STRENGTHENING OF CONCRETE STRUCTURES WITH PRE-STRESSED FIBER REINFORCED PLASTIC SHEETS

[1]K.Rajeswari,[2]N. Bala Tripura Sundari, [3]S.Mounika
[1]Assistant Professor, [2]Assistant Professor, [3]Assistant Professor
[1]Civil Department,
[1]Narayana Engineering College, Nellore, Andra pradesh

Abstract: Metal foundries use large amounts of sand as part of the metal casting process. Foundries successfully recycle and reuse the sand many times in a foundry. When the sand can no longer be reused in the foundry, it is removed from the foundry and is termed "foundry sand." Foundry sand production is nearly 6 to 10 million tons annually. Like many waste products, foundry sand has beneficial applications to other industries. Foundry sand consists primarily of silica sand, coated with a thin film of burnt carbon, residual binder (bentonite, sea coal, resins) and dust. Foundry sand can be used in concrete to improve its strength and other durability factors. Foundry Sand can be used as a partial replacement of cement or as a partial replacement of fine aggregates or total replacement of fine aggregate and as supplementary addition to achieve different properties of concrete. In the present study, effect of foundry sand as fine aggregate replacement on the compressive strength of cement mortar having mix proportions was investigated. Fine aggregates were replaced with four percentages of foundry sand. The percentages of replacements were 0,40,50,60% by weight of fine aggregate. Test were performed for compressive strength test for all replacement levels of foundry sand at different curing periods (7,14,28-days).

IndexTerms - foundry sand, compressive strength, cement

I. INTRODUCTION

Cement is a binder, a substance used in construction that sets, hardens and `usually inorganic , often lime or calcium silicate based, and can be characterized as being either hydraulic or non hydraulic , depending upon the ability of the cement to set in the presence of water .Cement is used with fine aggregate to produce mortar for masonry , or with sand and gravel aggregates to produce concrete. Concrete plays a vital role in the development of infrastructure i.e., buildings, industrial structures, bridges and highways etc leading to utilization of large quantity of concrete. On other side, cost of concrete is attributed to the cost of its ingredients which is scarce and expensive; this leading to usage of economically alternative materials in its production. Concrete is the finished product while cement is simply one of its main ingredients. A concrete plant stores different stones, sand and cements for the types of concrete that each plant is capable of producing. We create unique mixes to deliver customized performance suitable for each construction need.

Chemical composition of cement

Chemical Composition of Cement	
Cao	60 – 67 %
SiO_2	17 – 25 %
Al_2O_3	3 – 8 %
Fe_2O_3	0.1 – 6 %
Mgo	0.1 – 4 %

1.1 GLASS FIBER

Glass fiber is a material consisting of numerous extremely fine fiber of glass. Glassmakers throughout history have experimented with glass fibers, but mass manufacture of glass fiber was only made possible with the invention of finer machine tooling. In 1893, Edward Drummond Libbey exhibited a dress at the World's Columbian Exposition incorporating glass fibers with the diameter and texture of silk fibers. Glass fibers can also occur naturally, as Pele's hair.

Glass wool, which is one product called "fiberglass" today, was invented in 1932–1933 by Russell Games Slayter of Owens-Corning, as a material to be used as thermal building insulation.[1] It is marketed under the trade name Fiberglas, which has become a genericized trademark. Glass fiber when used as a thermal insulating materials, is specially manufactured with a bonding agent to trap many small air cells, resulting in the characteristically air-filled low-density "glass wool" family of products.

