International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online)
Vol. 4, Issue 1, pp: (159-173), Month: April 2016 - September 2016, Available at: www.researchpublish.com

Experimental Study on Sulphate Attack in Granite Powder Concrete with GGBFS

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Abstract: **Sulphate attack or commonly known as acid attack is having adverse effects on conventional concrete. Granite powder concrete also faces the same problem. Sulphate attack reduces the compressive strength of concrete and thereby it affects its durability. In practice to avoid sulphate attack effect on conventional concrete generally use of sulphate resisting cement is preferred. With reference to literatures listed below, GGBS is a by-product from the blast furnaces used to make iron and possess binding properties as cement, we have replaced cement partially (15%,25%,35%of cement by weight) by GGBS and concrete specimens are casted for M30 grade conventional concrete and for granite powder concrete . Curing is done for 7days in normal condition and for acidic condition some specimens are cured for 7days & others is cured for 28 days, this helped us to distinguish the short term & long term effects of sulphate attack on GGBS granite powder concrete concrete**

Keywords: **Sulphate Attack, granite powder Concrete, GGBS.**

1. INTRODUCTION

A. General:

Concrete exposed to sulfate solutions can be attacked and suffer deterioration by expansion. The deterioration of reinforced concrete by sulfate attack causes the reinforcing steel to be exposed to the action of aggressive agents starting the corrosion of the reinforcement. It is known that the concrete resistance to sulfates can be significantly improved by addition of GGBS a dense waterproof concrete. Both the physical resistance of concrete to the penetration and capillary-induced migration of aggressive agents and the chemical resistance of the concrete to the deleterious reactions described above are important attributes of sulfate resisting concrete. Thus factors influencing the permeability and surface porosity of the concrete and the chemical resistance of cement are prime performance parameters of concrete exposed to sulphate attack. In this project physical resistance of concrete is traditionally achieved by specifying mix design parameters such as maximum water–cement ratio and minimum cement content, while the chemical resistance is by the use of sulphate resisting cement As GGBS is a by-product from the blast furnaces used to make iron, available cheaply and in ample quantity, GGBS GRANITE POWDER CONCRETE concrete is economical as compared to the concrete which is used as sulphate resisting concrete.

II. SULPHATE ATTACK DEFINITION

Sulfate attack is a chemical breakdown mechanism where sulfate ions attack components of the cement paste.

The compounds responsible for sulfate attack are water-soluble sulfate-containing salts, such as alkali-earth (calcium, magnesium) and alkali (sodium, potassium) sulfates that are capable of chemically reacting with components of concrete. The deterioration of concrete exposed to sulfate is the result of the penetration of aggressive agents into the concrete and their chemical reaction with the cement matrix. The three main reactions involved are:

- Enttringite formation- Conversion of hydrated calcium aluminates to calcium sulpho aluminate,
- Gypsum formation- Conversion of calcium hydroxide to calcium sulphate, and
- Decalcification- Decomposition of the hydrated calcium silicate.

These chemical reactions can lead to expansion and cracking of concrete, and/or the loss of strength and elastic properties of concrete. The form and extent of damage to concrete will depend on the sulfate concentration, the type of cations (e.g. sodium or magnesium) in the sulfate solution, the pH of the solution and the microstructure of the hardened cement matrix. Some cement is more susceptible to magnesium sulfate than sodium sulphate; the key mechanism is the replacement of calcium in calcium silicate hydrates that form much of the cement matrix. This leads to a loss of the binding properties.

III. EXPERIMENTAL STUDY

With the above objectives and aim, a comparative study on strength parameters is done against conventional against conventional concrete to study the behavior of cement concrete with granite powder concrete and GGBS. The experimental tests carried out on parameters are:

1. The physical properties of blended cement (Portland cement replaced by 15% ,25%,35% on weight basis by GGBS) and sand by Granite powder

2. With constant water/cement ratio concrete design mix of grade M30 was prepared, cured normal condition for 7days & acid curing for some specimens is done for 7days and for other specimens acid curing is done for 28 days and each concrete design mix was studied for Compressive, Flexural and Split Tensile Strength. iii) Comparison of conventional concrete and granite powder concrete with replacement of cement by GGBS concrete by observing change in dimensions and weight loss due to acid curing.

The concrete design mixes are used for general reinforced concrete works such as beams, slabs, columns and panels, walls etc. It has been studied for compressive as well as flexural and split tensile strength. The cement is replaced 15%,25%,35% GGBS. The compressive strength, flexural and split tensile test are done after curing periods of 7days and 28 days.

1. For concrete design mix of grade M 30 the w/c ratio was 0.45

2. For concrete design mix of grade M 30 with 15% granite powder and 15%,25%,35% GGBS the w/c ratio was 0.36

For compressive strength test specimens of size 150mm × 150mm × 150mm were used, for flexural strength tests beam specimens of size 100mm × 100mm × 500mm were used and for split tensile strength cylinders of size 150mm dia. and 300mm height were prepared for each water- (cement + GGBS) ratio for every mix and for one curing period cement is replaced by 15%, 25%, 35% on weight basis. In all concrete mix designs ultra-tech 53 grade cement, locally available river sand ,15% of granite powder and course aggregate (12.5 mm and down size) were used.

IV. MIX DESIGN

Following is the mix proportion for M30 grade concrete and concrete design mix ratio for both conventional concrete and Granite powder concrete with GGBS.

