EXPERIMENTAL STUDY OF PROPERTIES OF SELF COMPACTING CONCRETE AND SELF COMPACTING CONCRETE USING GLASS FIBER

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Abstract - *The self compacting concrete is a most widely preferred concrete, due to its complete flow ability without using any vibrating machines or tools. It is easily practicable for any size and shape of the formworks. This is one of the "Green Technique" for avoiding sound effect on construction site. The glass fibers are introduced to improve the strength of the concrete, the material which is made up of extremely fine fiber glass. These fibers are not heavy but more strong and robust.*

The raw material of this fiber are less expensive and less brittle. These fibers are favorable due to the ratio of extensive surface area to weight. By using the fiber reinforcement in the concrete the low tensile strength and flexural strength can be improved. The modulus of elasticity of glass fibers is slightly higher than others.

The mix designed is prepared according to the IS 10262:2009, in this study we used aggregates from 10mm to 20mm and glass fibers are used with various percentages such as 0.25%, 0.5%, 0.75%, 1%, and 1.25% . The fresh properties are conducted for slump flow test, T_{50}cm test, V-funnel test, T_5 minutes test, L-box test, all results are acceptable. The hardened state of properties are evaluated after the curing period of 3 days, 7 days, and 28 days. The results are obtained in hardened state for compressive strength, split tensile strength, flexural strength and the modulus of elasticity is determined for the respected strength.

***Key Words*: SCC (Self Compacting Concrete), SCCG (Self Compacting Concrete with Glass Fibre), Compressive Strength, Split Tensile Strength, Flexural Strength, Modulus of Elasticity.**

1. INTRODUCTION

1.1 GENERAL

There is a drastic development in the construction from the last three to four decades due to various enhancements in their durability and their strength, and other properties as well. A concrete which totally gets compacted by itself for the required size and shape of elements is known as "Self compacting concrete". It is considered as self consolidating. Concrete, it is easily possible to flow under on its own weight and fills the form work fully without compaction or vibration. The self compacting concrete is developed since 1980's in Japan. This method is adopted all over the world, it has been used for the high raised or heavy structures or large constructions and also used in advanced types of tunnels with combination of fiber reinforcement.

The utilization of this technology is less in India when compared to foreign countries, because the people are not aware of the technology and its recompense or repay. The self consolidating concrete may also used in high pace in upcoming projects are under taken by the construction companies.

1.2 SELF COMPACTING CONCRETE

This is most favored category of concrete due to its flow ability without any variations. It can fill any size and shape of formwork. Thus the concrete is also filled in congested narrow space due to their self compacting nature, hence homogeneity is achieved without bleeding and segregation, which avoid the honeycombing in its lifespan.

This technology is better working environment due to it reduces the noise level, use of the vibrating machines while construction period. It has an advantage when compared to other type of concrete. Which provides minimum percentage of voids and greater workability, smooth finishing for the surfaces and diminish the manpower. Self compacting concrete imparts the facility in providing and dismantling the formwork and will shows improvement in results (strength parameters).

Professor OKAMURA from Japan proposed, the concept of SCC member in 1986 and the prototype was first completed in the world in 1988. The motive for improvement of SCC was the main common problem on concrete structure can be implemented. Since then, the different investigations have been conducted and that concrete has been used in convenient structure in Japan, mainly by a huge construction industries.

1.3 GLASS FIBER

This is also known as fiber glass, the material which is made up of extremely fine fiber glass. These fibers are not heavy but more strong and robust. The raw material of this fiber is less expensive and less brittle.

These fibers are favorable due to the ratio of extensive surface area to weight. By using the fiber reinforcement in the concrete, the lower flexural and tensile strength can be enhanced.

2. OBJECTIVES

1. To compare the properties of fresh state and hardened state of SCC using glass fibers and NSCC.
2. To determine the fresh properties of SCC using glass fibers and NSCC.
3. To determine hardened properties of SCC using glass fiber and NSCC.
4. To compare elastic modulus of NSCC and SCC using glass fiber.

