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Comparative study on tensile property of different grades of concrete containing glass fibres

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ABSTRACT

The concept and usage of Fibre reinforced concrete gained more recognition and has also proved to result in greater tensile strength. The concrete, which contains fibrous materials are called fibre reinforced concrete. Glass fibre reinforced concrete (GFRC) is a material made of cementitious compounds consists of cement, aggregates, water, admixtures and discrete fibres. The performance of different grades of concrete such as M25, M30, M35 with addition of various percentage of glass fibre such as 0.2%, 0.4%, 0.6%, 0.8%, 1% with different W/c ratio are used to maintain the high workability. The tensile property of various mixes of glass fibre reinforced concrete is compared with conventional concrete at the age of 7 days and 28 days. The optimum value fibre percentage in different grades of concrete is 0.6%.

Keywords: Discrete Fibres, Tensile strength, Workability

INTRODUCTION

Concrete is a quasi brittle material with high compressive strength and weak in tensile strength. Reinforcing bar are used to improve the tensile strength. In addition to that fibre can make the concrete more homogeneous and can improve the tensile response , particularly he ductility. Fibre reinforced concrete (FRC) is a new class of strong, tough and highly durable material. Fibre in the cement based matrix acts as a crack arrester which restricts the growth of flow in the matrix, preventing these from widening under load in to cracks which cause failure. FRC is a relatively new material. There are so many types of fibres which are steel fibres, glass fibres, metallic fibres, man made fibres and natural fibres. Fibre reinforced concrete changes with varying concretes, fibre materials, geometrics, distribution, orientation and densities [1-5].

MATERIAL PROPERTIES

Cement

The ordinary Portland cement of grade (53) is used for the present investigation and tested as per IS 12269-2013. The cement sample was tested as per the procedure given in BIS:4031-1996 (reaffirmed 2005) and BIS : 4032-1985 (2005).

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Table 2.1 Properties of Cement

S. No	Properties	Test value	Recommended Value	As per code
1	Specific gravity	3.12	3-3.25%	IS 4031:2005 (part 11)
2	Initial setting time	35 minutes	Not less than 30 mins	IS 12269:2013
3	Final setting time	420 minutes	Not greater than 600 mins	IS 12269:2013
4	Consistency	27%	26-31%	IS 4031:2005 (part 4)

Fine Aggregates

Fine aggregate generally consists of natural sand or crushed stone with most particles passing through a 10 mm sieve. In this investigation M Sand is used.

Table 2.2 Properties of Fine Aggregates

S.No	Properties	Test Value	Recommended Values IS 383-2016
1	Grading Zone	Zone II	I to III
2	Specific gravity	2.52	2.5-2.9
3	Water absorption	4%	2-4%
4	Fineness modulus	2.75	Medium sand
5	Bulk density (kg/m^3)		
	• Loose	1440.00	1400-1600
	• Rodded	1718.40	

Coarse Aggregates

Coarse aggregate have a wide variety of construction applications because they resemble standard rock particle, as opposes to fine aggregate which more closely resembles sand. Coarse aggregate are generally classified as rock larger than a standard no.4 sieve (3/1 inches) and less than 2 inches.

Table 2.3 Properties of Coarse Aggregates

S.No	Properties	Test Value	Recommended Values IS 383-2016
1	Specific gravity	2.72	2.5-3
2	Water absorption	1%	0.1-2%
3	Fineness modulus	7.37	6-8

Water

Water conforming to the requirements of BIS:456-2000 is found to be suitable for making high strength concrete. It is generally stated that water fit for drinking is fit for making concrete.

Glass Fibre

Glass fibers have the properties of high strength, good temperature and corrosion resistance, and low price. When used as a thermal insulating material, is bonding agents to trap many small air cells, resulting in the characteristically air –field low- density glass wool family products.

