International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 09 | Sep 2019 www.irjet.net p-ISSN: 2395-0072

Strength Properties of Hybrid Fiber Reinforced SCC for Different Ratio

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Abstract - *Concrete is a largest using construction material. It is difficult to compact where congested reinforcement is present and also it increases labours and finance for effective compacted concrete. To avoid this difficulties self compacted concrete is used in construction.*

Self compacting concrete can be defined as concrete that can compact itself without any external vibrations. The SCC used in construction should have good filling and passing ability.by using self compacted concrete we can reduce the number of labours, vibrating needles and equipment and also overall cost of construction.

To increase the tensile strength and resistant to cracking fibres are added for he concrete. Fibres reinforced concrete can be defined as the concrete which contains discrete discontinuous and uniformly dispersed suitable fibres. There are several types of fibres which can be used in concrete. All fibres are its own properties and characteristics. Some of the fibres used in concrete are steel fibres, polypropylene fibres, glass fibres, asbestos fibres and carbon fibres.

Hybrid fibre reinforced self compacted concrete can be defined as the addition of two or more fibres to self compacted concrete to change some properties of concrete.

Key Words: *SCC, steel fibre, Glass fibre, compression strength, tensile strength, flexural strength.*

1. INTRODUCTION

SCC is a flowing concrete that compact by its weight without any external vibrations. OR It's a highly flowable, non segregating type of concrete which spreads itself without mechanical vibration.

1.1 Benefits of SCC

Improved construction ability, Reduction in labours, improved structural integrity, Reduces the requirement of skilled labour, Minimizes air voids produces good surface finish, Improved strength & durability, pumping is easy, Produces uniform surface.

1.2 Fibres

Plain concrete is having a less tensile strengths, ductility and low resistant to cracking, it leads to develop the internal cracks and that causes brittle fracture of concrete. To increase the tensile strength of concrete fibres are adding to concrete.

Fibre reinforced concrete can be defined as a composite material consisting of cement, mortar or concrete and discontinuous discrete. Uniformly dispersed fibres. Fibres are thread like structure which may be vegetable tissues, mineral substances or textiles and also substances of cellulose, lignin and pectin.

Table -1: material test results

TESTS	RESULTS	STANDARDS
ON CEMENT		
Fineness of cement	8.16%	<10% as per BIS
Normal consistency	28%	26-33% as per IS403 1-PART 4 -1988
Initial setting time	60 min	>30min as per IS-1269
Final setting time	600 min	<600min as per IS-1269
Specific gravity	3.12	3.12-3.15 as per IS 12269-1987
ON FINE AGGREGATE		
Specific gravity	2.71	2.6-2.8 as per IS 2386-part-3
Water absorption	0	0.1-2.0% as per IS 2386-part-3
Fineness modulus	Zone II specifications (2.82%)	<3.2
ON COARSE AGGREGATE		
Specific gravity	2.59	2.5-3.0 as per IS 2386-part-3
Water absorption	0.14%	<0.6 as per IS 2386-part-3
Fineness modulus	2.61%	<3.2

In this project steel and glass fibres are used to know the changes in tensile and flexural strength of concrete. Crimped steel fibres of 0.45mm diameter and 60mm length and glass fibres of 0.14mm diameter and 60mm length is used. The fly ash which is used grey in colour with specific gravity of 2.25 and moisture content of 0.35. The GGBS which is used is having a specific gravity of 3.15 and fineness is about 2%.

Mix design as per 10262-2009:

For 1m^3 of volume quantities of materials:

Cement: 437.78kg/m^3

Water= 197li/m^3

F.A= 982.2kg/m^3

C.A= 771.74kg/m^3

SP= 4.37li/m^3

Table 2: QUANTITIES REQUIRED FOR 9 CUBES:

Size of 1 cube= 150*150*150mm

Volume of 1 cube = 0.003375m^3

Volume of 9 cubes = 0.030m^3

TRIAL 1 - plain SCC

TRIAL 2 - 1% steel fibre+ 2% glass fibres by weight of cement

TRIAL 3 – 1.5% steel fibre+ 1.5% glass fibres by weight of cement

TRIAL 4 – 2% Steel fibre+ 1% glass fibre by weight of cement

MATERIALS	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Steel fibres	-	0.13kg	0.197kg	0.26kg
Glass fibres	-	0.26kg	0.197kg	0.13kg
Cement	13.13kg	12.74kg	12.74kg	12.74kg
Fine aggregate	29.46kg	29.46kg	29.46kg	29.46kg
Coarse aggregate	23.15kg	23.15kg	23.15kg	23.15kg
Water	5.91li	5.91li	5.91li	5.91li
Super plasticizer	0.13li	0.13li	0.13li	0.13li