Table.1: Proportion of M 30 Grade Conventional and Granite powder concrete with GGBS concrete design mix

Cement		Sand	Coarse Aggregate	Water
385 kg/m^3		883 kg/m^3	1124 kg/m^3	140 kg/m^3
Concrete Design Mix Ratio				
1		2.2	3.4	0.45
0.15	0.85	0.15	3.4	0.36
0.25	0.75	0.15	3.4	0.36
0.35	0.65	0.15	3.4	0.36

V. RESULT ANALYSIS

Different tests are carried out on M30 grade conventional as well as Granite powder concrete with replacement of cement with GGBS concrete. In this chapter results obtained from the different tests are tabulated along with the graphs.

A. Result analysis with respect to compressive strength:

The Compressive strength of concrete mix design was checked by casting and testing of concrete cube specimens of size 150mm × 150mm × 150mm after 7 days &28days normal curing & acid curing as well. Obtained results are tabulated below.

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Compressive strength of granite powder concrete with replacement of cement by GGBS:

Table.2: (7 Days and 28 days Normal curing -Compressive strength)

Mix Type	W/C Ratio	Cube Size	Specimen	GGBS replacement in granite powder concrete by %	Compressive Strength , N/mm²		Average Compressive Strength, N/mm²	
					7th Day	28th Day	7th Day	28th Day
A 1	0.45	150 mm	1	Nominal Concrete	37.3	40.0	35.7	39.1
			2		36.8	39.2		
			3		33.0	38.2		
M 1	0.36	150 mm	1	15%	32.8	40.1	34.3	39.2
			2		32.5	38.2		
			3		37.6	39.5		
M 2	0.36	150 mm	1	25%	40.7	41.4	41.7	42.4
			2		42.0	43.5		
			3		42.3	43.6		
M 3	0.36	150 mm	1	35%	36.6	39.3	33.6	39.6
			2		33.0	40.0		
			3		31.2	39.7		

Table.3: (7 Days and 28 daysH_2SO_4 curing-Compressive Strength)

Mix Type	W/C Ratio	Cube Size	Specimen	GGBS replacement in granite powder concrete by %	Compressive Strength , N/mm²		Average Compressive Strength, N/mm²	
					7th Day	28th Day	7th Day	28th Day
B 1	0.45	150 mm	1	Nominal Concrete	37.7	39.7	36.75	39.6
			2		35.6	39.8		
			3		36.96	39.4		
G 1	0.36	150 mm	1	15%	37.4	38.4	34.29	39.6
			2		33.2	40.2		
			3		32.27	39.5		
G 2	0.36	150 mm	1	25%	40.13	42.9	41.39	42.56
			2		42.16	42.08		
			3		41.9	42.8		
G 3	0.36	150 mm	1	35%	37.2	39.3	35.6	39.6
			2		36.3	40.2		
			3		33.4	39.4		

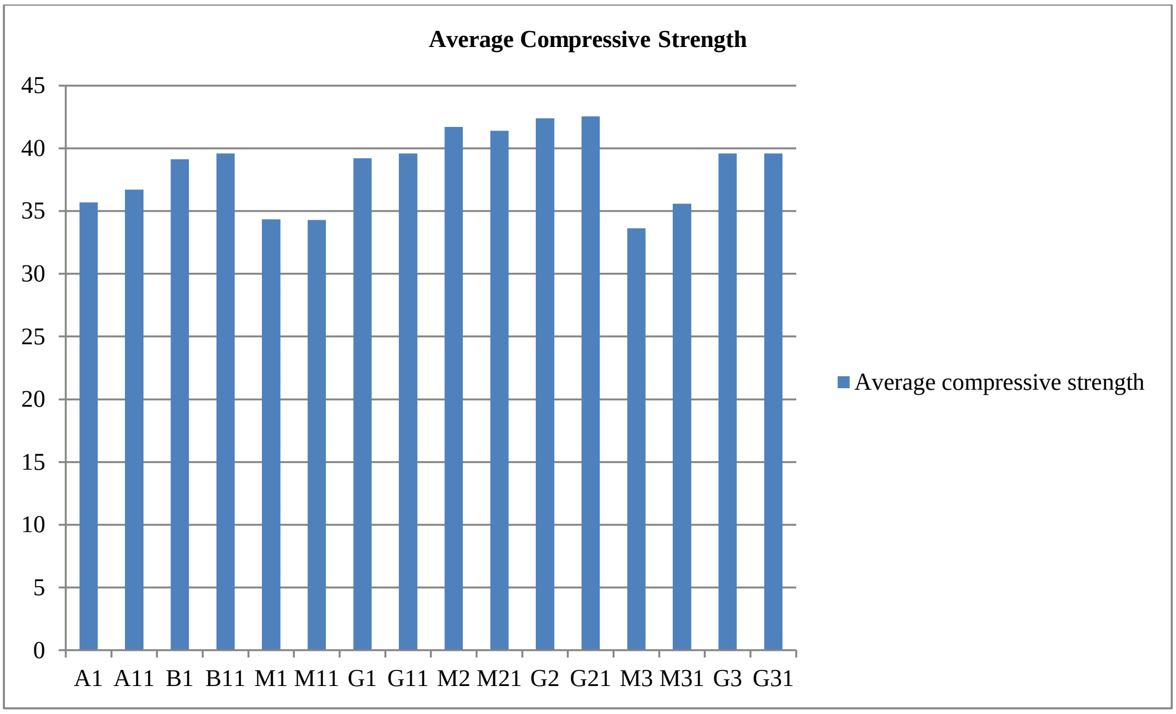

Fig.1: Average Compressive Strength

B. Study of weight loss:

The weight of M30 grade concrete specimens (conventional & granite powder concrete with replacement of GGBS) were measured before placing the specimens for 7days & 28 days normal & acid curing. After the curing period of 7 days & 28 days again the weights were checked and tabulated below. The purpose for this study was to check the effect of acid curing on the concrete specimen with respect to weight