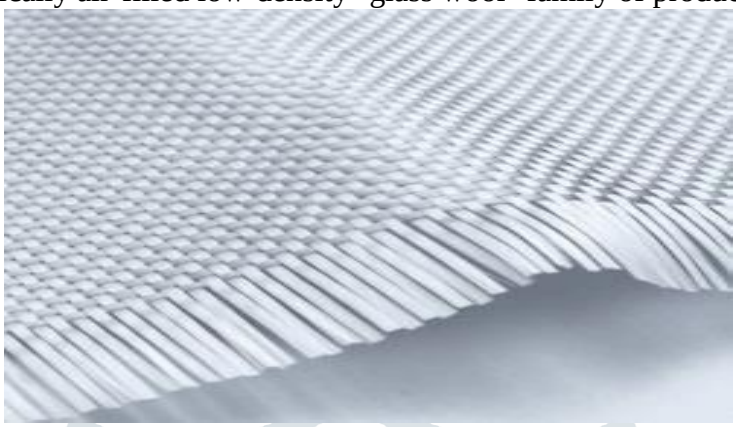


Fig: Glass Fibre sheet

1.2 GLASS FIBER POWDER

The Glass fiber powder can be added to concrete along with Portland cement, aggregates and water. The normal ratios of aggregates and water to cementations material in the mix remain unchanged. Glass fiber powder used as a direct replacement for Portland cement, on a one-to-one basis by weight

Fig: Glass Fibre Powder

II. EXPERIMENTAL PROGRAM

Table: properties of cement

S.NO	PROPERTIES OF CEMENT	LIMITS	TEST RESULT
1	Fineness	9%	9%
2	Initial setting time	30 minutes	32 minutes
3	final setting time	600 minutes	593 minutes
4	Compressive strength(28 days)	53 MPA	52 MPA
5	Consistency	28%	27.8%

Table: properties of fine aggregates

S.NO	PROPERTIES OF CEMENT	LIMITS	TEST RESULT VALUE
1.	Fineness modulus	2 to 3.5	3.536
2.	Specific gravity	2.5 to 2.65	2.64

3.	Bulk density	1.2 to 1.5	1.449

Table: properties of coarse aggregates

S.NO	PROPERTIES OF CEMENT	LIMITS	TEST RESULT VALUE
1.	Fineness modulus	8 to 9	8.66
2.	Specific gravity	2.6 to 2.8	2.72
3.	Bulk density	1.2 to 1.5	1.434

III. MIX DESIGN OF CONCRETE

Mix proportions of the concrete materials

CEMENT = 376.133kg/m^3

WATER = 169.26kg/m^3

C.A = 1087.27kg/m^3

F.A = 805.89kg/m^3

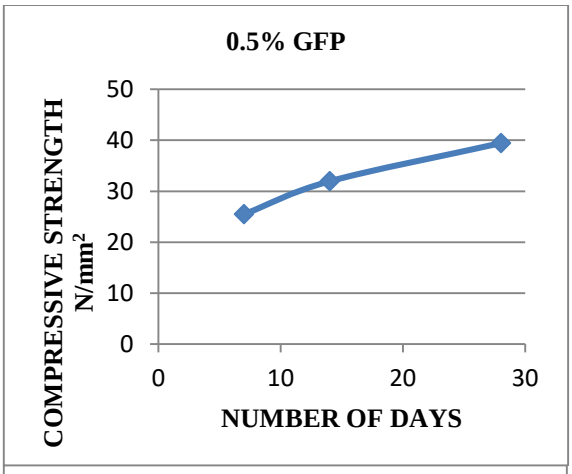
Mix Proportions of M35 Grade Natural aggregate Concrete is used to produce Concrete. The glass fiber powder used in different percentages like 1%,1.5%,2% are prepared concrete specimens. The compressive test is carried out for 7days, 14days and 28days with and without glass fiber powder.

