Experimental Study on Pervious Concrete

V.Parthiban[1], K.Venkat Ragavan[2], S.Rivin[3] ,T.Kalidass[4]
[1]Assistant Professer, Dept of Civil Engineering
[2, 3, 4]Dept of Civil Engineering
[1, 2, 3, 4] Sri Ramakrishna Engineering college, Coimbatore,TamilNadu.

Abstract- *Pervious concrete is a special type of concrete with high porosity used for concrete flat work applications that allow water from precipitation and other source to pass directly through there by reducing the runoff from a site and allowing ground water recharge this porosity is attained by a highly inter connected void content. Typically, pervious concrete has little or no fine aggregate and has just enough cementing paste to coat the coarse aggregate On testing nominal pervious concrete properties, it does not attain the required strength so we carried out a study on adding GGBS and silica fume as a partially replacement for cement to increase the compressive strength*

Keywords- Silica fume, GGBS, Cement, Coarse aggregate

I. INTRODUCTION

Pervious concrete or porous concrete is a unique and effective means to meet growing environmental demands. By capturing rainwater and allowing it to seep into the ground, pervious concrete is instrumental in recharging groundwater, reducing storm water runoff. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm water management devices. In doing so, pervious concrete has the ability to lower overall project costs on a first cost basis. In pervious concrete, carefully controlled amounts of water and cementitious materials are used to create a paste that forms a thick coating around aggregate particles. A pervious concrete mixture contains little or no sand, creating a substantial void content. Using sufficient pastes to coat and bind the aggregate particles together creates a system of highly permeable, interconnected voids that drains quickly.

II. NEEDSOFPERVIOUSCONCRETE

- A large amount of rain water ends up falling on impervious surfaces such as parking lots, drive ways, sidewalks, and streets rather than soaking into the soil.
- This creates an imbalance to the natural ecosystem and leads to a host of problems including erosion, floods, ground water level depletion and pollution of rivers, lakes etc.
- A simple solution to avoid these problems is to stop constructing impervious surfaces that block natural water infiltration into the soil.
- Instead of constructing them with conventional concrete or asphalt, we should be switching to pervious concrete or porous pavement.
- Pervious concrete also naturally filters water from rainfall or storm and can reduce pollutant loads entering into streams, ponds and rivers so in this way it helps in ground water recharge.

PERVIOUSCONCRETEININDIA:

This technique can be adopted in India for construction of parking lots, footpaths, rural roads etc. In coming two decades there will be significant housing projects in India and the roads around the apartments and surfacing inside the compounds can be made with pervious concrete. The water demand in cities is going up day by day due to urban migration. Due to depletion of ground water level, the water shortage will be experienced. The pervious concrete if adopted, as mentioned above, will allow the water to percolate into the ground, which will help in increasing the ground water level. Another advantage in Indian scenario is that the pervious concrete construction is mostly manual and can be done without any heavy equipment. The labor cost India being less, the construction cost of pervious concrete will be lower. Considering these advantages, this technique will become popular in India.

Cement:(OPC)

Cement used is ordinary port land cement . It is used to bind the materials in the concrete. The grade of cement is 53 grade.

Types of cement:

- Ordinary Portland cement
- Portland pozzolana cement
- Rapid Hardening cement
- Sulphate Resisting cement
- Portland slag cement
- Air entraining cement

The following are the some of the properties of the cement:

- Fineness
- Setting time
- Soundness
- Compressive strength

SILICAFUME

- Silica fume is a by product of producing silicon metal or ferrosilicon alloys.
- One of the most beneficial uses for silica fume is in concrete.
- Because of its chemical and physical properties, it is a very reactive pozzolan.
- Concrete containing silica fume can have very high strength and can be very durable.

GROUNDGRANULATEDBLASTFURNACESLAG

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

WATER:

Water is one of the most critical but probably the cheapest constituents of concrete. Water in concrete should be as low as possible, however, minimum amount of water is essential for hydration of cement. Lower water cement ratio increases the strength and generally improves the durability of concrete. It is therefore desirable to keep water cement ration as low as possible but adequate to get workable concrete and achieve adequate hydration of cement.