Table.4: (7 Days and 28 days Normalcuring -Weight Loss)

Id	7 days normal curing				28 days normal curing			
	Before curing	After curing	Difference in Kg	Avg difference in Kg	Before Curing	After Curing	Difference in Kg	Avg Difference in Kg
A1	9.15	9.17	.08	.09	9.07	8.98	0.09	.093
	9.24	9.11	.1		9.02	8.92	0.1	
	9.04	8.93	.01		9.13	9.04	0.09	
M1	9.12	8.95	.17	.19	9.13	9.02	0.11	.12
	9.2	8.91	.29		8.92	8.79	0.13	
	9.17	9.06	.11		9.12	8.98	0.14	
M2	9.15	9.10	.05	.21	9.39	9.36	0.03	.053
	9.20	9.14	.06		9.17	9.13	0.04	
	9.21	9.11	.1		9.26	9.17	0.09	
M3	9.32	9.22	.1	.11	9.32	9.22	0.1	.10
	9.3	9.21	.11		9.32	9.2	0.11	
	9.32	9.2	.12		9.3	9.2	0.1	

Table.5: (7 Days and 28 days H_2SO_4 curing -Weight Loss)

Id	7 days H_2SO_4 curing				28 days H_2SO_4 curing			
	Before curing	After curing	Difference in Kg	Avg difference in Kg	Before Curing	After Curing	Difference in Kg	Avg Difference in Kg
B1	9.12	9.04	.08	.08	9.01	8.9	0.11	.11
	9.22	9.09	.13		9.38	9.25	0.13	
	9.01	8.98	.03		9.41	9.3	0.11	
G1	9.17	9.1	.07	.076	9.38	9.25	0.13	.12
	9.01	8.98	.03		9.41	9.3	0.11	
	9.22	9.09	.13		9.17	9.11	0.13	
G2	9.15	9.13	.02	.21	9.09	9.06	0.04	.04
	9.12	9.03	.09		9.09	9.02	0.03	
	9.15	9.07	.08		9.07	9.02	0.05	
G3	9.32	9.22	.1	.11	9.01	8.85	0.16	.14
	9.06	98.9	.15		9.06	8.91	0.15	
	9.13	9.2	.11		9.38	9.25	0.13	

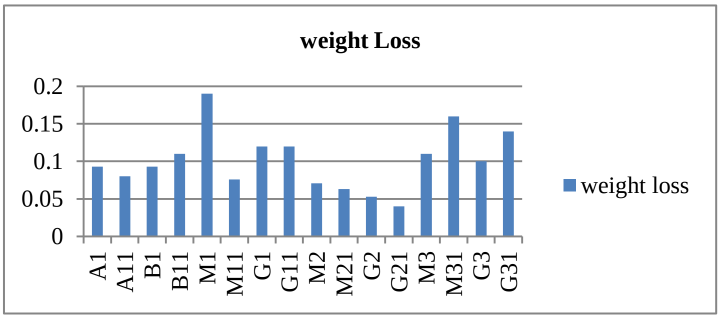

Fig.2: Change in weight

C. Result analysis with respect to dimensions:

The dimensions of M30 grade concrete (Conventional and granite powder concrete with GGBS) specimens were measured before placing the specimens for 7 days & 28 days normal & acid curing. After the curing period of 7days & 28 days again the dimensions were checked and tabulated below. The purpose for this dimensions study was to check the effect of acid curing on the concrete specimens.

Table.6: (7 Days Normal Curing -Dimension Analysis)

ID	Width		Breadth		Height	
	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %
A1	1.26	.77	1.28	.88	1.29	.8
	1.21		1.12		1.27	
	1.02		1.6		1.15	
M1	1.31	.85	1.12	.81	1.29	.86
	1.38		1.39		1.15	
	1.15		1.16		1.44	
M2	1.22	.81	1.44	0.88	1.16	.81
	1.22		1.39		1.26	
	1.24		1.16		1.25	
M3	1.31	.90	1.52	0.98	1.47	.90
	1.38		1.51		1.56	
	1.40		1.44		1.27	

Table.7: (7 Days H_2SO_4 Curing -Dimension Analysis)

ID	Width		Breadth		Height	
	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %
A11	1.23	.80	1.23	.79	1.22	.82
	1.29		1.14		1.29	
	1.11		1.9		1.20	
M11	1.34	.85	1.17	.82	1.30	.86
	1.37		1.37		1.17	
	1.14		1.17		1.45	
M21	1.18	.78	1.32	0.82	1.11	.76
	1.11		1.27		1.21	
	1.15		1.11		1.11	
M31	1.31	.88	1.27	0.93	1.47	.90
	1.38		1.34		1.44	
	1.28		1.37		1.39	

Table.8: (28 Days Normal Curing -Dimension Analysis)

ID	Width		Breadth		Height	
	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %
A1	2.01	1.18	1.77	1.11	1.71	1.3
	1.59		1.55		1.63	
	1.73		1.72		1.94	
M1	1.8	1.25	1.7	1.17	1.91	1.16
	1.82		1.86		1.57	
	2.05		1.75		1.79	
M2	1.59	1.05	1.55	1.05	1.54	1.04
	1.55		1.54		1.59	
	1.6		1.65		1.58	
M3	1.74	1.15	1.8	1.15	1.77	1.16
	1.77		1.79		1.72	
	1.69		1.6		1.74	