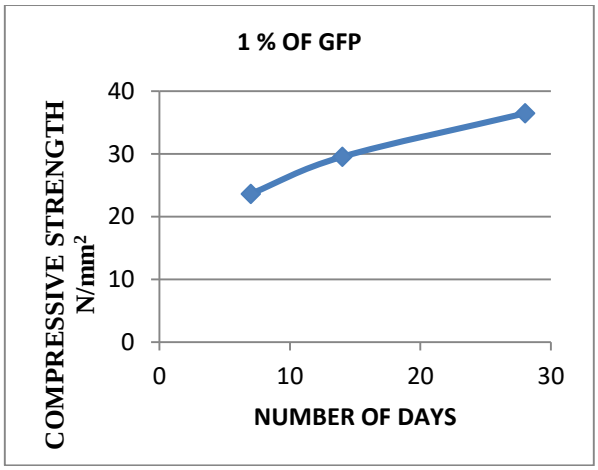
IV. PROPERTIES OF CONCRETE

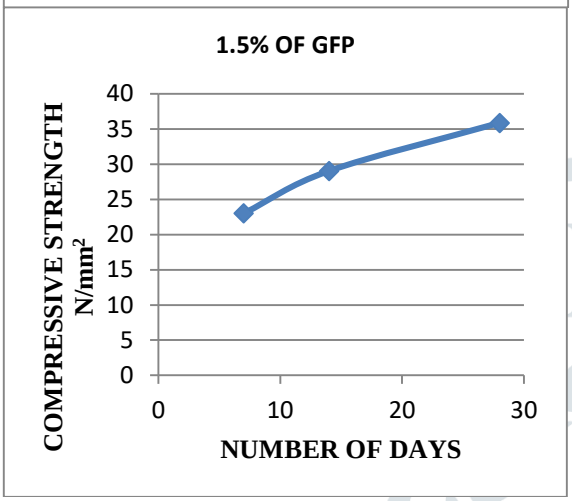
Table: Workability

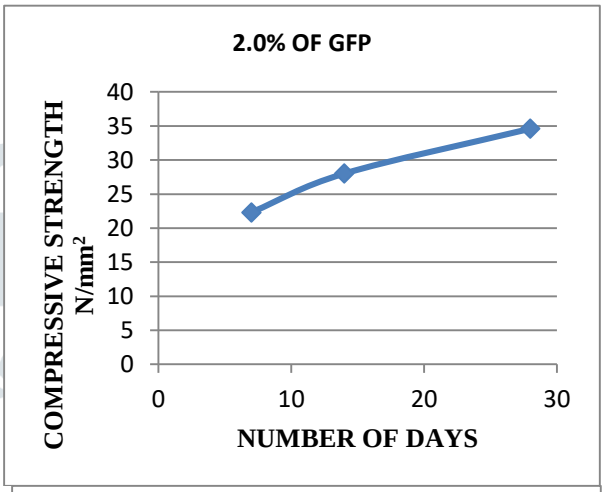
Mix	Slump Value(mm)
0%	55
5%	54
10%	53
15%	52
20%	51
25%	49
30%	48
35%	46
40%	45

