International Journal of
Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

Vol.3, Special Issue 1 Aug - 2017

Influence of Geofabrics on the Performance of Concrete Elements

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ABSTRACT

In recent technological applications, use of geofabric materials have gained importance in various civil engineering works, geotechnical, transportation systems, hydraulic and other applications like embankments, irrigation structures, airfields, agriculture etc. These geofabrics have been particularly useful in reinforced soil systems which have led to economical civil engineering structural elements. These materials exhibit appreciable tensile strength and bond strength. The performance of civil engineering structures mainly depend on the quality of the constituent materials of which concrete is that material which is extensively used in all structures. Concrete being a very brittle material,its performance as a construction material is largely influenced by suitable reinforcements. The present study is aimed at investigating the performance of concrete elementswith geofabric material.

Keywords: Concrete, Geofabrics, Geotextile, Flexural Strength, Elastic Modulus.

INTRODUCTION

The strength and durability of concrete structures majorly depends on various materials compositions used in concrete mix design. The concrete is a heterogeneous mixture. The behavior of concrete structures under different varieties of combinations of loads are highly unpredictable, Recent advances in the construction field is to invent variety of new concrete to satisfy both strength and durability condition by considering different environmental factors.

In the present paper, an attempt is made to check the performance of concrete members with different volume of fractional replacement of non-wovenGeo-fabrics and the same is compared without geo-fabrics concrete members.

EXPERIMENTAL WORKS

The previous works with Geo-fabrics in soil media showed best performance in all aspects, hence further in this work the tests has been conducted to study the performance of concrete elements in the presence of Geo-fabric material. The material behavior under compression is performed by testing blocks and Flexure, Shear behavior is performed with beams by adding different percentage volume fraction of geo-fabric material in concrete mix. The compressive strength criteria is studied with by 150mm*150mm*150 mm cube and flexure and shear strength criteria is performed with 100mm*100mm*500mm prisms moulds respectively.

Materials Used

Cement

Cement Grade- OPC 53 conforming to IS 8112

Specific gravity of cement-3.15

Aggregates

Maximum nominal size of aggregate-20mm

Specific gravity of coarse and fine aggregate-2.74

Fine aggregate-Conforming to Zone-1 of table-4 of IS-383

Mix proportion-1:2:4

Geofabric material

Figure-1 shows Nonwoven Fabric-PE12XEF is a polyester fiber; needle punched nonwoven geotextile manufactured by Sofinco Industries (Pvt) ltd with its systematic approach to quality. The properties of fabric is indicated in table-1.

Figure-1 Nonwoven Geo-fabric

Table-1: properties of Nonwoven fabric material (source-Sofinco industries (p) Ltd.)

PROPERTY	TEST METHOD	UNIT	VALUES
Physical			
Mass per unit area	ASTM D5261	g/m^2	120
Thickness	ASTM D5199	mm	1.25
Mechanical			
Grabtensile strength	ASTM D4632	N	225
Grab elongation at break	ASTM D4533	%	116
Bursting Strength	ASTM D3786	Kpa	800
CBR Puncture Strength	ASTM D6241	kN	710

EXPERIMENTAL TEST RESULTS

The experimental observations made on various volume fraction of fabric addition to concrete cubes and prisms,thespecimensshown in figure-2. The flexure test is performed on prisms and compressive strength test is conducted on blocks. The various test results are tabulated in table-2 to table-6.

Figure-2 Experimental specimans Cubes and Prisms

Compressive strength of Cubes (150mmX150mmX150mm)

Table1-Compressive Strength without fabric

Specimen Number	Compressive load[KN]		Area of specimen[mm^2]	Compressive Strength[N/mm^2]	
	7th Day	28th Day		7 Days	28 Days
1	400	750		17.7	33.34
2	405	725		18	32.23
3	400	735		17.77	32.67
4	410	756		18.22	33.6
5	396	742		17.6	32.92
6	402	730	150X150	17.86	32.44

