GEOPOLYMER CONCRETE WITH PARTIALLY REPLACEMENT OF GRANITE WASTE A FINE AGGREGATE

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ABSTRACT :- *Granite wastes are generated from granite polishing industry or granite cutting industry. Disposal of granite waste is a major problem. As the granite waste is reactive it cannot be disposed into land which increases land pollution. As per world health organization report production of cement concrete accounts to about 5 % of the man made pollution for global warming. The granite waste because of its fineness and size it can be effectively used as a replacement of sand. An attempt was made to introduce granite aggregate into geo polymer concrete.. The paper present results of experimental program on mechanical properties such as compressive strength, flexural strength, and split tensile strength of Geopolymer concrete in two composite 90% fly ash, 10% GGBS or lime with varying percentage of granite waste in Ambient Curing.*

Keyword: - Geopolymer concrete, Fly ash, Strength, Granite waste, Lime, GGBS curing etc.

1INTRODUCTION

The production of Portland cement is an energy-intensive process that releases a very large amount of greenhouse gas into the atmosphere. Therefore totally replace of Portland cement by cementious material such as geopolymer. In terms of geopolymer technology could significantly Reduces the co2 emission to atmosphere caused by cement industries.fly ash is by product of thermal power plants which facing the problem of its disposal. By using fly ash in concrete will help to reduction of co2 emission. Granite tiles manufacturing industries are also producing tones of granite dust during the manufacturing process. When dumped on land, these wastes adversely affect the productivity of land. Used of this granite waste in concrete by partially replacement of sand will help reducing the pollution of land.

2LITREATURE REVIEW

P.pavanil, A.Roopa, Dr. J. Guru Jawahar, C.Sreenivasulu studied on Geopolymer concrete partially replacement of granite slurry powder as sand(0 %,20%,40%& 60%).Sodium silicate and sodium hydroxide solution has been used as alkaline activator. They studied that properties of concrete such as compressive strength, flexural strength, Split Tensile strength for 7,28 & 90day of Ambient room temperature. From this result concluded that due to Granite slurry increases the as compressive strength , flexural strength, Split Tensile strength of concrete.

Eliyas Basha Shaik , Sreenivasulu Reddy studied Geopolymer Concrete with the replacement of granite Aggregate as Fine Aggregate. they concluded that strength of geopolymer concrete increases with increase in alkalinity of NaOH. They studied the properties of concrete such as compressive strength, flexural strength, Split Tensile strength of concrete. by replacement of granite with various percentage.

3 OBJECTIVES OF INVESTIGATION

To know the fresh concrete properties of Granite waste concrete.

To study the effect of Granite Waste on compressive strength, flexural strength and split tensile strength of geopolymer concrete.

Comparison of Engineering properties hardened geopolymer Concrete by replacement of Partially Granite Waste a fine Aggregate With Ambient Curing By replacement of fly ash 10 % Lime & GGBS

4 METHODOLOGY

4.1Material

a. fly ash

In present experimental work, low calcium, class F dry fly ash obtained from Dirk India put limited, was used as the base material. Fly ash(pozzocrete60) is high efficiency class F pozzolanic material confirming to BS 3892, is obtained by after processing of power station fly ashes resulting from the combustion of pulverized coal.

b. alkaline liquid

Sodium silicate and sodium hydroxide solution was chosen as the alkaline solution. This is taken by as per concrete mix design. Sodium-based solutions were chosen because they were cheaper than Potassium-based solutions. The sodium hydroxide solids were either technical grade in flakes form (3 mm), with a specific gravity of 2.130, 97% purity. The sodium hydroxide (NaOH) solution will be prepared by dissolving either the flakes or the pellets in water. The mass of NaOH solids in a solution varied depending on the concentration of solution expressed in terms of molar, M.F for instance, NaOH solution with concentration of 13M consisted of 13 x 40= 520 grams of NaOH solids (in flake or pellet form)per liter of the solution solution, where 40 is the molecular weight of NaOH.

Table-4.1 1:Chemical composition of sodium Silicate ($Na_2 SiO_3$)

Mix	Na_2O	SiO_2	Water Content	Total Solids
1	14.53%	23.72%	61.75%	38.25%

c. fine aggregate

Locally available natural river sand is used confirming to IS 383-1970. Properties of aggregate are as shown in table.

d. coarse aggregate.