Table.9: (28 Days H_2SO_4 Curing -Dimension Analysis)

ID	Width		Breadth		Height	
	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %	Erosion in mm	Avg erosion in %
A11	2.04	1.18	1.73	1.10	1.77	1.17
	1.58		1.55		1.61	
	1.72		1.7		1.9	
M11	1.77	1.24	1.69	1.18	1.94	1.18
	1.79		1.9		1.61	
	2.04		1.77		1.77	
M21	1.77	1.15	1.64	1.09	1.69	1.13
	1.69		1.74		1.71	
	1.74		1.55		1.7	
M31	1.73	1.19	1.89	1.21	1.94	1.27
	1.77		1.88		1.44	
	1.9		1.72		1.39	

Graph Showing 7 days Normal and H_2SO_4 curing:

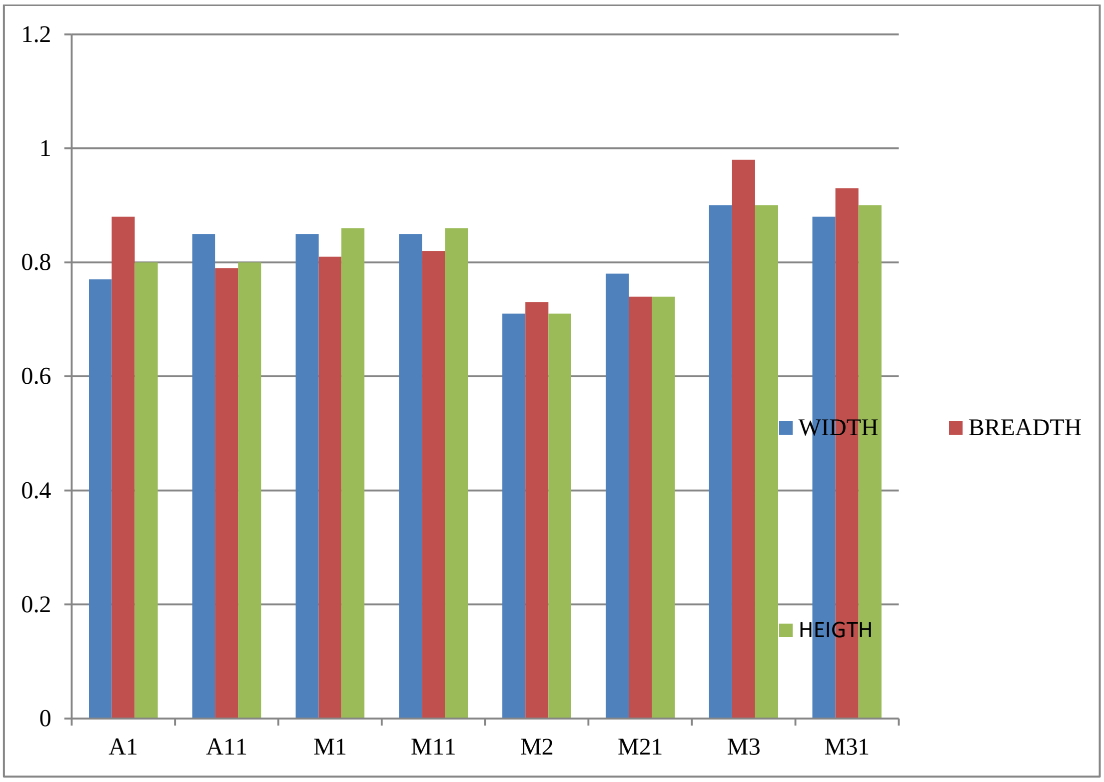

Fig.3: Change in Dimension

Graph Showing 28 days Normal and H_2SO_4 curing:

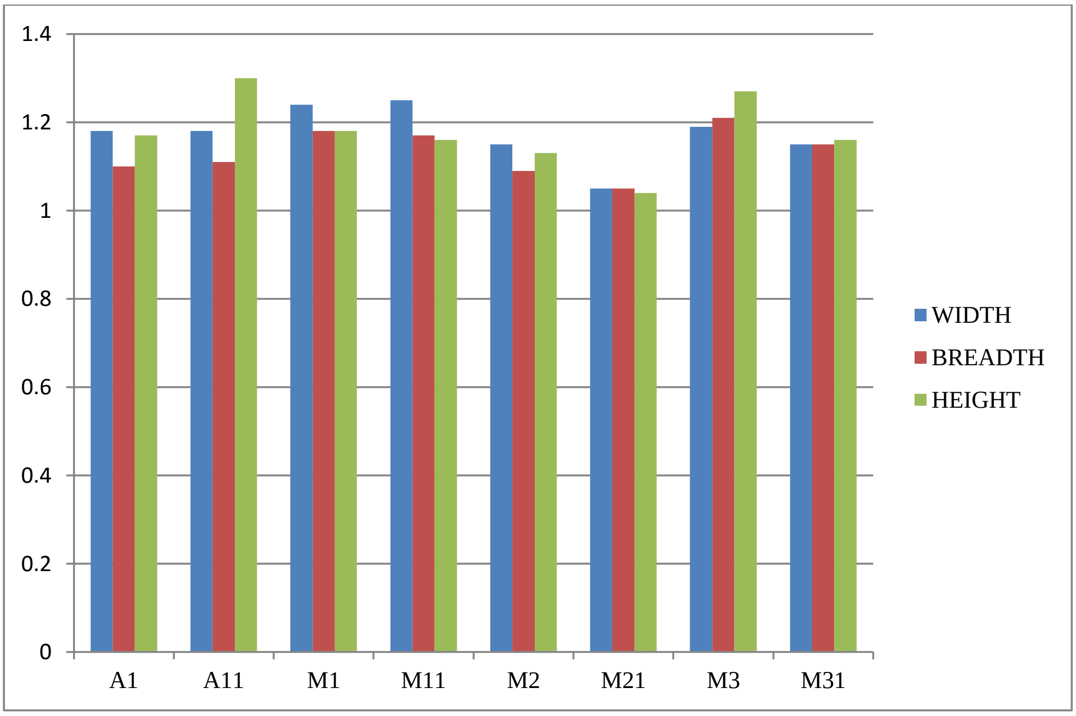

Fig.4: Change in Dimension

D. Result analysis with respect to split tensile strength:

The split tensile strength of concrete mix design was checked by casting and testing of concrete cylinder specimens of size 150m m × 300 mm after 7 days & 28days normal curing & acid curing as well. Obtained results are tabulated below

Split Tensile Strength of Cylinder:

Table.10: (7 Days and 28 Days Normal Curing -Split Tensile Strength)

Mix Type	w/c Ratio	Cylinder Size	Specimen	GGBS replacement in granite powder concrete by %	Split tensile Strength , N/mm2		Average Split tensile Strength, N/mm2	
					7th Day	28th Day	7th Day	28th Day
A1	.45	300×150 mm	1	Nominal concrete	3.30	4.25	3.28	4.18
			2		3.25	4.15		
			3		3.30	4.15		
M1	.36	300×150 mm	1	15%	3.75	4.5	3.43	4.29
			2		3.15	4.21		
			3		3.71	4.16		
M2	.36	300×150 mm	1	25%	4.15	4.56	4.17	4.65
			2		4.25	4.75		
			3		4.15	4.64		
M3	.36	300×15 mm	1	35%	3.15	4.21	3.365	4.17
			2		3.24	4.15		
			3		3.25	4.15		

Tensile strength is one of the most important fundamental properties of concrete. An accurate prediction of tensile strength of concrete will be mitigating cracking problems. Improve shear strength prediction and minimize the failure of concrete in tension due to inadequate of tensile strength prediction

Table.11: (7 Days and 28 Days H_2SO_4 Curing -Split Tensile Strength)

Mix Type	w/c Ratio	Cylinder Size	Specimen	GGBS replacement in granite powder concrete by %	Split tensile Strength , N/mm2		Average Split tensile Strength, N/mm2	
					7th Day	28th Day	7th Day	28th Day
B1	.45	300×150 mm	1	Nominal concrete	3.25	4.23	3.26	4.15
			2		3.30	4.10		
			3		3.25	4.14		
G1	.36	300×150 mm	1	15%	3.80	4.6	3.9	4.32
			2		4.24	4.23		
			3		3.79	4.13		
G2	.36	300×150 mm	1	25%	4.11	4.59	4.16	4.68
			2		4.12	4.78		
			3		4.25	4.67		
G3	.36	300×15 mm	1	35%	3.20	4.15	3.25	4.2
			2		3.27	4.22		
			3		3.30	4.23		

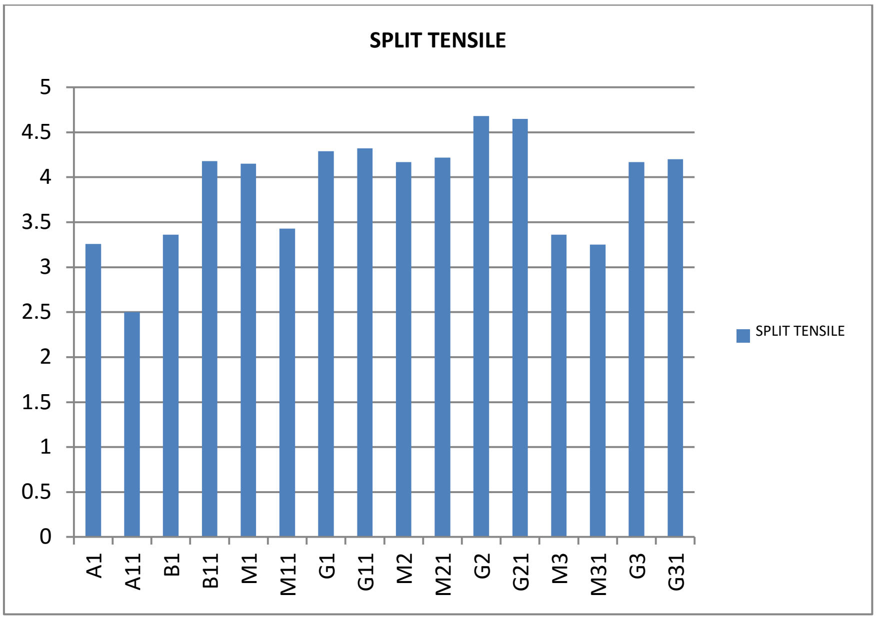

Fig.5: Average Split Tensile Strength

E. Study of weight loss in cylinder:

The weight of M30 grade concrete Cylinder specimens (conventional & granite powder concrete with replacement of GGBS) were measured before placing the Cylinder specimens for 7days & 28 days normal & acid curing. After the curing period of 7 days & 28 days again the weights were checked and tabulated below. The purpose for this study was to check the effect of acid curing on the concrete specimen with respect to weight

Table.12: (7 Days and 28 Days Normal Curing -weight loss in cylinder)