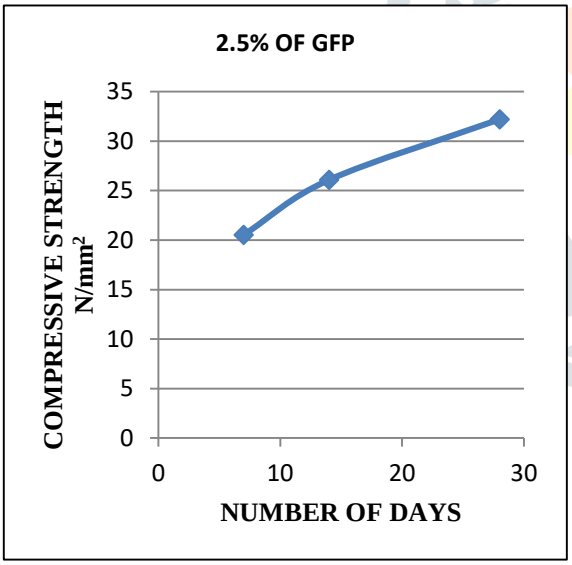
V. Results and discussions

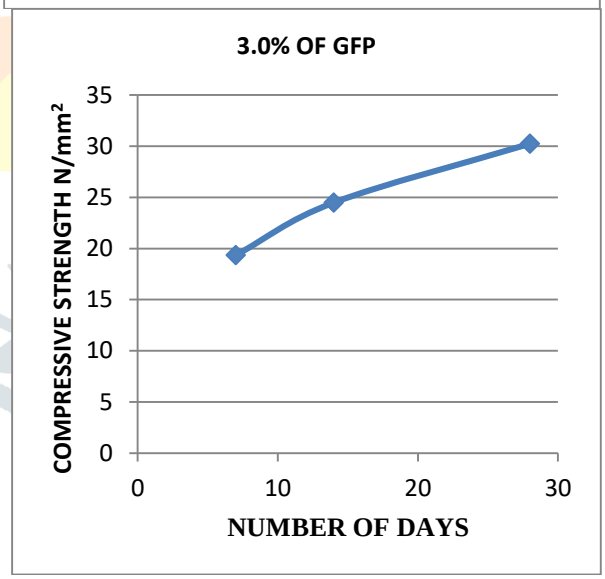

0.5% GFP
COMPRESSIVE STRENGTH N/mm²
50
40
30
20
10
0
0
10
20
30
NUMBER OF DAYS

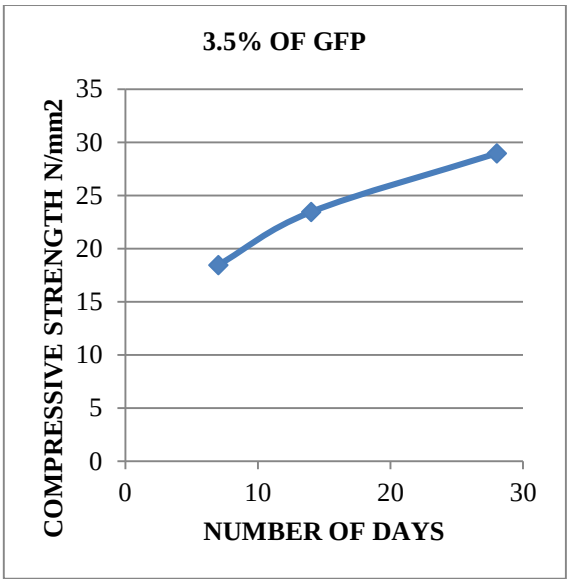

1 % OF GFP
COMPRESSIVE STRENGTH N/mm²
40
30
20
10
0
0
10
20
30
NUMBER OF DAYS


1.5% OF GFP
COMPRESSIVE STRENGTH N/mm²
40
35
30
25
20
15
10
5
0
0
10
20
30
NUMBER OF DAYS


2.0% OF GFP
COMPRESSIVE STRENGTH N/mm²
40
35
30
25
20
15
10
5
0
0
10
20
30
NUMBER OF DAYS


2.5% OF GFP
COMPRESSIVE STRENGTH N/mm²
35
30
25
20
15
10
5
0
0
10
20
30
NUMBER OF DAYS


3.0% OF GFP
COMPRESSIVE STRENGTH N/mm²
35
30
25
20
15
10
5
0
0
10
20
30
NUMBER OF DAYS



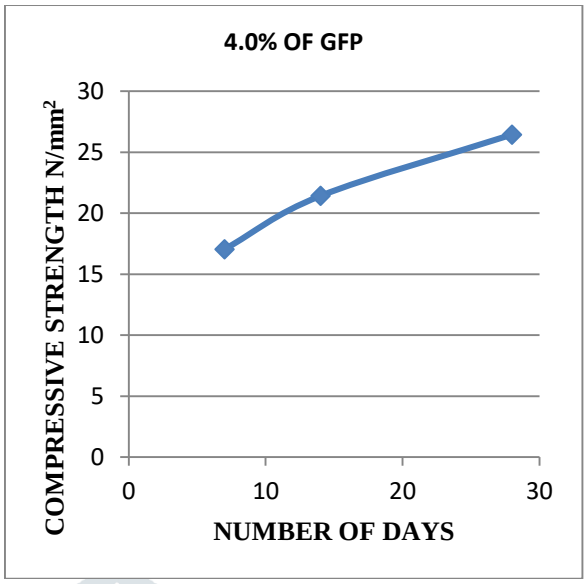


Table: Glass fiber powder mix proportions

	GFP MIX PROPORTIONS					
S.NO	GLASS FIBERPOWDER (%)	CEMENT	FINE AGGREGATES	COARSE AGGREGATES	WATER	SUPER PLASTICIZER
1	0.5	1	2.16	2.19	0.45	0.75
2	1	1	2.17	2.93	0.45	0.75
3	1.5	1	2.19	2.96	0.45	0.75
4	2	1	2.21	2.98	0.45	0.75
5	2.5	1	2.23	3.01	0.45	0.75
6	3	1	2.25	3.03	0.45	0.75
7	3.5	1	2.26	3.06	0.45	0.75
8	4	1	2.88	3.08	0.45	0.75