The aggregate of size 20mm &12.5mm were used confirming to IS 383-1970.Properties of aggregate are as shown in table.

Table -4.2.:Properties of aggregate

Properties	Coarse Aggregate	Coarse Aggregate	Fine Aggregate	Granite waste
Type	Crushed angular	Crushed angular	Spherical (River sand)	Crushed Regular
Maximum Size	20mm	12.5mm	4.75 mm	4.75
Fineness modulus	2.55	2.51	2.77	2.72
Specific Gravity	2.70	2.65	2.63	2.67
Water Absorption	0.67%	0.7%	1.32%	1.23%
Impact value	9.50%	9.62%	-	-
Crushing value	18.58%	18%	-	-

e. water

Water just plays the role of enhancing the workability of geopolymer.

f. lime

The locally available hydrated lime used for ambient curing. Replacement of lime as fly ash by 10% for ambient curing

g.ground granulated blast furnace slag: Replacement of GGBFS as fly ash by 10% for ambient curing..

4.2 Concrete Mix Design-

As Geopolymer concrete is new invention, the procedure for mix design of conventional concrete as per the procedure of Bureau of Indian Standards IS 10262: 2009 is not applicable. In the present study, Mix design procedure for geopolymer concrete by prof. S.V.Patankar is used for M30 grade of concrete.9 cubes were casted for each proportion and tested after curing for 7 days, 14 days and 28 days (3each). Three beams and three cylinders specimens were casted for each proportion and tested after curing for 28 days.

Mix Design For Grade M 30
Target Mean Strength= 38.5 N/MM

Table – 4.2: Concrete mix Designation

Sr.No.	Mix	DESIGNATION 10%REPACEMENTOF LIME AS FLY ASH	DESIGNATION 10%REPACEMENT OF GGBS AS FLY ASH
1	0%Granite.waste Replacement	GL0	GG0
2	5%Granite.waste Replacement	GL5	GG5
3	10%Granite.waste Replacement	GL10	GG10
4	15%Granite.waste Replacement	GL15	GG15
5	20%Granite.waste Replacement	GL20	GG20
6	25%Granite.waste Replacement	GL25	GG25
7	30%Granite.waste Replacement	GL30	GG30

Table- 4.4: Quantity of materials required per cubic meter for M30 grade of geo polymer concrete is shown in below.

MIX	GL/GG 0	GL/G G5	GL/GG 10	GL/ GG1 5	GL/ GG2 0	GL/ GG2 5	GL/GG 30
Fly ash (KG)	432	432	432	432	432	432	432
Lime /GGBF S KG)	48.5	48.5	48.5	48.5	48.5	48.5	48.5
NaOH	56.05	56.05	56.05	56.0 5	56.0 5	56.0 5	56.05
Na2sio 3 KG)	112.10	112.1 0	112.10	112. 10	112. 10	112. 10	112.10
Sand KG)	631.05	600.0 7	568.49	536. 91	505. 33	473. 75	442.17
Granit e KG)	0	31.58	63.16	94.5 4	126. 32	157. 9	189.48
Coarse Aggreg ate	1173.0 7	1173. 07	1173.0 7	1173 .07	1173 .07	1173 .07	1173.0 7
Water(lit)	110	110	110	110	110	110	110
Extra Water	13.16	13.16	13.16	13.1 6	13.1 6	13.1 6	13.16

A Compressive Strength Test:

A cube compression test was performed on standard cubes of GPC of size150mm x 150mm x 150 mm after 3 days, 7 days and 28 days after ambient curing

Table-4.5: 7th day&14thDay 28th Day compressive strength

SPECIMEN	7DAYAVG. COMP. STRENGTH N/mm2	14DAYAVG. COMP. STRENGTH N/mm2	28DAYAVG. COMP. STRENGTH N/mm2
GL0	13	25.65	39.07
GL5	13.20	26.21	39.40
GL10	13.42	26.41	39.97
GL15	13.50	26.45	40.65
GL20	13.68	26.72	41.01
GL25	13.85	26.83	42.02
GL30	13.73	27.74	40.68