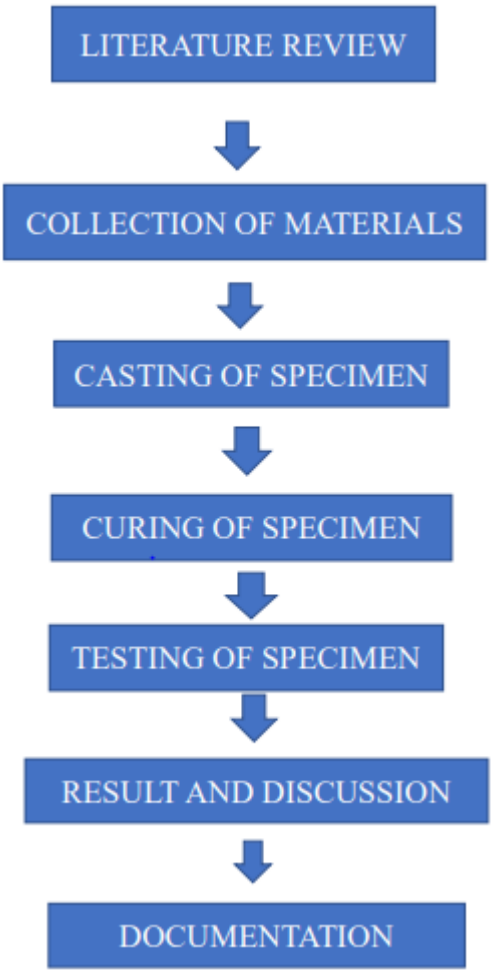
COARSE AGGREGATE:

Aggregate are the important constituents in concrete. They give boy to the concrete, reduce shrinkage and effect economy. Earlier, aggregate were considered as chemically inert materials but now it has been recognised that some of the aggregates are chemically active and also that certain aggregates exhibit chemical bond at the interact of aggregate and paste. The mere fact that the aggregates occupy 70-80 % of the volume of concrete, their impact on various characteristics and properties of concrete is undoubtedly considerable. Without 14 the study of the aggregate in depth and range, the study of the concrete is incomplete. Cement is the only factory-made standard component in concrete. Size: The largest maximum size of aggregate practicable to handle under a given set of conditions should be used. Perhaps, 80mm size is the maximum size that could be conveniently used for concrete making. The maximum size of aggregate that can be us8d in any given condition may be limited by the following conditions:

- Thickness of section
- Spacing of reinforcement
- Clear cover
- Mixing, handling and placing techniques.

Shape: The shape of aggregates is an important characteristic since it affects the workability of concrete. It is difficult to really ensure the shape of irregular body like concrete aggregate which are derived for various rocks. It also reflects the internal petrographic structure. As a consequence of these tendencies, schists, slates and shales commonly produce flaky forms, whereas, granite, basalt and quartzite usually yield more or less equidimensional particles. Similarly, quartzite which does not possess cleavage planes produces cubical shape aggregates.

III. METHODOLOGY



TESTONMATERIALS

- TEST CONDUCTED FOR CEMENT

SI NO	TESTS FOR CEMENT	RESULT
1	SPECIFIC GRAVITY	3.16
2	FINESNESS TES	97.2%
3	CONSISTENCY	35%
4	INITIAL SETTING TIME	30 mins

- TEST CONDUCTED FOR COARSE AGGREGATE

SI NO	TESTS FOR COARSE AGGREGATE	RESULT
1	SPECIFIC GRAVITY	2.71
2	FINESNESS MODULUS	3.79

- TEST CONDUCTED FOR SILICA FUME

SI NO	TESTS FOR SILICA FUME	RESULT
1	SPECIFIC GRAVITY	2.2
2	BULK DENSITY	96Kg/m^3
3	FINENESS TEST	96.2%

- Mix ratio: 1:8CUBE
- Volume of the cube = 3.375x$10^3$$m^3$
- Total weight of Cement=1/9x6.413=0.713kg
- Weight of coarse aggregate(12mm)=8/9x6.413=5.7kg
- Water content=0.36x0.713=0.256litreCYLINDER
- Volume of the cylinder=0.0053m^3
- Total weight of Cement=1/9x10.067=1.12kg
- Weight of coarse aggregate(12mm)=8/9x10.067 =8.95kg
- Water cement ratio=0.36x1.12kg=0.4032litre