3. METHODOLOGY

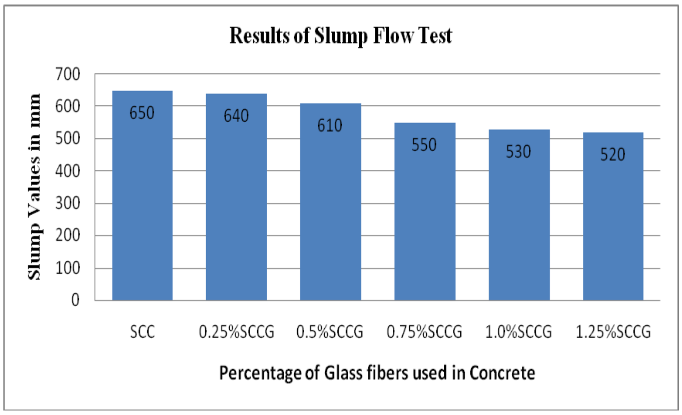
The practical test assessments were conducted on fresh properties as well as hardened properties.

1. Slump Flow Test
2. T50cm Flow Test
3. V-Funnel Test
4. L-Box Test
5. Compression Test
6. Split Tensile Test
7. Flexural Test
8. Modulus of Elasticity

4. Results and Discussions

Table-1: Results of Slump Flow Test

Percentage of Glass fibers used in Concrete	Slump Values (mm)
SCC	650
0.25%SCCG	640
0.5%SCCG	610
0.75%SCCG	550
1.0%SCCG	530
1.25%SCCG	520

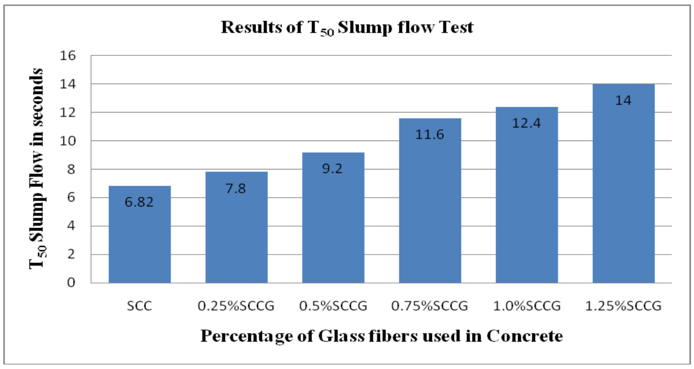


Graph-1: Results of Slump Flow Test

This graph reflects the outcomes of the slump flow test, which is showing ability of filling of concrete with high ability of filling at SCC and low ability of filling at 1.25%SCCG.

Table - 2: Results T_{50}CM Slump Flow Test

Percentage of Glass fibers used in Concrete	T_{50} CM Slump Flow in Seconds
SCC	6.82
0.25%SCCG	7.8
0.5%SCCG	9.2
0.75%SCCG	11.6
1.0%SCCG	12.4
1.25%SCCG	14



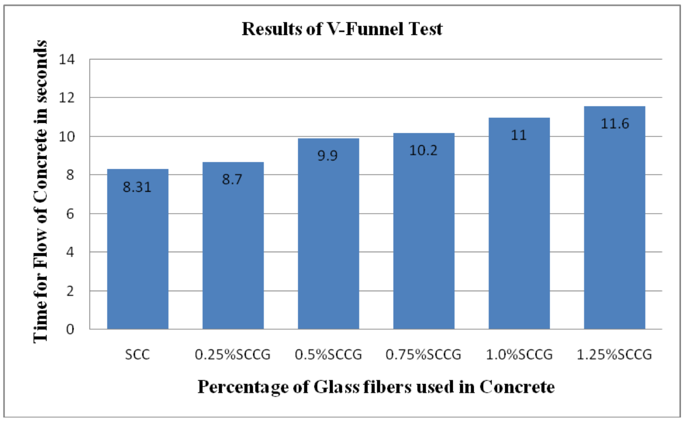
Graph-2: Results of T_{50} Slump Flow Tests

The graph reflects the outcomes of the T_{50} slump flow test , which is showing ability of filling of concrete in seconds. It is also representing the duration required for the filling ability of concrete.