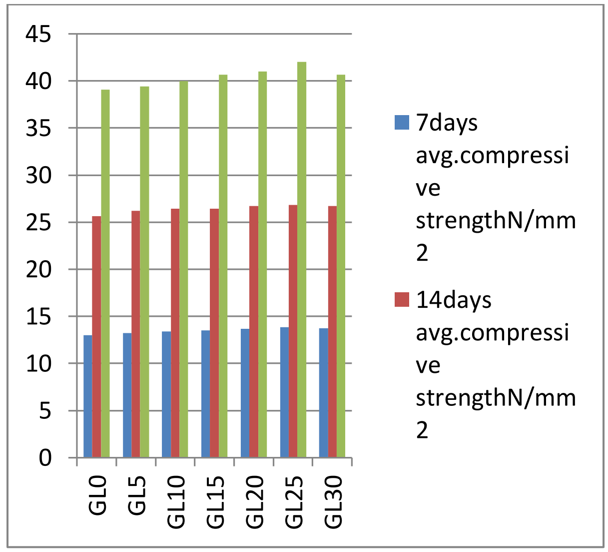

Fig4.1 7th, 14th&28th Day Compressive Strength

Table4.6:7thday&14thDay&28THcompressive strength

SPECIMEN	7DAYAVG. COMP. STRENGTH N/mm2	14DAYAVG. COMP. STRENGTH N/mm2	28DAYAVG. COMP. STRENGTH N/mm2
GG0	12.82	25.59	38.78
GG5	13	25.95	39.03
GG10	13.11	26.05	39.21
GG15	13.28	26.15	39.65
GG20	13.45	26.18	39.78
GG25	13.68	26.30	40.31
GG30	13.55	26	39.91

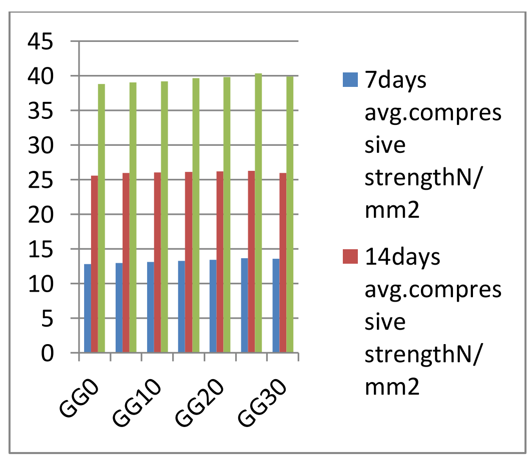

Fig.4.2 7th ,14th&28th Day Compressive Strength graph of geopolymer concrete.

B Flexural Strength Test

In flexure test, the Standard beam specimen of size 100mm x 100mm x 500mmwere supported symmetrically over a span of 400mm in the machine in such a manner at the load is applied uppermost surface as cast in the mould

Table-4.7: 28th Day Flexural strength geopolymer concrete

SPECIMEN	28DAYAVG. FLEXURAL. STRENGTH N/mm2
GL0	5.08
GL5	5.26
GL10	5.44
GL15	5.7
GL20	5.91
GL25	6.22
GL30	6.01

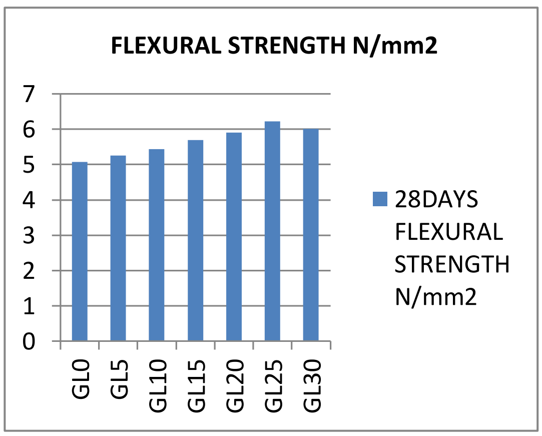

Fig.3 28th Day flexural Strength graph of geopolymer concrete

Table 4.8 28th Day Flexural strength geopolymer concrete

SPECIMEN	28DAYAVG. FLEXURAL. STRENGTH N/mm2
GG0	4.97
GG5	5.12
GG10	5.26
GG15	5.48
GG20	5.51
GG25	5.86
GG30	5.73

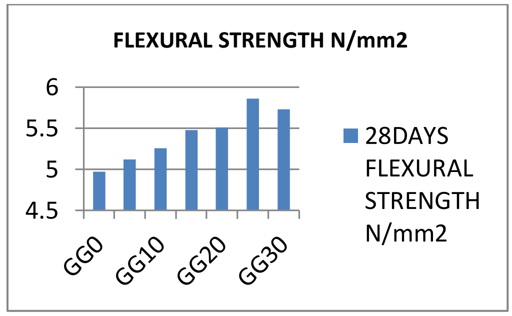

Fig.4.4 28th Day flexural Strength graph of geopolymer concrete

C. Spilt Tensile Test

The split tensile test conducted on cylinders of 150mm dia.x300mm height. Split tensile strength of cylinder specimens is determined by placing between the two plates of Compression Testing Machine.