WITH ADMIXTURES GGBS

CUBE

- Total weight of Cement and GGBS = 1/9 x 6.413 = 0.713 kg
- Weight of GGBS (10% replacing)= 0.10 x 0.713 = 0.0713 kg
- Weight of cement (90%)=0.90x0.713= 0.6417kg = 641.7gms
- Total weight of Cement and GGBS = 1/9 x 10.067= 1.12 kg CYLINDER
- Weight of GGBS (10% replacing) = 0.10 x 1.12 =0.112 kg
- Weight of cement (90%) = 0.90 x 1.12 =1.008 kg

ADMIXTURESWITHSILICAFUME

- Total weight of Cement and Silica fume =1/9 x 6.413= 0.713 kg
- Weight of Silica fume (5% replacing) = 0.05 x0.713= 35gms
- Weight of cement (95%) = 0.95 x 0.713 = 0.677kg
- Weight of coarse aggregate (12mm) = 8/9 x 6.413= 5.7kg
- Water content = 0.36 x 0.677 = 0.243 litre

CYLINDER:

- Total weight of Cement=1/9x10.067=1.12kg
- Weight of silica fume(5% replacing) = 5/100 x 1.12 = 0.05 x 1.12 = 0.06 kg = 60gms
- Weight of cement (95%) = 0.95 x 1.12 = 1.064kg
- Weight of coarse aggregate(12mm)=8/9x10.067 =8.95kg
- Water content = 0.36 x 1.064 = 0.385 litre

COMPRESSIONANDTENSILESTRENGTH:

Compression strength test on concrete was carried out in a universal testing machine and tested after 28 days.

TESTING OF NOMINAL PERVIOUS CONCRETE

TESTING OF CUBES

NO OF DAYS	LOAD ATTAINED	AVGG LOAD
7TH DAY TEST	5.022 mpa	5.048 mpa
	5.128 mpa	
	4.995 mpa	
14TH DAY TEST	7.348 mpa	7.440 mpa
	7.763 mpa	
	7.211 mpa	
28th DAY TEST	9.256 mpa	9.578 mpa
	9.655 mpa	
	9.825 mpa	

TESTING OF CYLINDERS

NO OF DAYS	LOAD ATTAINED	AVGG LOAD
7TH DAY TEST	0.966 mpa	1.071 mpa
	1.255 mpa	
	0.992 mpa	
14TH DAY TEST	3.112 mpa	2.786 mpa
	2.667 mpa	
	2.568 mpa	
28th DAY TEST	3.102 mpa	3.387 mpa
	3.286 mpa	
	3.752 mpa	

TESTING CONCRETE WITH SILICA FUME
TESTING OF CUBES

NO OF DAYS	LOAD ATTAINED	AVGG LOAD
7TH DAY TEST	6.955 mpa	6.954 mpa
	7.122 mpa	
	6.785 mpa	
14TH DAY TEST	9.321 mpa	9.332 mpa
	9.552 mpa	
	9.123 mpa	
28th DAY TEST	12.323 mpa	12.11 mpa
	12.012 mpa	
	11.995 mpa	

TESTING OF CYLINDERS

NO OF DAYS	LOAD ATTAINED	AVGG LOAD
7TH DAY TEST	1.677 mpa	1.761 mpa
	1.772 mpa	
	1.785 mpa	
14TH DAY TEST	2.321 mpa	2.651 mpa
	2.552 mpa	
	1.123 mpa	
28th DAY TEST	3.324 mpa	3.875 mpa
	3.012 mpa	
	3.995 mpa	

