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Research Article

High Strength Concrete with Pond-Ash as Partially Replaced by Fine Aggregate and Fine Fly-Ash, Alccofine as Cement

Nilesh R. Parmar [a*] , Vikunj K. Tilva[b], Sunil V. Jaganiya[c], Pritesh R. Rathod [d]

[a,b,c,d] Assistant Professor, Civil Engineering, GIDC Degree Engineering College, Gujarat, India
[a*]**Corresponding author:** nilesh.dip83@gmail.com

Abstract

India is a fast developing country with a large requirement of power for industrial sectors and households. Every year this power requirement gets higher and higher and 75% of this power is generated from thermal sources. Coal is the primary ingredient for this thermal power generation and 90% of power is generated using coal. Although the quality of coal in India is not the same in every area, some are of low quality with 35 per cent ash material. Every year more than 100 million of MT coal ash is generated while burning up this coal and it is predicted that 170 million MT by 2012. Now to avoid generating this bulk amount of ash production researchers are looking into pond ash for its fine particles and Pozzolanic properties. Researchers have proposed to use alccofine and fine fly ash as a substitute of cement and pond fly ash. In mix, cement will be replaced by alccofine 4% and fine fly ash by 26% and pond fly ash will be varied by 10%, 20% and 30% according to the M60 mixture. 7, 28, 56 and 90 days of readings will be recordedand tested for mechanical properties, cube compressive strength, Flexural strength and compacting factor.On these different mixes. Eco friendly high strength concrete development is the aim of this project.

Introduction

A pond of fly ash is a manipulated structure for the dumping of fly ash and base ash. A pozzolan is ultramafic and aluminum that, in itself, dominates less or no polymeric value yet that will, in equally divided type an in existence of aqua response chemically escorted by calcium hydroxide at normal temperature to shape compounds controlling cementations properties. Pozzolanic solid materials are used widely all across the world in those places that have major users of nuclear, oil, gas and power manufacturers. The usage of these concretes is enlarging as the days pass because of its higher level constructional performance, background friendliness and enthusiasm preserving implications. The research is being organized on the application of ash fly, fierce ash, fierce pumice, crumbled fuel ash, draught slag and smoke of silicic oxide as replacement material of cement. Fly ash and other materials are Pozzolanic elements for the reason of their response with lime release at the time of Drench of the cement. These substances can upgrade power of concrete and the amount the received power can also diminish values of warmth released that is useful for whole concrete. Mineral commixture that includes concrete applied broadly all over the world for improved performance and for economic and biological system.

High Power Concrete

It is crucial for understanding that the elevated strength and elevated production material are not the same thing. The concrete is stated as power concrete mainly, by calculating the binding strength at a specific time. In 1970, specialists assumed that the practical restriction of prepared assorted concrete would be remote to outstrip a constrictive power more than 11,000 (psi) pound square inch. From the last 20 years, the improvement of high powered concrete has helped builders to meet and outdo the estimates very easily [1]. The basic difference between elevated powered concrete and basic concrete connects with the constrictive strength that mentions the highest hostility of a sample of concrete to used pressure. Even though, there is no accurate point of differentiation, between the elevated powered concrete and normal powered concrete, the elevated powered concrete is defined as concrete with constrictive power more than 6000 pic by the American concrete institution.

In addition, there is no specific point of differentiation between the elevated powered concrete and radical elevated powered concrete that have much higher constrictive power than elevated powered concrete and other better properties. Construction of elevated powered concrete includes creation of optimal application of the general elements that represents basic strength concrete. Manufacturers of elevated powered concrete know about the factors that can affect constrictive strength and also know the way to manipulate those elements to achieve the necessary strength [2]. In addition to choosing an elevated quantity of Portland cement, manufacturers optimize collection and then optimize the amalgamation of elements by assorting the proportions of aqua, collection, cement and admixtures. Normal strength in the testing is 20-50 Mpa that enhances the knowledge of the experiment better. On the other and, >150Mpa is the superiority is the progress that manages the performance to evaluate the structure in the experiment.

Normal Strength	20-50 MPa
High Strength	50-100 MPa
Ultra High Strength	100-150 MPa
Especial	> 150 MPa

Figure 1: Classification of Concrete

Literature review

Various different researches have been done by the examiners on different elements about the elevation of temperature. The following are some of the discussions:

As per the views of some studies, high temperature can effect machine likes parameters, stage constitution and interfacial of concrete of silica flour. The indurated concrete was conductively served for 2 hour at 100, 400, 600 and 800 degrees [3]. The outcomes showed that the inclusion of silica flour to OPC enhances the performance of the manufactured commixture concrete as soon as it was exposed to higher temperature till 400 degree Celsius.