Table 2.4 Properties of Glass Fibre

Description	Properties
Type of fibre	S-Glass Fibre
Length of fibre	12mm
Diameter of Fibre	14 micron
Tensile strength	2500Mpa
Elasticity	70Gpa
appearance	White colour chopped,strand fibre

Super plasticizer

These are chemicals that improve the workability of the paste. This allows a lower W/c to be used for a given workability, resulting in higher quality concrete also known as plasticizers or high –range water reducers (HRWR). For the present investigation, a super plasticizer by the name CONPLAST SP421 complies with BIS: 9103-1999 and BS:5075-part 3 and ASTM C494.

Table 2.5 Properties of Conplast SP421

Description	Properties
Type	Lignosulphonate conplast
Specific gravity	1.22 @30’
Chloride content	Nil as per BIS:456 and BS:5075
Recommended dosage	0.6 Litres per 100kg of cement
Compatibility	All type of cement except high alumina cement
Solid content	40%
Workability	Producing high workable flowing concrete mix without segregation and requires no compaction
Cohesion	Minimizing segregation and improving surface finish
Compressive strength	Early strength upto 20%

MIx Proportion

The mix design is done as per BIS 10262:2016 procedure. The proportions of materials arrived for M25, M30 and M35 grade of Concrete.

Table 3.1 Mix Proportions For M25 Grade

Mix prodetails	Cement (kg/m^3)	Glass fibre (kg/m^3)	FA (kg/m^3)	CA (kg/m^3)	SP (kg/m^3)	W/c
25GF0.0	394	0.0	583.45	1175.04	0.0	0.50
25GF0.2	394	0.2	583.45	1175.04	0.2	0.50
25GF0.4	394	0.4	583.45	1175.04	0.2	0.50
25GF0.6	394	0.6	583.45	1175.04	0.2	0.50
25GF0.8	394	0.8	583.45	1175.04	0.2	0.50
25GF1.0	394	1.0	583.45	1175.04	0.2	0.50

Table 3.2 Mix Proportions For M30Grade

Mix prodetails	Cement (kg/m^3)	Glass fibre (kg/m^3)	FA (kg/m^3)	CA (kg/m^3)	SP (kg/m^3)	W/c
30GF0.0	437.77	0.0	571.10	1150.66	0.0	0.45
30GF0.2	437.77	0.2	571.10	1150.66	0.2	0.45
30GF0.4	437.77	0.4	571.10	1150.66	0.2	0.45
30GF0.6	437.77	0.6	571.10	1150.66	0.2	0.45
30GF0.8	437.77	0.8	571.10	1150.66	0.2	0.45
30GF1.0	437.77	1.0	571.10	1150.66	0.2	0.45

Table 3.3Mix Proportions For M35 Grade

Mix prodetails	Cement (kg/m^3)	Glass fibre (kg/m^3)	FA (kg/m^3)	CA (kg/m^3)	SP (kg/m^3)	W/c
35GF0.0	447	0.0	568.51	1145.44	0.0	0.4
35GF0.2	447	0.2	568.51	1145.44	0.2	0.4
35GF0.4	447	0.4	568.51	1145.44	0.2	0.4
35GF0.6	447	0.6	568.51	1145.44	0.2	0.4
35GF0.8	447	0.8	568.51	1145.44	0.2	0.4
35GF1.0	447	1.0	568.51	1145.44	0.2	0.4

EXPERIMENTAL TEST AND INTERPRETATIONS

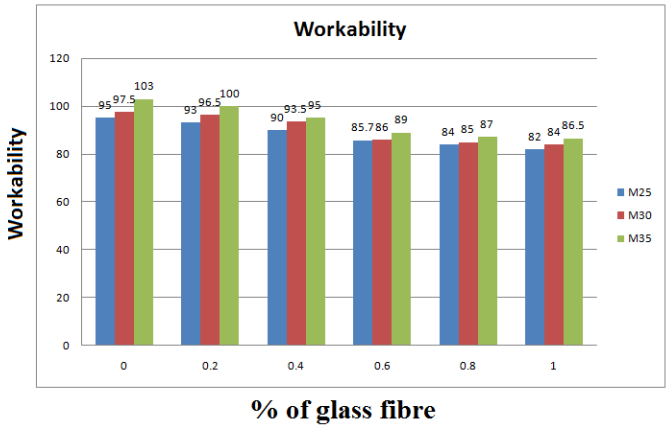
Workability

Workability is a property of freshly mixed concrete. Workability of concrete simply means the ability to work with concrete.