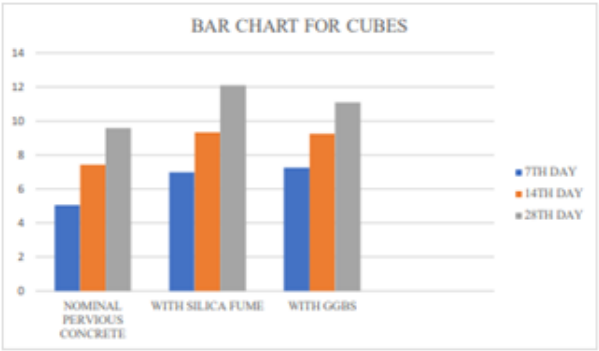
TESTING CONCRETE WITH GGBFS
TESTING OF CUBES

NO OF DAYS	LOAD ATTAINED	AVGG LOAD
7TH DAY TEST	7.123 mpa	7.261 mpa
	6.924 mpa	
	7.592 mpa	
14TH DAY TEST	9.321 mpa	9.251 mpa
	9.552 mpa	
	9.123 mpa	
28th DAY TEST	11.323 mpa	11.075 mpa
	11.012 mpa	
	10.995 mpa	

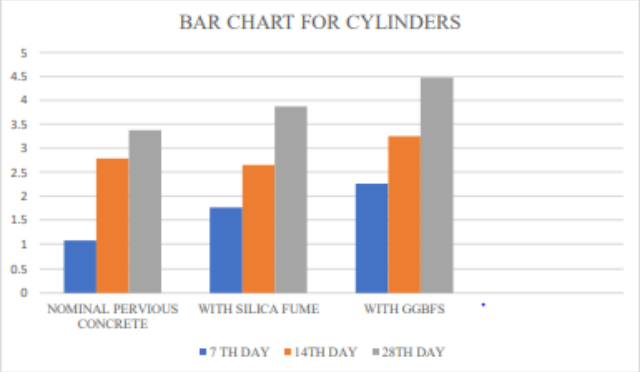
TESTING OF CYLINDERS

NO OF DAYS	LOAD ATTAINED	AVGG LOAD
7TH DAY TEST	2.122 mpa	2.261 mpa
	1.924 mpa	
	2.592 mpa	
14TH DAY TEST	2.321 mpa	3.215 mpa
	3.552 mpa	
	3.123 mpa	
28th DAY TEST	4.323 mpa	4.475 mpa
	3.912 mpa	
	4.395 mpa	