Table-4.9:28th Day Split Tensile strength geopolymer concrete with replacement of fly ash by lime.

SPECIMEN	28DAYAVG. SPLIT TENSILE. STRENGTH N/mm2
GL0	4.37
GL5	4.49
GL10	4.54
GL15	4.61
GL20	4.72
GL25	4.73
GL30	4.58

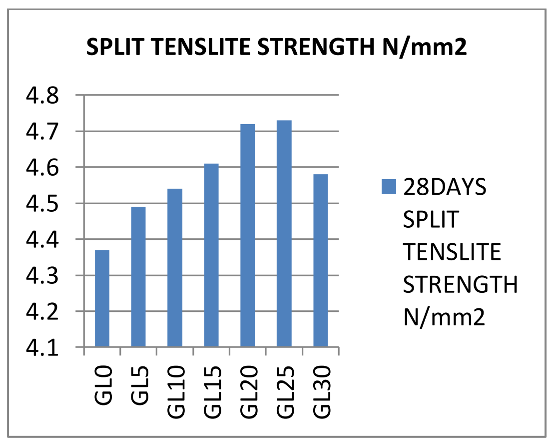

Fig.4.5 28th Day Split Tensile Strength graph of geopolymer concrete

Table-4.10:28th Day Split Tensile strength geopolymer concrete

SPECIMEN	28DAYAVG. SPLIT TENSILE.STRENGTH N/mm2
GG0	4.32
GG5	4.37
GG10	4.52
GG15	4.53
GG20	4.57
GG25	4.60
GG30	4.55

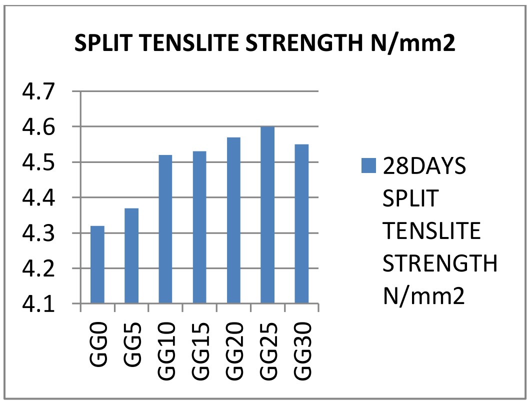

Fig4.5 28th Day Split Tensile Strength graph of geopolymer concrete

D Rebound Hammer Test (IS: 13311 (Part 2) – 1992).

Rebound hammer test is used to be finding the compressive strength of concrete members.

Fig.6 28th Day Rebound hammer test of geopolymer concrete.

Table 4.11: 28thDay rebound compressive strength geopolymer concrete.