Id	7 days normal curing				28 Days normal curing			
	Before curing	After curing	Difference in Kg	Avg difference in Kg	Before Curing	After Curing	Difference in Kg	Average Difference in Kg
A1	13.1	12.9	0.12	0.11	13.01	12.9	.03	.05
	13.2	13.1	0.1		13.1	13.0	.07	
	13.1	12.9	0.13		13.01	12.9	.05	
M1	13.3	13.2	0.07	0.08	12.98	12.	.07	.06
	13.2	13.1	0.09		13.2	13.1	.06	
	13.2	13.1	0.08		13.2	13.1	.06	
M2	12.9	12.8	0.09	0.06	12.95	12.9	.04	.07
	13.0	12.9	0.05		13.13	13.0	.12	
	13.0	12.9	0.05		12.95	12.9	.05	
M3	13.2	13.1	0.1	0.76	12.97	12.9	.03	.08
	13	12.9	0.05		13.3	13.2	.12	
	13.2	13.1	0.08		13.3	13.2	.1	

Table.13: (7 and 28 Days H_2SO_4 Curing -weight loss in cylinder)

Id	7 Days H_2SO_4 Curing				28 Days H_2SO_4 Curing			
	Before curing	After curing	Difference in Kg	Avg difference in Kg	Before Curing	After Curing	Difference in Kg	Avg Difference in Kg
B1	12.98	12.91	.12		12.95	12.90	0.05	
	13.1	13.0	.1	.11	13.1	13.0	0.12	.0073
	12.98	12.91	.12		12.95	12.90	0.05	
G1	13.1	12.98	.12		13.25	13.11	0.14	
	13.25	13.1	.15	.13	13.21	13.14	0.07	0.11
	13.1	12.98	.12		13.2	13.11	0.14	
G2	13.2	12.98	.08	.07	13.12	13.0	0.12	
	12.98	12.93	.05		12.97	12.93	0.04	.93
	13.2	13.12	.08		13.12	13	0.12	
G3	13.2	13.1	.1		13.3	13.2	0.1	
	12.98	12.9	.03	.76	13.0	12.98	0.03	.076
	13.2	13.1	.1		13.3	13.2	0.1	

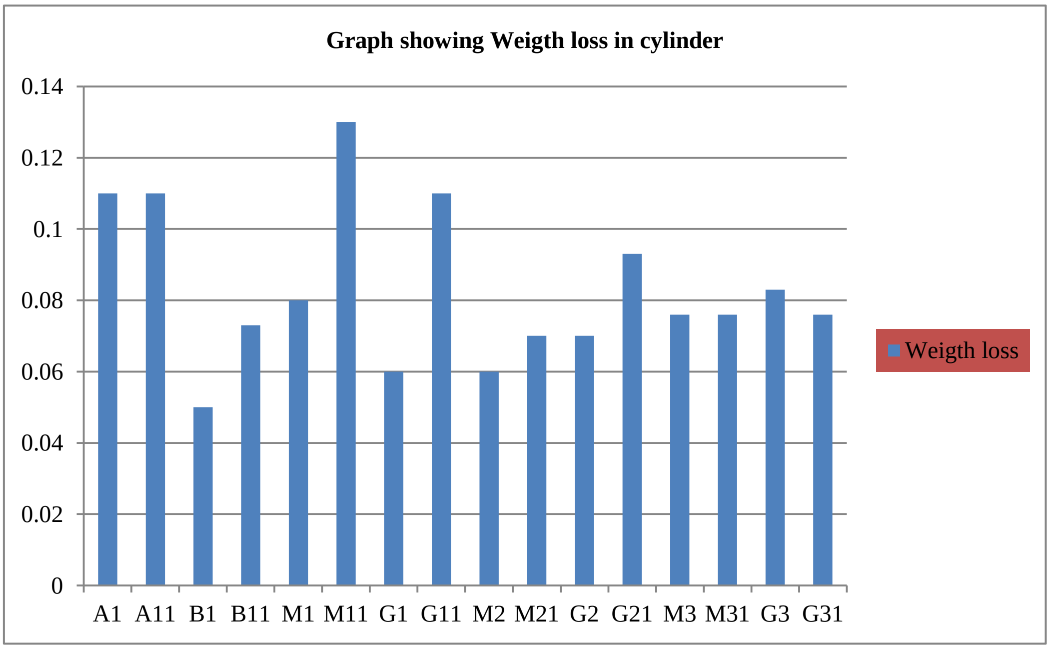

Fig.6: Change in Weight of Cylinder

F. Result analysis with respect to dimensions in cylinder:

The dimensions of M30 grade concrete (Conventional and granite powder concrete with GGBS) Cylinder specimens were measured before placing the specimens for 7 days & 28 days normal & acid curing. After the curing period of 7days & 28 days again the dimensions were checked and tabulated below. The purpose for this dimensions study was to check the effect of acid curing on the concrete specimens.