Many researchers present their research based on hostility to fire of cement ash limes including elevated volume of fly ash. Sudden fire breakout, terrorist strike and various other types of outburst makes a rapid change of the temperature for a momentary period. Then each layer is filled in and each layer is tamped with twenty-five strokes using the rounded end of the tamping rod. For ensuring the exact filling of the mould, the top layer is rodded and the concrete is struck off level with a tamping rod. In those circumstances, the element properties are important parameters in diminishing the expected damage because of the elevated temperature [4].The outcome of the test indicates that ash lime including 50% of fly ash, a substitution of cement, shows higher resistance to elevated

temperature. Also, binding and bond powers of ash lime including various per cent of fly ash originally improves with the improvement of temperature yet after 200 degree Celsius, it diminishes with the additional inflation of the temperature.

Some investigators conducted their research based on the improvement of elevated strength ash limes with increased thermals and hostility to acids. As GBFS (Granulated Blast Furnace Slag) cement, including maximum 60% slag, is even so often used for repairing the materials applied at halfway temperatures of 150 to 300 degree Celsius. It was initiated that the improvement of GBFS-Portland cement-dependent elements can be gained with the assistance of silica fume and a super masticator. The investigation was done on the impact of different plastic masticators on the binding and flexural powers of silica fume blasts furnace slag Portland cement ash limes [5]. Another relative study was based on concrete mixes, testimonial mix in the absence of an extra and that with the commixture. The concrete was revealed for about 2 hours at three different levels of elevated temperature that is 200, 400 and 600 degree Celsius in the absence of any foist lead at the time of heating. Five different types of commixtures were applied, super masticator, masticator, limiter and water diminishing commixture, a gas pedal and an air boarding commixture. Machine-like properties of concrete were considered at various elevated temperatures that include binding strength, breaking tensile power, modulus of flexibility and maximum strain [6]. The test outcomes displayed a depletion in the properties of studies, by various rates for various other additions and for every individual temperature, the diminishing rate was very much restrictive at a temperature till 200 degree Celsius yet was explicit at 400 and 600 degree Celsius.

Materials Used (Table)

- Cement

Sr no.	characters	result	As per IS: 8112-1939
1	Specific Gravity	3.14	3.15
2	Initial Setting Time	35 Min	>30 Min
3	Final Setting Time	225 Min	<600 Min
4	Fineness of cement	10%	10%
5	Compressive Strength 3 days 7 days 28 days	23.5 35.8 60	>23 >33 >53

Figure 2: OPC 53 grade properties to IS: 8112-1939

- Fly ash

Property	Pond Ash
Specific gravity	2.1 - 2.7
Dry Unit Weight	7.07 - 15.72 kN/m3
Plasticity	None
Absorption	0.8 - 2.0 %

Figure 3: substantial assets of pond fly ash

Sr.no	Type of test	Test Method	Result
1	CaO%	IS-1727	0.25
2	SiO2%	IS-1727	73.6
3	Al2O3%	IS-1727	9.1
4	MgO%	IS-1727	0.05
5	SO3%	IS-1727	0.01
6	NaO2%	IS-4032	0.004
7	K2O%	IS-4032	0.002
8	Total Chloride%	IS-12423	0.002
9	L.O.I	IS-1727	3.7
10	Fe2O3%	IS-4031	1.35
11	TiO2%	IS-4031	Nil
12	P2O3%	IS-4031	0.0001

Figure 4: chemical substances of pond fly ash

Sr. no	Characteristic	Results
1	Lime reactivity ,N/mm2	8 min
2	Retention On 25 Micron Sieve	>0.5
3	Drying Shrinkage, percentage	0.06
4	Soundness by Autoclave expansion, percent	0.05
5	Specific gravity	2.2
6	Compressive Strength, as percent of strength of corresponding plain cement mortar cubes	80

Figure 5: physical assets of fine fly ash

Sr No	Type of test	Test Method	Result obtained
1	CaO%	IS-1727	0.50
2	SiO_2%	IS-1727	67.60
3	Al_2O_3%	IS-1727	11.30
4	MgO%	IS-1727	0.10
5	SO_3%	IS-1727	0.06
6	NaO_2%	IS-4032	0.035
7	K_2O%	IS-4032	0.005
8	Total Chloride%	IS-12423	0.008
9	Loss on Ignition%	IS-1727	2.60
10	Fe_2O_3%	IS-4031	1.15
11	TiO_2%	IS-4031	Nil
12	P_2O_3%	IS-4031	0.0002