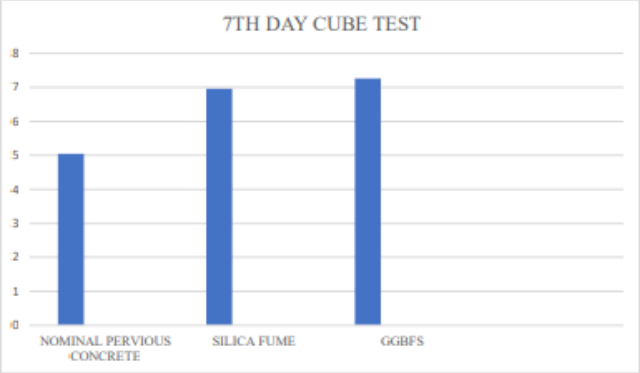
BAR CHART
BAR CHART FOR CUBES



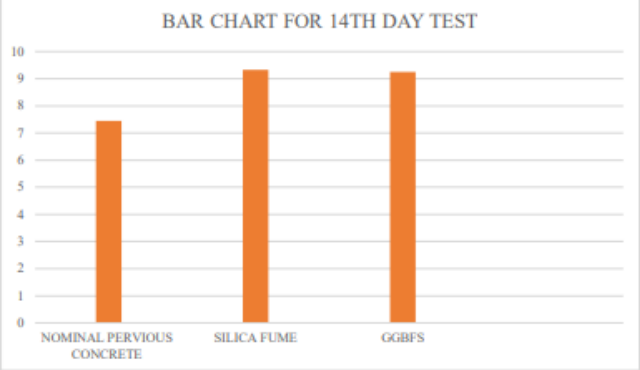
BAR CHART FOR CYLINDERS



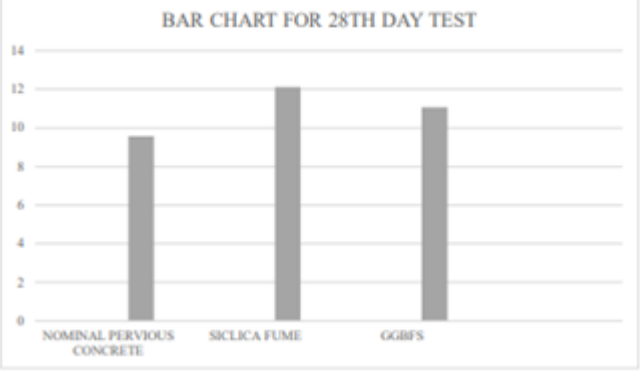
7th TEST FOR ALL CUBE



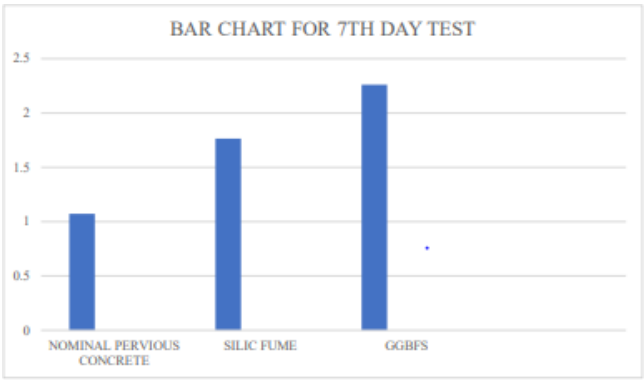
14th DAY TEST FOR ALL CUBES



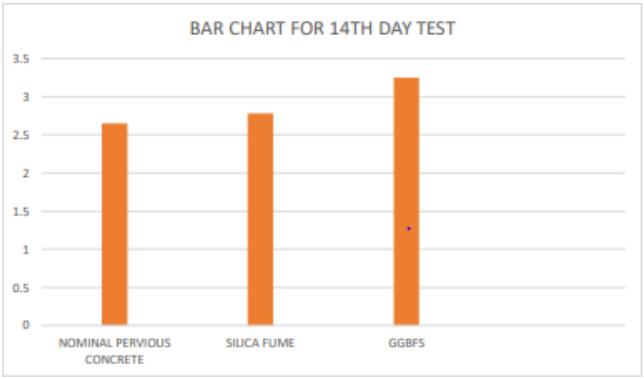
28tth DAY TEST FOR ALL CUBES



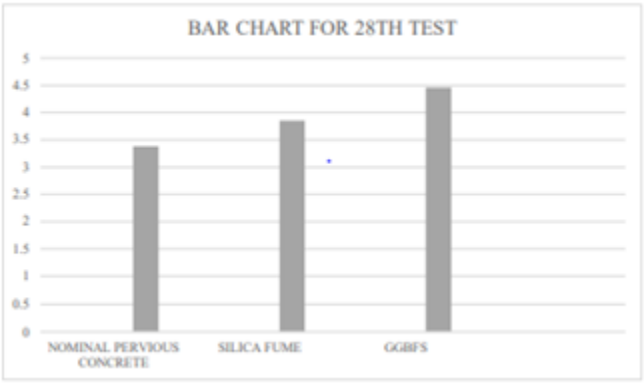
7th DAY TEST FOR ALL CYLINDERS



14th DAY TEST FOR ALL CYLINDERS



28th DAY TEST FOR ALL CYLINDERS



IV. RESULT AND CONCLUSIONRESULT

- Cube compressive strength and split tensile strength of the pervious concrete decreases with the increase in percentage of silica fume and GGBS.
- Rate of permeability is higher for 5 % and 10% of silica fume and GGBS compared to nominal concrete.
- 98 % of water is passed out through concrete within 40 sec.

V. CONCLUSION

- Compressive strength and tensile strength were sufficient corresponding to the 5 % and 10% of silica fume and GGBS respectively.
- Hydraulic conductivity of the material increases with increase in total porosity of mass.

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