SPECIMEN	28DAY.AVG.REBOUN COMP.STRENGTH N/mm2
GL0	39.18
GL5	39.75
GL10	40.11
GL15	40.61
GL20	41.75
GL25	42.18
GL30	41.06

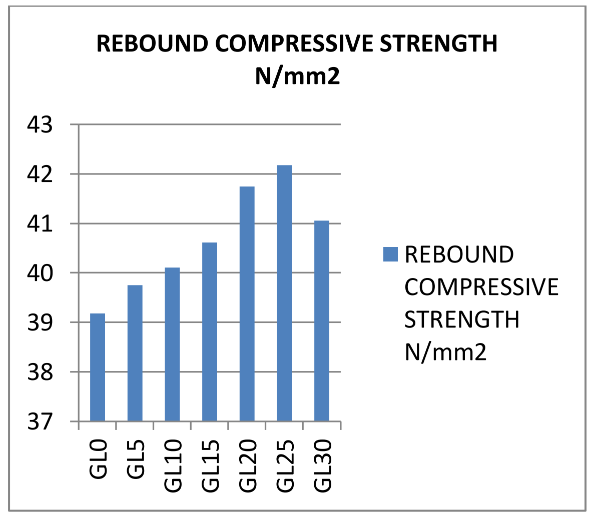

Fig.7 28th Day rebound hammer compressive strength of geopolymer concrete

Table 12: 28thDay rebound compressive strength geopolymer concrete

SPECIMEN	28DAY.AVG. REBOUND COMP.STRENGTH N/mm2
GG0	39
GG5	39.23
GG10	39.45
GG15	40.03
GG20	40.61
GG25	41.7
GG30	40.88

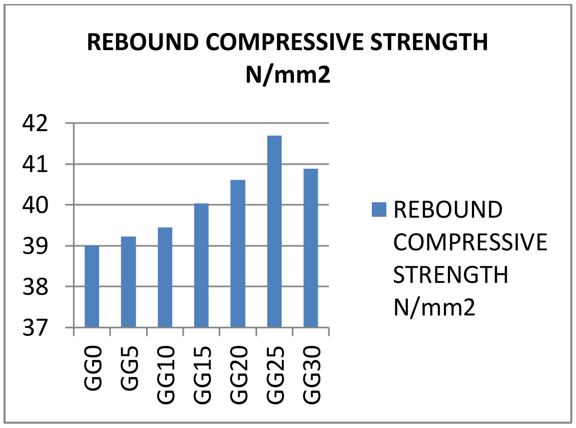

Fig.8 28th Day rebound hammer compressive strength of geopolymer concrete

E Ultrasonic pulse velocity Test:

A pulse of longitudinal vibrations is produced by an electro-acoustical transducer, which is held in contact with one surface of the concrete under test.

v = L/T

v = Longitudinal pulse velocity, Km/sec.

L = Path length, Km

T = Time taken by the pulse to traverse that length, Sec

Table4.13. UPV of geopolymer concrete with replacement of fly ash by lime

SPECIMEN	Timein Microsecond	UPV (Km/Sec)
GL0	38.5	3.9
GL5	39.5	3.8
GL10	37.8	3.95
GL15	37.1	4
GL20	37	4.1
GL25	38.5	3.9
GL30	38.3	3.85

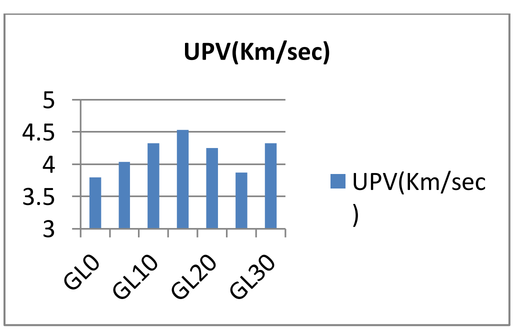

Fig.4.9 28th Day UPV graph of geopolymer concrete

Table 4.14. UPV of geopolymer concrete

SPECIMEN	Time, in Microsecond	UPV (Km/Sec)
GG0	39.5	3.80
GG5	37.10	4.04
GG10	34.58	4.33
GG15	33.08	4.53
GG20	35.30	4.25
GG25	38.7	3.87
GG30	34.58	4.33

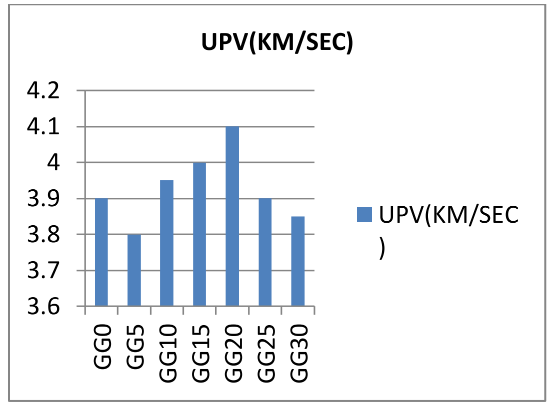

Fig.4.10 28th Day UPV graph of geopolymer concrete

5 CONCLUSION

The compressive strength of concrete from 0% to 25% replacement of sand by Granite Waste is satisfactory

The rate of gain in compressive strength of geopolymer concrete is very fast at 7 days curing period and the rate gets reduces with age, because initially geopolymerization process is very fast and afterwards geopolymerization process decreases.

The Compressive, Flexural, Tensile Strength in Geopolymer Concrete is more with replacement of of lime For Ambient Curing as compare to replacement with GGBFS

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