Figure 6: chemical assets of fine fly ash

Fineness (cm2/gm)	Specific Gravity	Bulk Density (Kg/m3)	Particle Size Distribution		
			d 10	d 50	d 90
12000	3.1	700-900	1.5µ	5.0µ	9µ

Figure 7: bodily substances of alccofine

Cao	So3	Sio2	Al2O3	Fe2O3	MgO	Cl
61-64%	2-2.4%	21-23%	5-5.6%	3.8-4.4%	0.8-1.4%	0.03-0.05%

Figure 8: chemical properties of alccofine

Property	Fine Aggregate	Coarse Aggregate
Specific gravity	2.63	2.61
Fineness modulus	2.25	6.61
SSD absorption (%)	0.86	1.12
Void (%)	36.2	39.6
Unit weight	1690	1615

Figure 9: physical assets of aggregate

Experimental Program

There are many important tests available for measuring concrete quality, and some of those are, Slump test, Compressive strength test, Water Permeability test, Rapid chloride Ion Penetration Test, Water Absorption test, Initial surface absorption test, Flow test, Compacting factor test [9]. Three types of tests are held to gain insight in this project and the tests are - Slump test, Flow test, Compacting factor test and the tests will be discussed further.

Slump test

As per IS 1199-1959 the slump test is conducted to check the workability of the mix. The mould is internally cleaned thoroughly and it is placed on a smooth, horizontal, rigid and non-absorbent surface. The mould is separated in 4 layers of approximately the same size [18]. Then each layer is filled in and each layer is tamped with twenty-five strokes using the rounded end of the tamping rod. For ensuring the exact filling of the mould, the top layer is rodded and the concrete is struck off level with a tamping rod [7]. The mould is raised carefully in a vertical direction from the concrete immediately. Thus the difference between the height of mould and the highest point of the specimen is tested.

Flow test

In case of flow test the mould is separated in two layers and these approximately equal sized layers are hit by straight round metal rod of 0.8 cm radius and 60 cm long.[13]. The strokes are distributed in a uniform manner thus it can penetrate into the underlying layer [11]. After hitting the upper layer the surface of the substance is struck off with a towel to fill the mould with accuracy. Applying upward pull, the mould is separated and the base table is taken at a height of 12.5 m and dropped, 15 times. The displacement of the layers will also evaluate the activities better to manage the entire activities in the experimental area.

Compacting factor test

Using a hand scoop the slab is placed on the higher hopper and the hopper is filled up with brim. The trap door is exposed so that the concrete can drop down to the next hopper [15]. After opening the second hopper the concrete falls into the cylinder. Excess amount of concrete is then omitted with a towel [8]. Fully compacted concrete weight and the derived concrete weight are compared and this ratio is known as compaction factor. The concrete was revealed for about 2 hours at three different levels of elevated temperature that is 200, 400 and 600 degree Celsius in the absence of any foist lead at the time of heating. Five different types of commixtures were applied, super masticator, masticator, limiter and water diminishing commixture, a gas pedal and an air boarding commixture.

Test Results

Sr. No.	Mix Proportion	Slump (mm)
1	G1	250
2	G2	230
3	G3	190
4	G4	260
5	G5	210
6	G6	200

Figure 10: Slump test results

Sr. No.	Mix Proportion	Flow Dia(mm)
1	G1	550
2	G2	600
3	G3	300
4	G4	610
5	G5	510
6	G6	300

Figure11: Flow test results

Sr. No.	Mix Proportion	C.F.
1	G1	0.98
2	G2	0.98
3	G3	0.98
4	G4	0.98
5	G5	0.98
6	G6	0.98

Figure12: Compacting factor test results

Mix Proportion

In this project fine fly ash and alccofine is replaced with fly ash and cement to produce six mixture proportions. In G1, G2 and G3 cement will be substituted with 4% alccofine and fine fly ash by 26%. Pond fly ash is varied in 10%, 20% and 30%. Mix GA also has4 per cent alccofine along with 26 per cent of fine fly ash instead of cement. Similarly the GB mix has 6% alccofine and 24% fine fly ash. This process will implement the process better t enhance the result in the experimental area. On the other hand, G1 and G2 can be aligned to implement the performance better to create a stable approach f the work.

