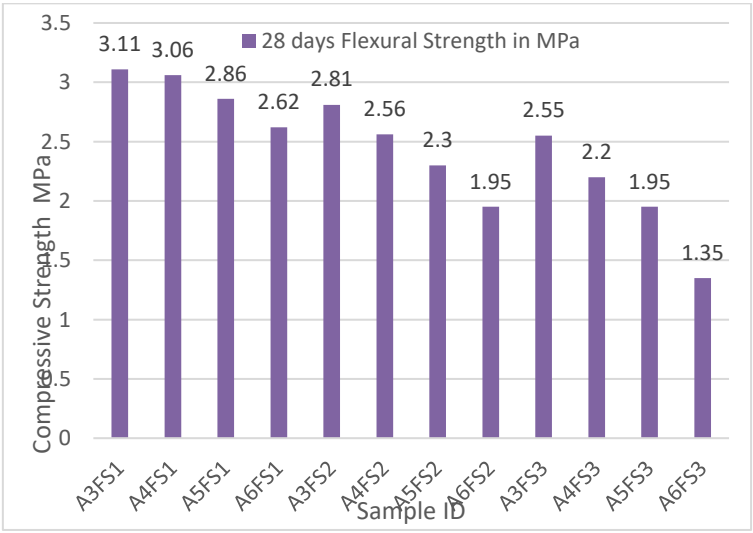

Fig. 5.4 Variation of flexural Strength Contain of Fly Ash

The flexural strength of pervious concrete with addition of fly ash and GGBFS were measured at 28 days as shown in figures. For GGBFS mix it ranges from 3.21 MPa to 1.83 MPa with increasing aggregate to cement ratio from 3:1 to 6:1. And for FA mix it ranges from 3.11 MPa to 1.35 MPa with increasing aggregate to cement ratio from 3:1 to 6:1 The variation in flexural strength between small S1 and medium size S2 aggregate mix is up to 7.75 % and between S1 and bigger size S3 aggregate mix is up to 10.91%. Increase in flexural strength of different mix was observed by de-creasing aggregate to cement ratio from 3:1 to 6:1.

4. CONCLUSION

- For GGBFS mix it ranges from 15.85 MPa to 5.47 MPa with increasing aggregate to cement ratio from 3:1 to 6:1. And for FA mix it ranges from 11.34 MPa to 5 MPa with increasing aggregate to cement ratio from 3:1 to 6:1. Increase in compressive strength of different mix was observed by decreasing aggregate to cement ratio from 3:1 to 6:1. The decrease in compressive strength between small S1 and medium size S2 aggregate mix is up to 13.35 % and between S1 and bigger size S3 aggregate mix is up to 21%.
- Pervious concrete mix made with 12.5 mm larger size aggregate exhibited higher coefficient of permeability and porosity than smaller size aggregate. It is worth noting that larger size aggregate creates more number of interconnected voids between the aggregate particles and those voids cannot be entirely occupied by the binder paste. This fact allows more amount of water to penetrate.

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