Table-3: Results V-Funnel Test

Percentage of Glass fibers used in Concrete	Time for Flow of Concrete in Seconds
SCC	8.31
0.25%SCCG	8.7
0.5%SCCG	9.9
0.75%SCCG	10.2
1.0%SCCG	11
1.25%SCCG	11.6

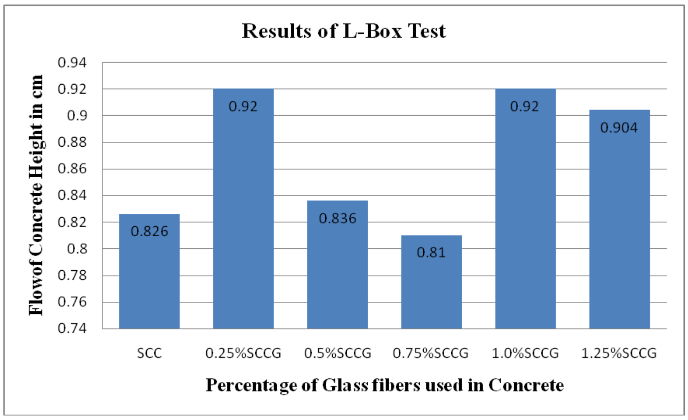
The graph-3 reflects the outcomes of the V-funnel test, which is resistance to segregation of coarse aggregates. It is also shows that the results are within the limit, and this is showing the 0.5%SCC to 1.25%SCCG is well in range and at SCC and are acceptable.



Graph -3: Results of V-Funnel Tests

Table-4: Results L-Box Test

Percentage of Glass fibers used in Concrete	Flow of Concrete Height in CM
SCC	0.826
0.25%SCCG	0.92
0.5%SCCG	0.836
0.75%SCCG	0.810
1.0%SCCG	0.920
1.25%SCCG	0.904

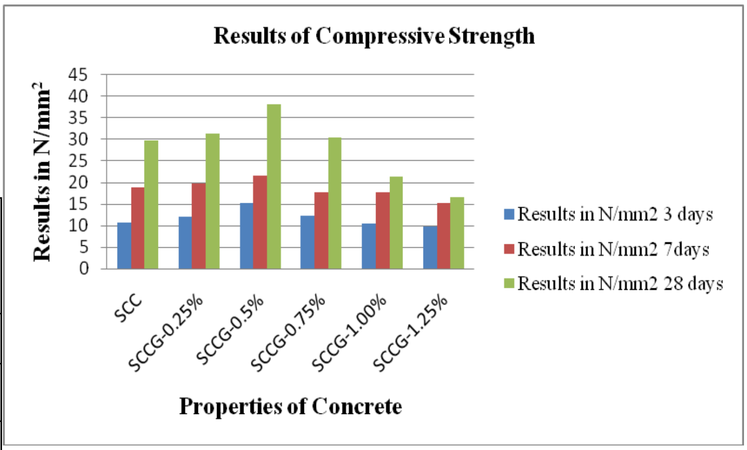


Graph-4: Results of L-Box Tests

The above graph reflects the outcomes of the L-Box test, which is ability of passing.

Table-5: Results Compressive Strength Test

Properties of concrete	Compressive Strength in N/mm²		
	3 days	7days	28 days
SCC	10.70	18.78	29.87
SCCG-0.25%	12.00	19.70	31.32
SCCG-0.5%	15.15	21.53	38.29
SCCG-0.75%	12.38	17.80	30.53
SCCG-1.00%	10.36	17.80	21.30
SCCG-1.25%	9.86	15.19	16.53