Table.14: (7 Days Normal Curing -Dimension Change)

ID	Diameter			Height		
	Erosion	Erosion in %	Average	Erosion	Erosion in %	Average
A1	1.34	0.89	0.88	1.51	0.50	0.52
	1.31	0.86		1.71	0.57	
	1.34	0.89		1.51	0.50	
M1	1.21	0.8	0.80	1.61	0.53	0.53
	1.23	0.82		1.63	0.54	
	1.21	0.8		1.61	0.53	
M2	1.20	0.8	0.80	1.41	0.47	0.47
	1.20	0.8		1.43	0.47	
	1.22	0.81		1.41	0.47	
M3	1.32	0.88	0.88	1.61	0.54	054
	1.33	0.88		1.65	0.55	
	1.32	0.88		1.62	0.55	

Table.15: (7 Days H_2SO_4 Curing -Dimension Change)

Id	Diameter			Height		
	Erosion	Erosion in %	Average	Erosion	Erosion in %	Average
A11	1.31	0.87	0.86	1.71	0.57	0.54
	1.41	0.84		1.51	0.50	
	1.31	0.87		1.71	0.57	
M11	1.47	0.98	0.92	1.62	0.54	0.54
	1.21	0.80		1.67	0.55	
	1.47	0.98		1.62	0.54	
M21	1.19	0.79	0.79	1.39	0.46	0.46
	1.19	0.80		1.40	0.46	
	1.21	0.79		1.40	0.46	
M31	1.30	0.86	0.86	1.62	0.54	0.54
	1.31	0.87		1.65	0.55	
	1,30	0.86		1.62	0.54	

Table.16: (28 Days Normal Curing -Dimension Change)

Id	Diameter			Height		
	Erosion	Erosion in %	Average	Erosion	Erosion in %	Average
B1	1.87	1.24		2.04	0.68	
	1.87	1.24	1.25	2.04	0.68	0.69
	1.92	1.28		2.19	0.73	
G1	1.53	1.02		2.23	0.74	
	1.79	1.19	1.13	2.14	0.71	0.73
	1.79	1.19		2.23	0.74	
G2	1.41	0.94		2.05	0.69	
	1.52	1.0	0.96	2.08	0.80	0.72
	1.41	0.94		2.05	0.69	
G3	1.87	1.24		2.41	0.80	
	1.87	1.24	1.25	2.31	0.77	
	1.92	1.28		2.41	0.80	0.79

Table.17: (28 Days H_2SO_4 Curing -Dimension Change)

ID	Diameter			Height		
	Erosion	Erosion in %	Average	Erosion	Erosion in %	Average
B11	1.87	1.24		2.01	0.67	
	1.92	1.28	1.25	2.04	0.68	0.67
	1.87	1.24		2.01	0.67	
G11	1.53	1.02		2.25	0.75	
	1.53	1.02	1.07	2.25	0.75	0.74
	1.79	1.19		2.17	0.72	
G21	1.41	0.94		2.01	0.67	
	1.52	1.0	0.96	2.03	0.67	0.67
	1.41	0.94		2.01	0.67	
G31	1.87	1.24		2.14	0.71	
	1.92	1.28	1.26	2.25	0.75	0.72
	1.92	1.28		2.14	0.71	

Graph showing Dimension loss in cylinder 7 days and 28 days normal and acid curing:

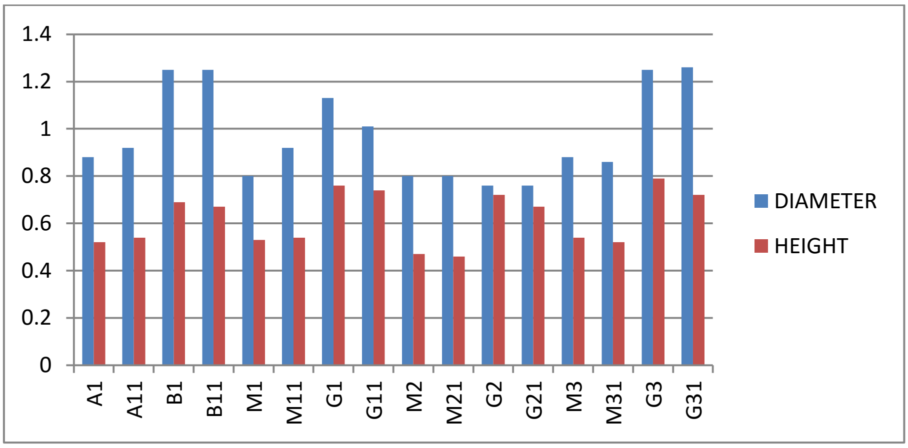

Fig.7: Change in Dimension of cylinder

G. Result analysis with respect to flexural strength:

The Compressive strength of concrete mix design was checked by casting and testing of concrete cube specimens of size 100mm × 100mm × 500mm after 7 days & 28days normal curing & acid curing as well. Obtained results are tabulated below.

Normal curing:

Table.18: Flexure test for 7 days and 28 days

ID	7 days Result		28 days Result	
	Load (kN)	Strength(N/mm)	Load(Kn)	Strength(N/mm)
A1	12.3	6.15	21	10.5
M1	11.2	5.6	22	11
M2	13.7	6.85	25	12.5
M3	11.3	5.65	20	10

H_2SO_4 Curing:

Table.19: Flexure test for 7 days and 28 days

ID	7 days Result		28 days Result	
	Load (kN)	Strength(N/mm)	Load(Kn)	Strength(N/mm)
B1	12.2	6.1	21	10.5
G1	11.4	5.7	23	11.5
G2	13.8	6.9	24	12
G3	11.5	5.75	22	11