Table 3 Quantities required for 3 beams:

Size of 1 beam= 100*100*500mm

Volume of 1beam = 0.005m^3

Volume of 3 beams = 0.015m^3

TRIAL 1 - 1% Steel fibre+ 2% glass fibres by weight of cement in SCC

TRIAL 2– 1.5% Steel fibre+ 1.5% glass fibres by weight of cement in SCC

TRIAL 3 – 2% Steel fibre+ 1% glass fibre by weight of cement in SCC

MATERIALS	TRIAL 1	TRIAL 2	TRIAL 3
Steel fibres	0.066kg	0.1kg	0.13kg
Glass fibres	0.13kg	0.1kg	0.066kg
Cement	6.37kg	6.37kg	6.37kg
Fine aggregate	14.73kg	14.73kg	14.73kg
Coarse aggregate	11.56kg	11.56kg	11.56kg
Water	2.96li	2.96li	2.96li
Super plasticizer	0.065li	0.065li	0.065li

Table 4: Quantities required for 3 cylinders:

Size of 1 cylinder = 0.150*300mm

Volume of 1 cylinder = 0.0053m^3

Volume of 3 cylinder = 0.0159m^3

TRIAL 1 - 1% Steel fibre+ 2% glass fibres by weight of cement in SCC

TRIAL 2– 1.5% Steel fibre+ 1.5% glass fibres by weight of cement in SCC

TRIAL 3 – 2% Steel fibre+ 1% glass fibre by weight of cement in SCC

MATERIALS	TRIAL 1	TRIAL 2	TRIAL 3
Steel fibres	0.069kg	0.1kg	0.13kg
Glass fibres	0.14kg	0.1kg	0.066kg
Cement	6.75kg	6.75kg	6.75kg
Fine aggregate	15.61kg	15.61kg	15.61kg
Coarse aggregate	12.27kg	12.27kg	12.27kg
Water	3.13li	3.13li	3.13li
Super plasticizer	0.069li	0.069li	0.069li

Table 5 : Slump flow and T 50 Slump test

PARTICULARS	D1(mm)	D2 (mm)	D(mm)	T50 value (sec)
For 100% cement				
Plain SCC	652	659	655.5	2
SCC with 1%S+2%G fibre	669	672	670.2	4
SCC with 1.5%S+1.5%G fibre	673	679	676	4
SCC with 2%S+1%G fibre	663	678	670.5	4

Table 6: L box test values

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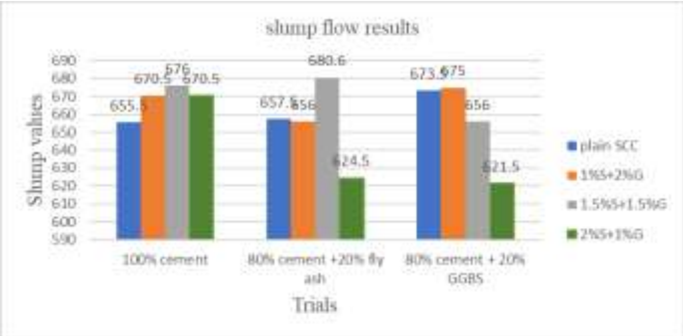
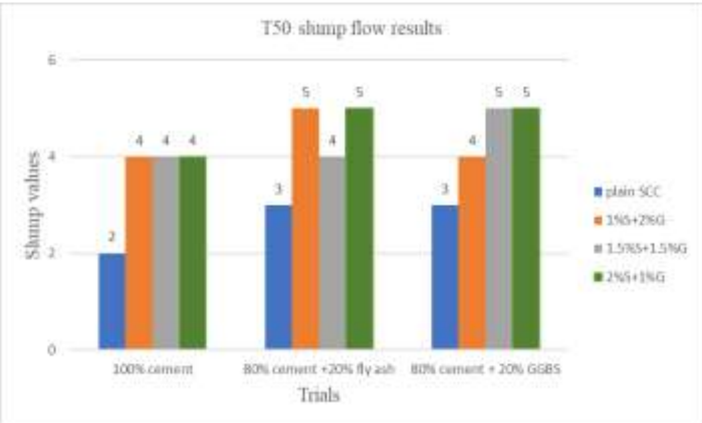
PARTICULARS	H1(mm)	H2 (mm)	H2/H1
For 100% cement			
Plain SCC	150	133	0.89
SCC with 1%S+2%G	146	128	0.88
SCC with 1.5%S+1.5%G	142	133	0.94
SCC with 2%S+1%G	148	130	0.88