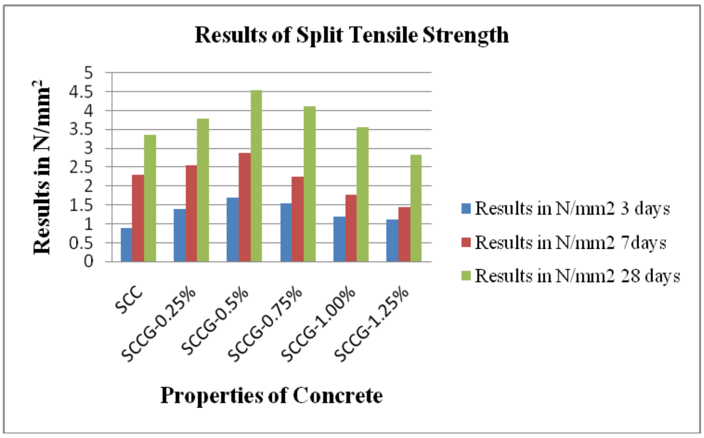
Graph - 5: Results of Compressive Strength Test

This Graph reflects the Compressive Strength's outcomes at 3 days, 7 days, 28 days showing that the SCCG-0.5% has greater Strength.

Table - 6: Results Split Tensile Strength Test

Properties of concrete	Split Tensile Strength in N/mm²		
	3 days	7days	28 days
SCC	0.89	2.30	3.35
SCCG-0.25%	1.40	2.56	3.80
SCCG-0.5%	1.69	2.88	4.54
SCCG-0.75%	1.53	2.25	4.11
SCCG-1.00%	1.19	1.77	3.57
SCCG-1.25%	1.12	1.43	2.82

The Graph 6 reflects the Split tensile Strength's outcomes at 3 days, 7 days, 28 days showing that the SCCG-0.5% has greater Strength.

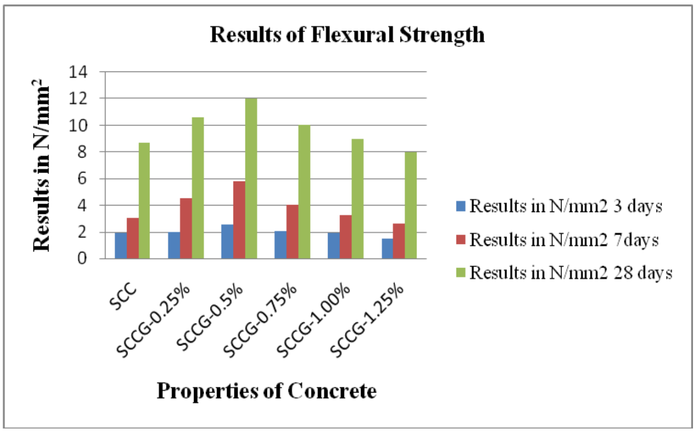


Graph – 6: Results of Split Tensile Strength Test

Table-7: Results of Flexural Strength Test

Properties of concrete	Flexural Strength in N/mm²		
	3 days	7days	28 days
SCC	1.89	3.07	8.69
SCCG-0.25%	2.00	4.50	10.61
SCCG-0.5%	2.53	5.82	12.00
SCCG-0.75%	2.04	4.00	10.05
SCCG-1.00%	1.88	3.24	9.00
SCCG-1.25%	1.51	2.64	7.98

This Graph reflects the Flexural Strength's outcomes at 3 days, 7 days, 28 days showing that the SCCG-0.5% has greater Strength.