Table 4.1 Workability of different grades of Concrete

S.No	% of glass fibre	M25	M30	M35
1	0	95	97.5	103
2	0.2	93	96.5	100
3	0.4	90	93.5	95

4	0.6	85.7	86	89
5	0.8	84	85	87
6	1	82	84	86.5



Tensile Strength

The tensile strength is one of the basic and important mechanical properties of the concrete. Cylinders of size (150mm*300mm) were used. The test specimen were casted in cast-iron moulds as per BIS Standards. The specimens are tested at the age of 7 days and 28 days.

Table 4.2 comparison of tensile strength test at 7 days for different grades of concrete

Fibre %	M25	M30	M35
0.0	2.00	2.02	2.62
0.2	2.06	2.08	2.78
0.4	2.26	2.36	2.96
0.6	2.47	2.5	3.03
0.8	2.4	2.41	2.00
1.0	2.35	1.91	1.81

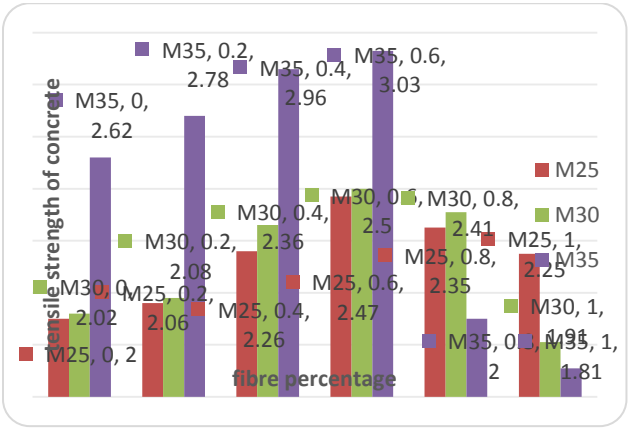
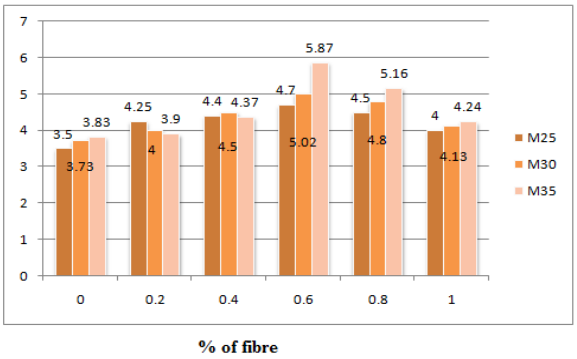


Table 4.3 comparison of tensile strength test at 28 days for different grades of concrete

Fibre%	M25	M30	M35
0.0	3.5	3.73	3.83
0.2	4.25	4.0	3.9
0.4	4.4	4.5	4.37
0.6	4.7	5.02	5.87
0.8	4.5	4.8	5.16
1.0	4.0	4.13	4.24



CONCLUSION

The results shows that the addition of glass fibre decrease the workability of concrete. Glass fibre bases split tensile strength of concrete is higher than conventional concrete. 0.6% of glass fibre gives higher strength than other fibre percentage in different grades of concrete. Here concluded that the tensile strength value is achieved earlier for addition of glass fiber content in the 7 days concrete mix compared to 28 days concrete mix. Split tensile strength for M25 grade of concrete increases upto 23.50%, for M30 grade of concrete increases upto 23.76%, and for M35 grade of concrete increases upto 15.64%.split tensile strength for M25 grade of concrete increases upto 34.28%,for M30 grade of concrete increases upto 34.58%,and for M35 grade of concrete increases upto 53.26%. When compared to conventional concrete when we added fibre it attains maximum tensile strength.

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