Table-2 Compressive strength with 1.26% volume fraction of fabric

Specimen Number	Compressive load[KN]		Area of specimen[mm^2]	Compressive Strength[N/mm^2]	
	7th Day	28th Day		7 Days	28 Days
1	350	605		15.56	26.88
2	360	585		16	26
3	350	600		15.56	26.67
4	375	632		16.67	28.08
5	367	628		16.31	27.91
6	372	605	150X150	16.53	26.88

Table-3 Compressive strength with 2.52% volume fraction of fabric

Specimen Number	Compressive load[KN]		Area of specimen[mm^2]	Compressive Strength[N/mm^2]	
	7th Day	28th Day		7th Day	28th Day
1	375	575		16.67	25.56
2	380	580		16.87	25.76
3	375	585		16.67	26
4	386	596		17.15	26.48
5	382	605		16.97	26.88
6	378	608	150X150	16.8	27.02

Flexure and Shear strength of prisms (10cmX10cmX50cm)

Sample Number	Ultimate Load [kN]		Flexure Strength [N/mm^2]		Shear Strength[N/mm^2]	
	7 Days	28 Days	7days	28 days	7 days	28 days
1	5.24	8.84	2.56	4.33	0.26	0.44
2	5.19	8.76	2.55	4.29	0.25	0.43
3	5.33	8.92	2.61	4.37	0.26	0.44
4	5.26	8.46	2.57	4.14	0.26	0.42
5	5.12	8.42	2.50	4.12	0.25	0.42
6	5.68	8.92	2.78	4.37	0.25	0.44

Table-4 Flexure and Shear strength without fabric

Sample Number	Ultimate Load[kN]		Flexural Strength [N/mm^2]		Shear Strength[N/mm^2]	
	7^{th} Day	28^{th} Day	7^{th} day	28^{th} day	7^{th} day	28^{th} day
1	5.84	7.44	2.92	3.72	0.30	0.38
2	5.6	9.35	2.80	4.65	0.28	0.46
3	6.02	11.3	3.01	5.65	0.30	0.56
4	5.84	9.6	2.92	4.8	0.29	0.48
5	5.92	9.82	2.96	4.91	0.29	0.49
6	6.12	11.2	3.06	5.6	0.30	0.49

Table-5 Flexure and Shear strength with 1.26% volume fraction of fabric

Sample Number	Ultimate Load[kN]		Flexure Strength [N/mm^2]		Shear Strength[N/mm^2]	
	7^{th} Day	28^{th} Day	7^{th} day	28^{th} day	7^{th} day	28^{th} day
1	6.2	10.54	3.10	5.27	0.31	0.52
2	6.6	10.2	3.30	5.10	0.33	0.51
3	6.48	10.6	3.24	5.32	0.34	0.53
4	6.56	10.32	3.28	5.16	0.33	0.51
5	6.74	10.52	3.37	5.26	0.34	0.52
6	6.66	10.32	3.33	5.16	0.34	0.51

Table-6 Flexure and Shear strength with 2.52% volume fraction of fabric

CONCLUSION

The table-2 represents the without fabric the compressive strength of specimen and table-2 and table-3 represents the fabric with volume fraction of 1.26% and 2.52%. The results observed that there is a decrement in the compressive strength of a concrete cube of having 1.26% volume fraction of fabric at 28 days is 17.6%, further Increase in the volume fraction of fabric from 1.26% to 2.52% is not shown any significant variation in 28^{th} day compressive strength of concrete cubes.The table-4 represents the without fabric the shear and flexuralstrength of specimen and table-5 and table-6 represents the fabric with volume fraction of 1.26% and 2.52%. The flexure and shear strength of concrete with 1.26% volume fraction of fabric is enhances the strength 14.14% and 13.12% respectively, further Increase in the volume fraction of fabric from 1.26% to 2.52% is 21.97% and 19.96% respectively. Hence the performance in flexure and shear enhanced due to increase in volume fraction of fabric even decrement in compressive strength is not shown any significant variation.

The shear reinforcement of concrete can be computed based on the enhanced shear strength of the concrete, by using fabrics which may reduce the area of steel used for stirrups but on not commenting the part of the minimum shear reinforcement requirement as discussed in codal provisions, presently this result will not be having any comment about minimum requirement of shear reinforcement.

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