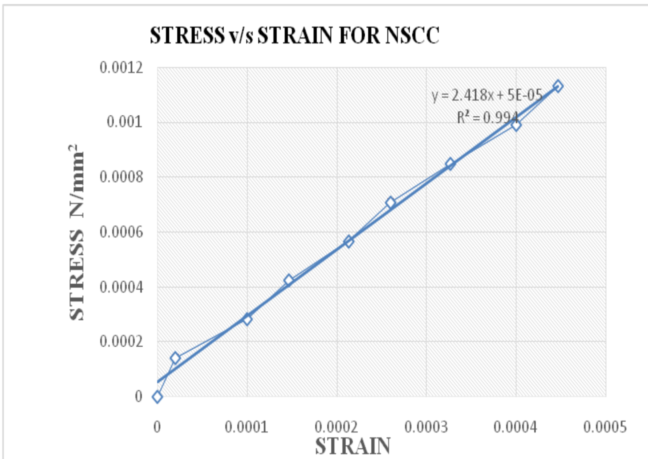


Graph - 7: Results of Flexural Strength Test

MODULUS OF ELASTICITY

Table-8: Results of Modulus of elasticity NSCC

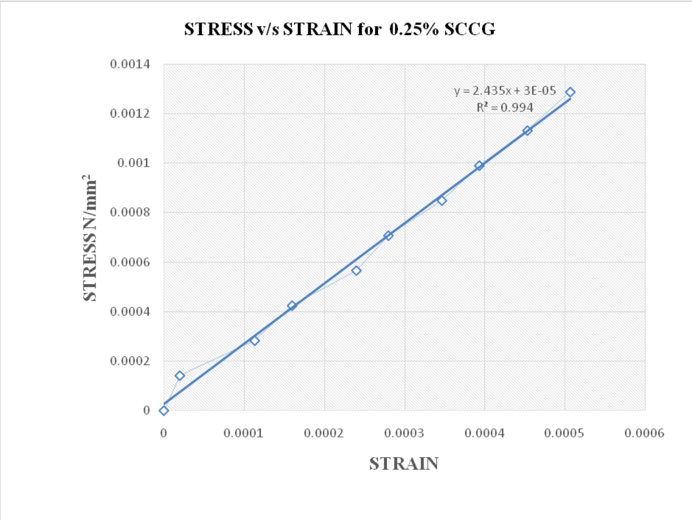
Load (KN)	D (mm)	L/C dial gauge	ΔL (mm)	L (mm)	Area (mm²)	Strain	Stress (N/mm²)
0	0	0.001	0	150	70650	0	0
10	3	0.001	0.003	150	70650	0.00002	0.000142
20	15	0.001	0.015	150	70650	0.0001	0.000283
30	22	0.001	0.022	150	70650	0.000147	0.000425
40	32	0.001	0.032	150	70650	0.000213	0.000566
50	39	0.001	0.039	150	70650	0.00026	0.000708
60	49	0.001	0.049	150	70650	0.000327	0.000849
70	60	0.001	0.06	150	70650	0.0004	0.000991
80	67	0.001	0.067	150	70650	0.000447	0.001132



Graph-8: Results of Modulus of elasticity for NSCC

Table-9: Results of Modulus of elasticity 0.25% SCCG

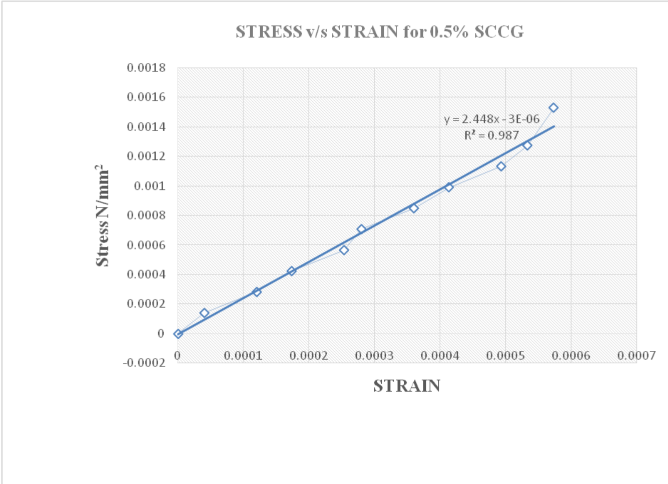
Load (KN)	D (mm)	L/C dial gauge	ΔL (mm)	L (mm)	Area (mm²)	Strain	Stress (N/mm²)
0	0	0.001	0	150	70650	0	0
10	3	0.001	0.003	150	70650	0.00002	0.000142
20	17	0.001	0.017	150	70650	0.000113	0.000283
30	24	0.001	0.024	150	70650	0.00016	0.000425
40	36	0.001	0.036	150	70650	0.00024	0.000566
50	42	0.001	0.042	150	70650	0.00028	0.000708
60	52	0.001	0.052	150	70650	0.000347	0.000849
70	59	0.001	0.059	150	70650	0.000393	0.000991
80	68	0.001	0.068	150	70650	0.000453	0.001132
91	76	0.001	0.076	150	70650	0.000507	0.001288