GFP MIX WITH CEMENT

GFP MIX WITH CEMENT

S.NO	GFP MIX%	DESGINATION	COMPRESSIVE STRENGTH (mPa)		
			7DAYS	14 DAYS	28DAYS
1	0.5	M1	25.48	31.95	39.45
2	1.0	M2	23.63	29.54	36.48
3	1.5	M3	23.02	29.04	35.86
4	2.0	M4	22.32	28.01	34.59
5	2.5	M5	20.52	26.07	32.19
6	3.0	M6	19.36	24.50	30.25
7	3.5	M7	18.45	23.45	28.96
8	4.0	M8	17.04	21.41	26.44

FIG 5.17: COMPARISION FOR 7, 14, 28 DAYS (scale 1:100)

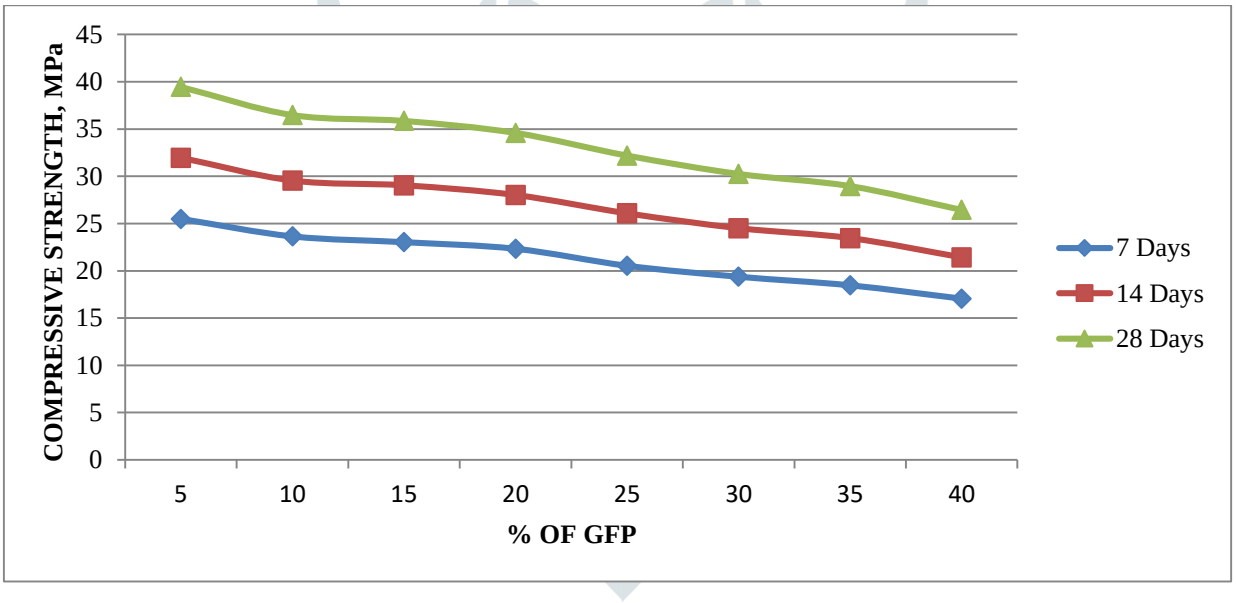
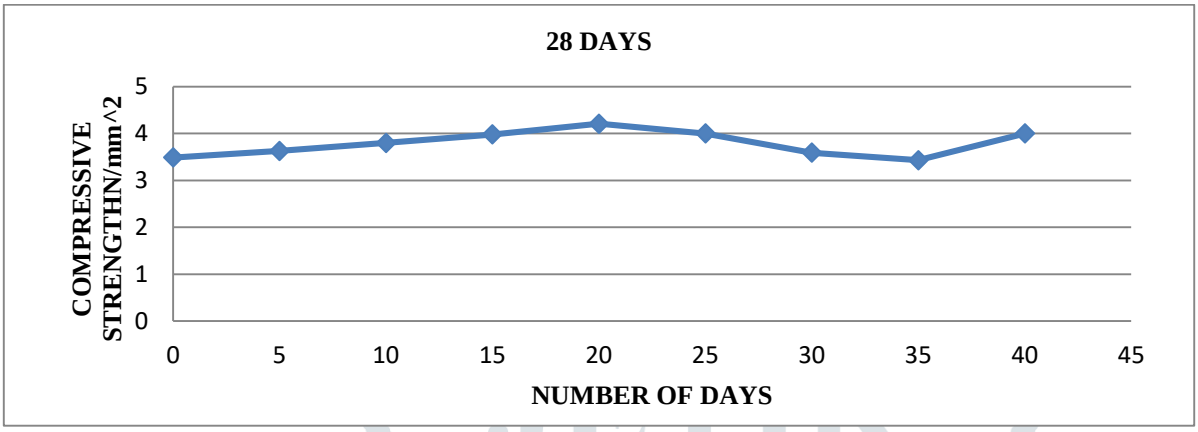