M 60	G1	G2	G3	G4	G5	G6	GA	GB
Cement(kg)	420	420	420	420	420	420	420	420
Fly ash(kg)	156	156	156	144	144	144	156	144
Aalcofine(kg)	24	24	24	36	36	36	24	36
Water(kg)	198	210	221	198	210	221	179	179
F.a(kg)	676.8	601.6	526.4	676.8	601.6	526.4	752	752
P.a(kg)	75.2	150.4	225.6	75.2	150.4	225.6	-	-
C.a(20) (kg)	672	672	672	672	672	672	672	672
C.a(10) (kg)	448	448	448	448	448	448	448	448
Admixer(kg)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
W/b	0.33	0.35	0.37	0.33	0.35	0.37	0.263	0.263

Figure13: Mix Proportion 1

M60	ALCCOFINE	FINE FLY ASH	POND FLY ASH
G1	4%	26%	10%
G2	4%	26%	20%
G3	4%	26%	30%
G4	6%	24%	10%
G5	6%	24%	20%
G6	6%	24%	30%
GA	4%	26%	0%
GB	6%	24%	0%

Figure14: Mix Proportion 2

Test & Results

Marsh cone test

In this test the concrete solution has 70% of cement, 22% of fly-ash and 8% Alccofine.

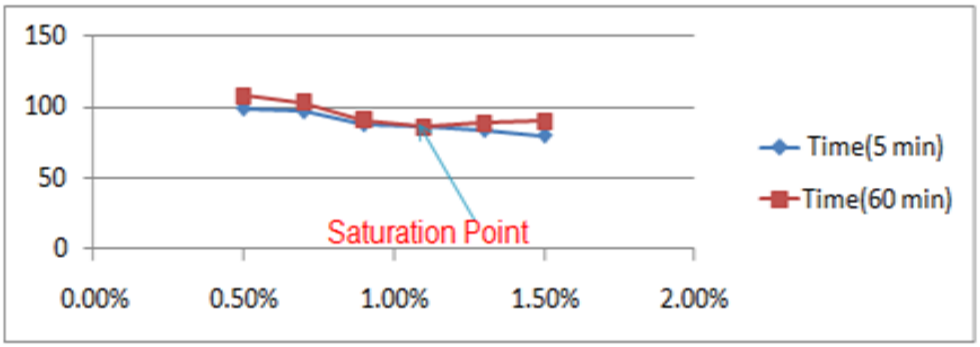

Figure 15: Graph of marsh cone test

Rebound Hammer

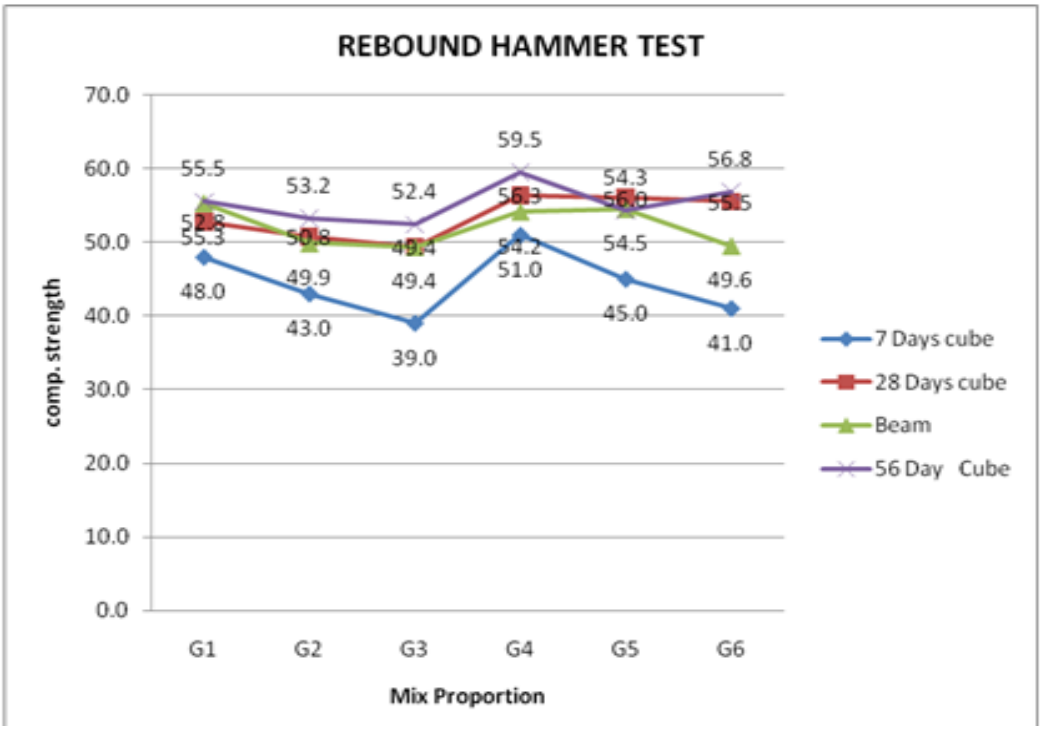

Figure 16: Graph of composition Strength of varying days

Mix Pro.	7 Day	28 Day	56 Day	Beam
G1	48.0	52.8	55.5	55.3
G2	43.0	50.8	53.2	49.9
G3	39.0	49.4	52.4	49.4
G4	51.0	56.3	59.5	54.2