Graph-9: Modulus of elasticity for 0.25%SCCG

Table-10: Results of Modulus of elasticity 0. 5% SCCG

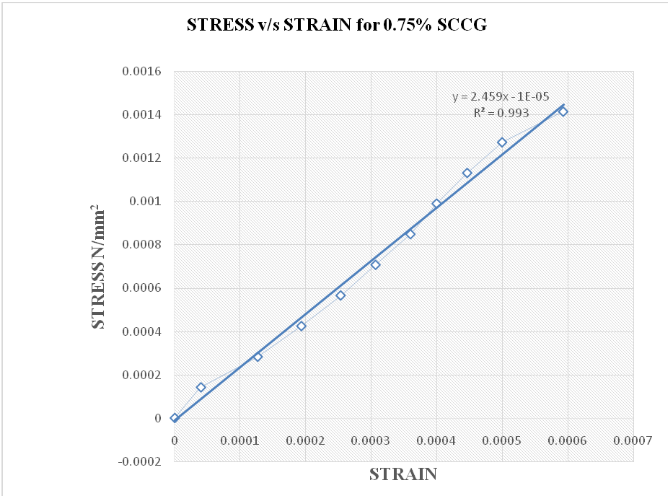
Load (KN)	D (mm)	L/C dial gauge	ΔL (mm)	L (mm)	Area (mm²)	Strain	Stress (N/mm²)
0	0	0.001	0	150	70650	0	0
10	6	0.001	0.006	150	70650	0.00004	0.000142
20	18	0.001	0.018	150	70650	0.00012	0.000283
30	26	0.001	0.026	150	70650	0.000173	0.000425
40	38	0.001	0.038	150	70650	0.000253	0.000566
50	42	0.001	0.042	150	70650	0.00028	0.000708
60	54	0.001	0.054	150	70650	0.00036	0.000849
70	62	0.001	0.062	150	70650	0.000413	0.000991
80	74	0.001	0.074	150	70650	0.000493	0.001132
90	80	0.001	0.08	150	70650	0.000533	0.001274
108	86	0.001	0.086	150	70650	0.000573	0.001529



Graph -10: Results of Modulus of elasticity for 0.5%SCCG

Table-11: Results of Modulus of elasticity 0.75% SCCG

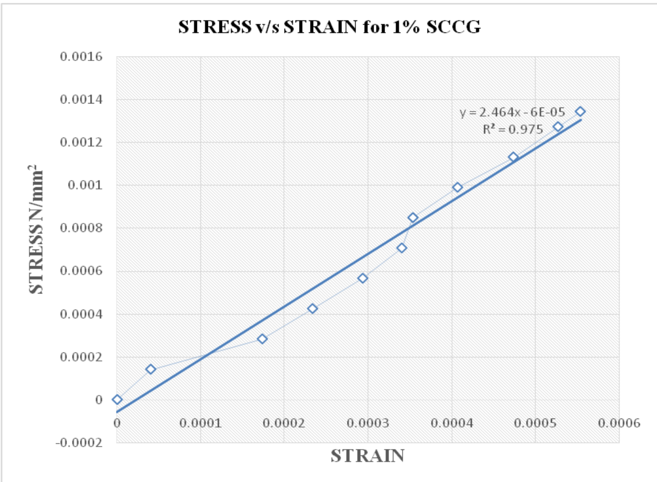
Load (KN)	D (mm)	L/C dial gauge	ΔL (mm)	L (mm)	Area (mm²)	Strain	Stress (N/mm²)
0	0	0.001	0	150	70650	0	0
10	6	0.001	0.006	150	70650	0.00004	0.00014
20	19	0.001	0.019	150	70650	0.00013	0.00028
30	29	0.001	0.029	150	70650	0.00019	0.00042
40	38	0.001	0.038	150	70650	0.00025	0.00057
50	46	0.001	0.046	150	70650	0.00031	0.00071
60	54	0.001	0.054	150	70650	0.00036	0.00085
70	60	0.001	0.06	150	70650	0.0004	0.00099
80	67	0.001	0.067	150	70650	0.00045	0.00113
90	75	0.001	0.075	150	70650	0.0005	0.00127
100	89	0.001	0.089	150	70650	0.00059	0.00142