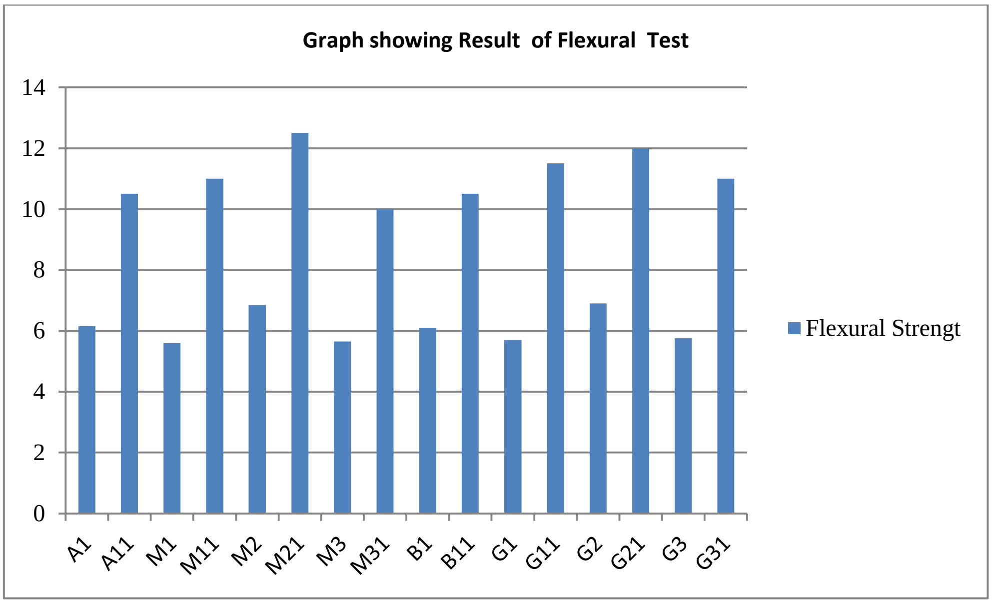

Fig.8: Average Flexural Strength

VI. CONCLUSION

The following conclusions could be arrived from this experimental study,from the above result analysis, following comments are concluded;

1. For 7 days normal curing the percentage reduction in dimensions of M30 grade conventional concrete and granite powder concrete with 25% GGBS are varies in between 0.83to 0.81

2. For 7 days Acid curing the percentage reduction in dimensions of M30 grade conventional concrete and granite powder concrete with 25% GGBS are varies in between 0.82 to 0.76%.

3. For 28 days normal curing the percentage reduction in dimensions of M30 grade conventional concrete and are varies granite powder concrete with 25% GGBS in between 1.17 to 1.13%

4. For 28 days Acid curing the percentage reduction in dimensions of M30 grade conventional concrete and granite powder concrete with 25% GGBS are varies in between 1.04 % to 1.31%.

5.Both 7 days and 28 days Normal curing and acid curing shows weight loss M30 grade conventional concrete and are varies granite powder concrete with 25% GGBS in between .06 to.08 and0.04 to 0.12

6. Compressive strength is high in granite powder concrete with 25% GGBS than of M30 grade conventional concrete from the both acid curing and normal curing results Form the present experimental study results & observations, it is cleared that construction work where the concrete is exposed to sulphate attack, granite powder concrete with 25% GGBS much suitable than Conventional concrete .From 15%, 25%, 35% replacement of GGBS with granite powder concrete 25% shows more positive results.

REFERENCES

[1] Dr. G. Prince Arulraj, Mr. A .Adin and Mr. T. Suresh Kannan "Granite Powder Concrete" Department of Civil Engineering, SNS College of Technology, Coimbatore, Vol.3, No.1, February 2013.

[2] Manasseh JOEL "Use of Crushed Granite Fine as Replacement to River Sand in Concrete Production" Civil Engineering Department University of Agriculture Nigeria, Issue 17, p. 85-96, July-December 2010.

[3] T. Felixkala and P. "Granite Powder Concrete" Partheeban, Dept. of Civil Engg, Sathyabama University, Chennai Vol. 3 No. 3 (Mar 2010).

[4] Felixkala T and Sethuraman V.S "Shrinkage Properties of HPC using Granite Powder as Fine Aggregate" , Volume-2, Issue-3, February 2013.

[5] Rafat Siddique, Department of Civil Engineering, Thapar " Effect of fine aggregate replacement with Class F fly ash on the mechanical properties of concrete" Institute of Engineering and Technology, Deemed University, Patiala, Received 28 February 2002; accepted 16 September 2002.

[6] Kanmalai Williams C. and Partheeban P "Mechanical Properties of High Performance Concrete Incorporating Granite Powder as Fine Aggregate" Felix Kala T, Department of Civil Engineering, Vol.2, No.1, July 2008.

[7] Dr. T. Felix Kala 1 "Effect of Granite Powder on Strength Properties of Concrete" , Department of Civil Engineering, Dr. M.G.R. Educational and Research Institute University, Maduravoyal, Chennai, Vol.2, Issue 12 Pp 36-50 (May 2013) .

[8] British Standards Institution (2006) BS 8500: 2002 Concrete. Complementary British Standard to BS EN 206-1:

[9] British Standards Institution. BS 1881:1988: Part 124: Testing concrete: Methods for analysis of hardened concrete.

[10] Building Research Establishment (2005). BRE Special Digest 1: Concrete in Aggressive Ground Third Edition. CRC, London.

[11] Building Research Establishment (2007). Radon: guidance on protective measures for new buildings. BR 211.

[12] Commentary on the Building Regulations 1965.

[13] Energy Saving Trust (2006). Practical refurbishment of solid-wall houses. Guide CE 184.

[14] Environment Agency (2003). Hazardous Waste: Interpretation of the definition and classification of hazardous waste. Technical Guidance WM2, Second Edition.

[15] Environment Agency (2007). What is Hazardous Waste? A guide to Hazardous Waste Regulations and a List of Waste Regulations in England and Wales. Guide HWR01.

[16] IS: 10262:2009, "Recommended Guidelines for Concrete Mix Design" Indian Standard Institution, New