G5	45.0	56.0	54.3	54.5
G6	41.0	55.5	56.8	49.6

Figure17: Compressive Strength of distinct timelines and 28days beam Ultrasonic pulse velocity test

Mix Proportion	Cube 7 day	Cube 28 day	Beam
G1	4.26	4.17	4.03
G2	4.24	4.41	4.17
G3	4.17	4.55	4.07
G4	4.52	4.23	3.99
G5	4.39	4.42	4.05
G6	4.26	4.19	3.95

Figure18: Ultrasonic pulse velocity results of different days cube and beam (28days)

Sr. No	Pulse velocity by Cross Probing (Km/sec)	Concrete Quality Grading
1	Above 4.5	Excellent
2	3.5 to 4.5	Good
3	3.0 to 3.5	Medium
4	Below 3.0	Doubtful

Figure19: Velocity criteria

Compressive Strength of cube

MIX	7-DAY MPa	28-DAY Mpa	56-DAY MPa
G1	39.5	38.80	60.77
G2	36.5	42.00	61.17
G3	32	40.20	51.05
G4	50.40	62.00	70.76
G5	46.3	55.90	65.43
G6	42.1	59.40	68.58
GA	47.36	58.82	72.9
GB	54.67	63.45	66.12

Figure 20: results of three different days cube

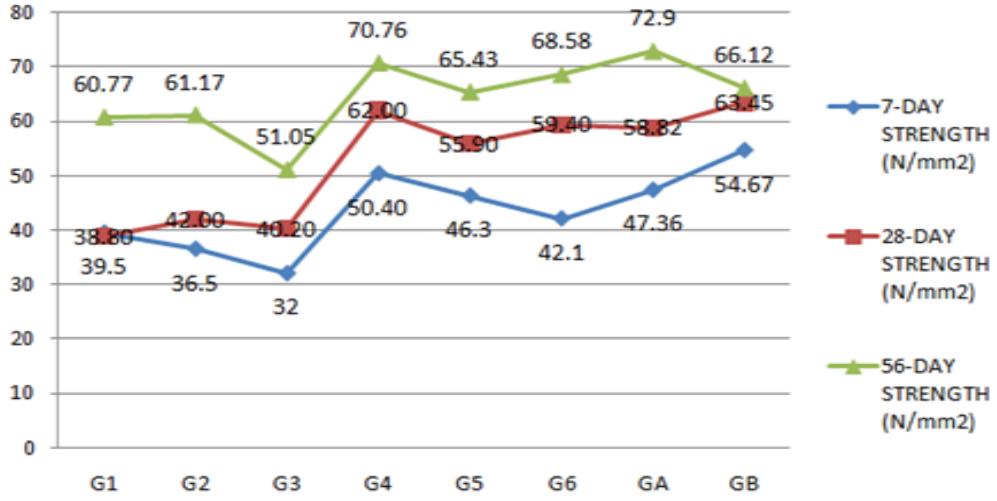

Figure 21: Graph of comp. Strength on three different days cubes

Split Tensile Strength of Cylinder

MIX	28-DAY	56-DAY	LIMIT
G1	3.57	4.79	5.42
G2	3.76	4.13	5.42
G3	2.89	4.71	5.42
G4	3.98	4.70	5.42
G5	3.46	4.24	5.42
G6	4.49	5.13	5.42
GA	4.32	5.34	5.42
GB	3.95	5.33	5.42