Graph-11: Results of Modulus of elasticity for 0.75%SCCG

Table-12: Results of Modulus of elasticity 1% SCCG

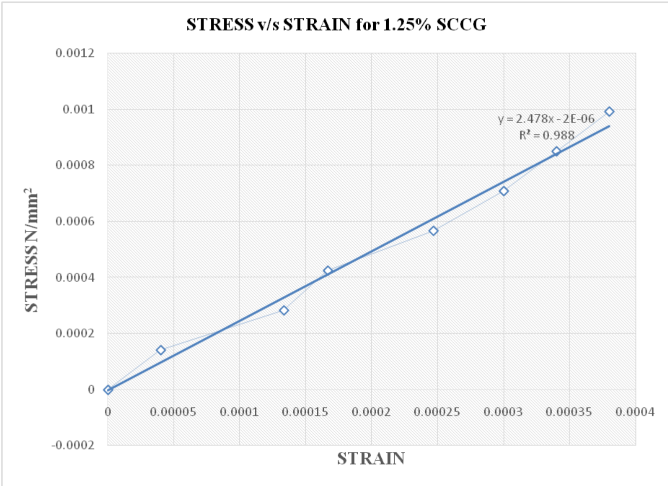
Load (KN)	D (mm)	L/C dial gauge	ΔL (mm)	L (mm)	Area (mm²)	Strain	Stress (N/mm²)
0	0	0.001	0	150	70650	0	0
10	6	0.001	0.006	150	70650	0.00004	0.00014
20	26	0.001	0.026	150	70650	0.00017	0.00028
30	35	0.001	0.035	150	70650	0.00023	0.00042
40	44	0.001	0.044	150	70650	0.00029	0.00057
50	51	0.001	0.051	150	70650	0.00034	0.00071
60	53	0.001	0.053	150	70650	0.00035	0.00085
70	61	0.001	0.061	150	70650	0.00041	0.00099
80	71	0.001	0.071	150	70650	0.00047	0.00113
90	79	0.001	0.079	150	70650	0.00053	0.00127
95	83	0.001	0.083	150	70650	0.00055	0.00134



Graph-12: Results of Modulus of elasticity for 1%SCCG

Table-13: Results of Modulus of elasticity 1.25% SCCG

Load (KN)	D (mm)	L/C dial gauge	ΔL (mm)	L (mm)	Area (mm²)	Strain	Stress (N/mm²)
0	0	0.001	0	150	70650	0	0
10	6	0.001	0.006	150	70650	0.00004	0.00014
20	20	0.001	0.02	150	70650	0.00013	0.00028
30	25	0.001	0.025	150	70650	0.00017	0.00042
40	37	0.001	0.037	150	70650	0.00025	0.00057
50	45	0.001	0.045	150	70650	0.0003	0.00071
60	51	0.001	0.051	150	70650	0.00034	0.00085
70	57	0.001	0.057	150	70650	0.00038	0.00099



Graph-13: Results of Modulus of elasticity for 1.25%SCCG

5. CONCLUSIONS

After the complete study of literature reviews, experimental discussions and investigations of outcomes following conclusions are drawn.

1. The compressive, tensile and flexural strength of SCC using glass fibers were found to be slightly superior than the corresponding characteristics of NSCC.
2. The Compressive strength is improved by 28.19% at 0.5% of glass fiber reinforcement.
3. The tensile strength is improved by 35.52% at 0.5% of glass fiber reinforcement.
4. The Flexural strength is improved by 35.52% at 0.5% of glass fiber reinforcement.
5. The elastic modulus of SCCG found to be slightly superior to the corresponding properties of NSCC.
6. The addition of high amount of glassfibers to concrete slightly reducing the fresh properties of SCC.
7. The GFRSCC with 0.5% shows the substantial increment in the strength for all above three parameters than other specimen.

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