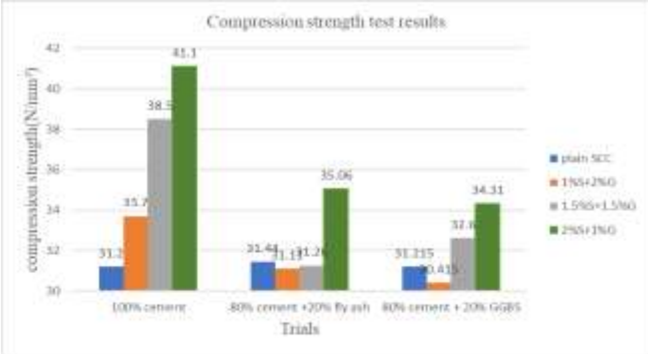
Bar chart 1: Slump flow test results



Bar chart 2: T50 slump flow test results

Table 6: Compression strength test result

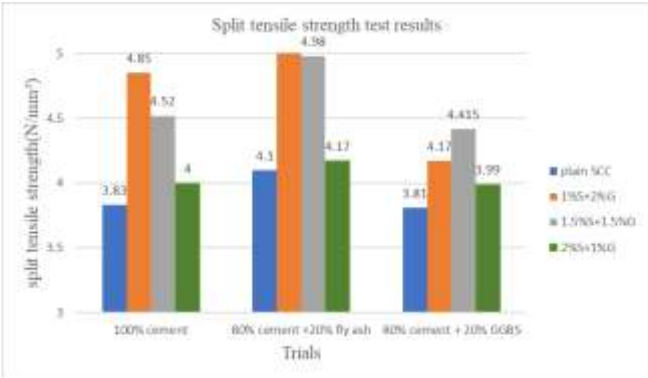
PARTICULARS	100% CEMENT
Plain SCC	31.2
1%S+2%G	33.7
1.5%s+1.5%G	38.5
2%S+1%G	41.1



Bar chart 3: compression strength test results

Table 8: Split tensile strength test results

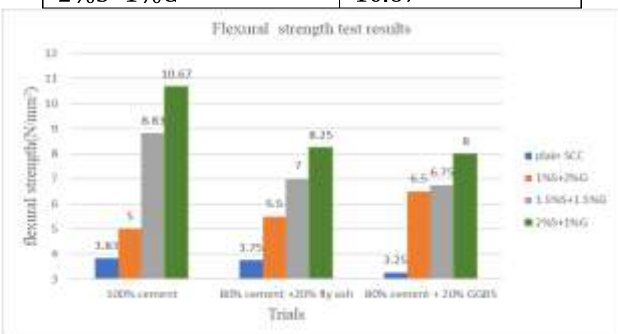
PARTICULARS	100% CEMENT
Plain SCC	3.83(std)
1%S+2%G	4.85
1.5%s+1.5%G	4.52
2%S+1%G	4



Bar chart 4: Split tensile strength test results

Table 9: Flexural strength test results

PARTICULARS	100% CEMENT
Plain SCC	3.83(std)
1%S+2%G	5
1.5%s+1.5%G	8.83
2%S+1%G	10.67



Bar chart 5: Flexural strength test results

3. CONCLUSIONS

•The minimum slump flow value for SCC should be 650mm. In the present case the minimum slump flow of 621.5mm is for the 2%S+1%G. the all other mix proportions provides the slump flow of more than 650mm.

•The T50 slump should be 2 to 5 sec for SCC. Here this mix proportions are achieved minimum of 2 sec of time. This results achieves required flowing ability.

•The L-box values for SCC should be 0.8-1. All the mixes in the project have achieved minimum of 0.8 for L – box test results. So we can consider that this SCC is having good passing ability.

•For M30 SCC minimum compression strength test values should be 30N/mm². when we use 100% cement with 2% steel and 1% glass fibre is resistant for more compression loads then without adding any fibres.

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