Table: Flexural strength for 28 days

NO.OF DAYS	MIX	COMPRESSIVE STRENGTH (mPa)
28	0.5	3.49
	1.0	3.63
	1.5	3.80
	2.0	3.98

	2.5	4.21
	3.0	4.00
	3.5	3.59
	4.0	3.43

FIG 5.18: FLEXURAL STRENGTH FOR 28 DAYS



VI. CONCLUSION

The project "STRENGTHENING OF CONCRETE STRUCTURES WITH PRE-SRESSED FIBER REINFORCED SHEETS'' focuses on glass fiber powder used in concrete at various percentages. As a part of primary investigation, materials used is concrete are tested for their properties and results are analysed. As a part of secondary investigation, Concrete of Grade M35 is selected and several trial mixes were performed according to IS 10262:2009. The trial mix cubes are dried out after 28 days curing and tested for compressive strength. One of the mix proportions in trial mix is selected as control concrete and their mix proportions are used to investigate glass fiber powder. The GFP is mixed along with cement in the percentage such as 0.5,1,1.5,2,2.5,3,3.5,4 and cubes are prepared. The normal proportions of aggregates and water to cementitious materials in the mix remain unchanged. The cubes are cured and tested after 7 & 28 days. The values obtained after both normal ordinary concrete cubes and combination of cement and GFP cubes are compared.

Glass fiber powder compressive strength of Concrete is concluded below:

- Workability of GFP concrete decreases with increase in percentage replacement of GFP
- Compressive strength of GFP concrete increases with increase in age of curing.
- Compressive strength of GFP concrete decreases with increase in percentage replacement of GFP.
- Compressive strength of GFP concrete With 0.5% replacement shows higher strength, compared to 4.0% replacement.

REFERENCES

[1] R.V. Balendran, T.M. Rana, A. Nadeem, (2001) "Strengthening of concrete structures with FRP sheets and plates", Structural Survey, Vol. 19 Issue: 4, pp.185-192

[2] Bairagi N. K. and Modhera C D (2001), 'Shear strength of fibre reinforced concrete, Indian Concrete Institute Journal, Vol. 1, No. 4, pp. 47-52. 18.

[3] Balaguru P. N. (1994), 'Contribution of fibres to crack reduction of cement during the initial and final setting period',American Concrete Institute Materials Journal, Vol 91, No. 3, pp. 280-288.

[4] Zheng Q. and Chung D.D.L. (1989), 'Carbon fibre reinforced cement composites improved by using chemical agents', Cement and Concrete Research, Vol. 19, No. 1, pp. 25-41.