Figure 22: results of two different days cylinder

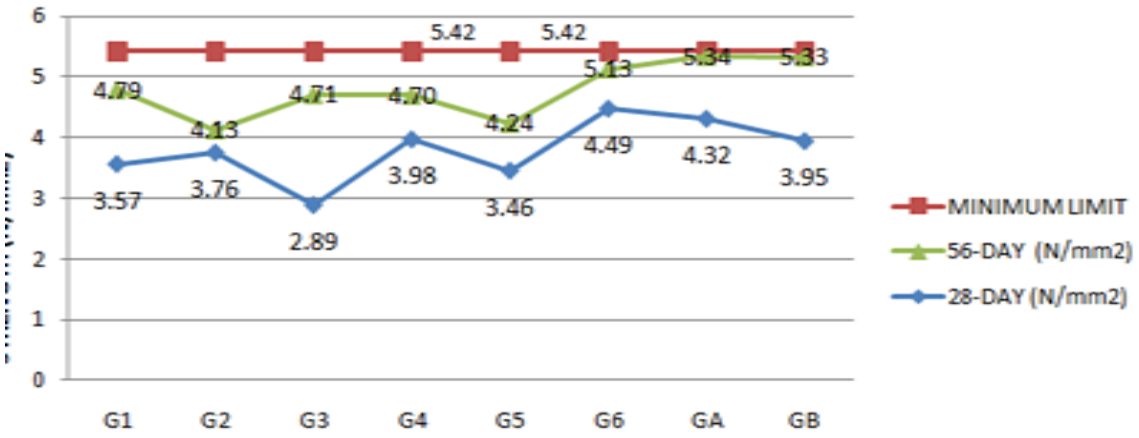

Figure 23: Graph of tensile Strength on different days

Mix	G1	G2	G3	G4	G5	G6	GA	GB
Flexural strength	5.5	4.8	5.07	4.8	4.6	4.8	5.5	6.0

Table 24: Flexural bending strength results

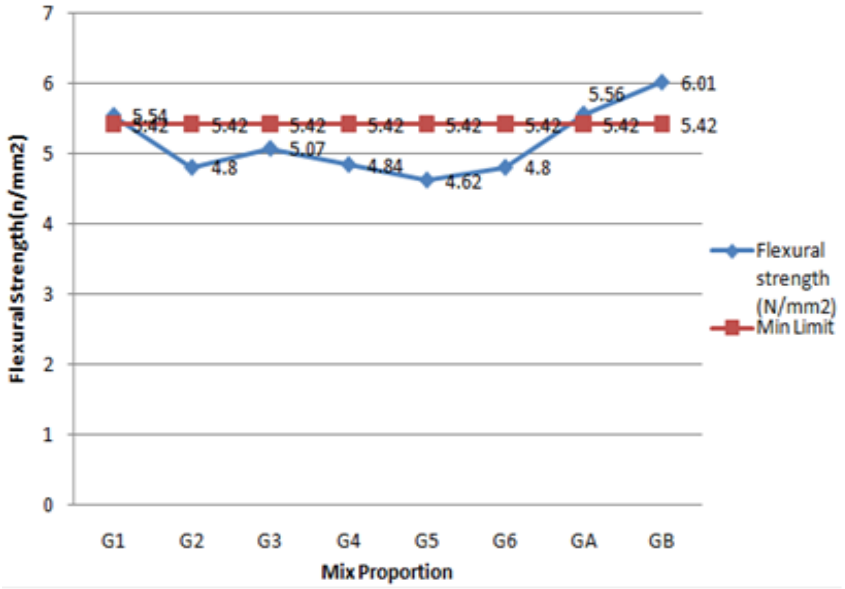

Figure 25: Figure of flexure strength

Conclusion

The factors measured from this project to determine quality of concrete are Work efficiency, strength of compression, Flexural strength and splitting tensile strength. In case of workability, with addition in pond fly ash the workability got decreased as the water demand also got increased. Increased dosage in Super plasticizer is incorporated with it. Compressive strength has been seen highest with 6 per cent alccofine present as cement and 10 % of pond ash as a substitute. At 7th day compressive strength is 50.4 Mpa and at 28 day 62.0 Mpa and 67.7 Mpa at 28th day.4.84 Mpa flexural strength can be seen for alccofine present 6% and pond ash available 10%, usage at 28 days. The split tensile strength of the cylinder is not giving tensile strength up to 5.42 Mpa the expected limit. Areas with higher availability of pond ash such as Mumbai, Goa and Kerala can use it as replacement of sand with lower cost and this can benefit the environment also.

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