EXPERIMENTAL STUDY ON STRENGTH PROPERTIES OF GEOSYNTHETICS IN CONCRETE

X.Lordson
M.E- Structural Engineering,
Oxford Engineering College,
Trichy-09, India.
lordson.xavier@gmail.com

Dr.G.Dhanalakshmi (Prof & Head)
Department of Civil Engineering,
Oxford Engineering College,
Trichy-09, India.
civil.oxford09@gmail.com

Abstract — ***The application of geogrids in concrete constitutes a new dimension for using geosynthetics in infrastructure. Geosynthetics are widely used as soil reinforcement, separators, drainage, and filters and also used across the globe in the various infrastructure projects. The objective of studying the behavior of geogrids and Geotextiles in concrete members is to assess the feasibility and benefit of using these in thin concrete overlays. The experiments were performed to examine the mechanical properties of concrete which tried to verify the possibility of utilizing the geosynthetics as an alternative material to the steel reinforcement in concrete.***

Keywords- Portland Pozzolona cement (PPC), Conventional concrete (CC), Geogrid(GG), Geotextile(GT)

I. INTRODUCTION

Geosynthetics in the term used to describe a range of generally polymeric products used to solve civil engineering problems. In this nature make this material have a high durability. Reinforcement is the synergistic improvement of a total system strength created by the introduction of a geotextile or a geogrid (both of which are good in tension) into a soil (that is good in compression, but poor in tension) or other disjointed and separated material. Applications of this function are in mechanically stabilized earth walls and steep soil slopes. Also involved is the application of basal reinforcement over soft soils and over deep foundations for embankments and heavy surface loadings

II. MATERIALS USED

A. *Cement*

PPC used in this project. Cement is a binding material that sets and hardens independently, and can bind fine and coarse aggregate together. At ordinary temperature to form compounds possessing cementitious properties. PPC produces less heat of hydration and offers greater resistance to attack of aggressive waters than ordinary Portland cement. it chemically react with calcium hydroxide Pozzolona cement shall comply the requirements of IS 1489. 53 grade PPC.

B. *Fine Aggregate*

The sand is collected from the local area. The sand sieved in 1.18mm (passed) and retained in 600µ. After that the retained sand was weighted. The procedure was continued to find out the fineness modulus of sand. Fine aggregates filled the gap between coarse aggregate to increase bonding between cement and coarse aggregate

C. *Coarse Aggregate*

Aggregate shall comply the requirements of IS 383. As far as possible, preference shall be given to natural aggregates. The nominal size of coarse aggregate should be large as possible within the limits specified but in no case greater than one-fourth of the minimum thickness of the member. 20mm size respectively was selected as coarse aggregate.

D. *Geogrid*

Polypropylene geogrids used in this project. It improve the structural integrity of soils in roadways, walls and slopes by reinforcing and confining fill materials and distributing load forces. Geogrids are also used in base reinforcement applications to reduce aggregate thickness requirements or extend roadway performance life.

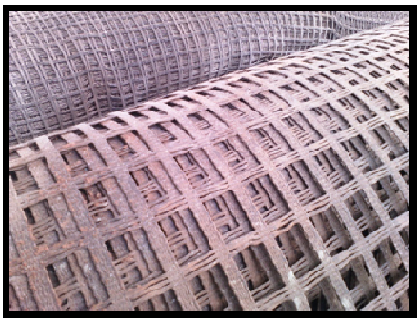

Fig. 1 – Polypropylene Geogrid

E.Geotextile

Geotextiles forms one of the largest groups of Geosynthetic material. Its functions and properties are deeply studied, so now it is widely accepted and used in various areas of Geotechnical structures. Most important factor that makes it prominent is its longer life and resistance to biodegradation because of its synthetic fiber content rather than natural content like Jute, cotton, wool or silk. Unlike natural fibers like cotton, jute etc

Fig. 2 –Polyester Geotextile

III. MATERIAL PROPERTIES

A. *Cement Properties*

The property of the cement is tabulated below,

Table 1 – Cement Properties

Property	Value
Initial setting time	45 minutes
Final setting time	8 hours
Specific gravity	3.11
Consistency	30%
Fineness modulus	6.38%

B. Fine Aggregate Properties

The property of the river sand is tabulated below,

Table II – Fine Aggregate Properties

Property	Value
Specific gravity	2.62
Water absorption	1.6%

C. *Coarse aggregate Properties*

The property of the coarse aggregate is tabulated below,

Table III – Coarse Aggregate Properties

Property	Value
Specific gravity	2.65
Water absorption	1.3%
Free moisture content	0

D. Polypropylene Geogrid Properties

Table IV – Geogrid Properties

Property	**Value**	**Min. Value**
Type of Polymer	Polypropylene	----------
Open Area (%)	78	>50.0, <80.0
Mass per Unit area (g/m^2)	530	----------
Ultimate Tensile Strength (KN/m)	19.2	>11.67 (ASTM D6637)

E. Polyester Geotextile Properties

Table V – Geotextile Properties

Material	**Moderate Survivability**		
Property	**ASTM Test**	**Elongation <50%**	**Elongation >50%**
Grab Tensile Strength (N)	D 4632	1100	700
Trapezoid Tear Strength (N)	D 4533	400	250
CBR Puncture Value (N)	D 6241	2250	1400

Table VI – Mix Proportion of concrete

Materials	Mix proportion
Cement	1
Fine aggregate	1.28
Coarse aggregate	2.31
W/C ratio	0.4

IV. RESULTS AND DISCUSSIONS

The results and discussions about the various tests are as follows

A. *Compression test on cubes*

The test is done on 7th , 28th day of curing to determine the compressive strength of concrete specimens as per IS: 516 – 1959. Size of the cube specimens are 15cm x 15cm x 15cm .It expressed in terms of N/mm^2.

Table VII – Compressive Strength Results

Specimen	Compressive strength (N/mm^2)	
	7 days	28 days
CC	22	33.7
GG	23.75	36.4
GT	23	34.8

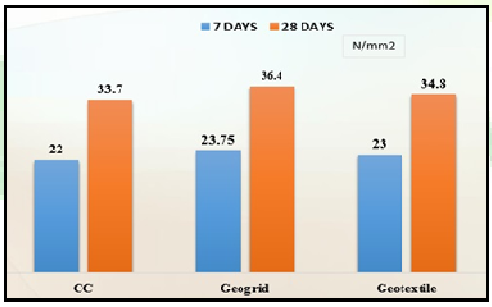

Fig.3 - Compressive Strength chart

B. *Split tensile test on cylinders*

The test is done on 7th, 28th day of curing to determine their split tensile strength. Size of the cylindrical specimens are 15cm in diameter and 30cm long. Polypropylene GG & Polyester GT is shaped into a tubular form and inserted in the cylindrical mould before the concrete lay The specimens are placed horizontally between the loading surface of the Compression testing machine and the load is applied till the specimens fails. The ultimate load at the time of the failure is noted down.

compressive strength = 2p/LD

Where

P – Compressive load

L – Length of the cylinder

D – Diameter of the cylinder

Table VIII – Split Tensile Strength Results

Specimen	Split Tensile strength (N/mm^2)	
	7 days	28 days
CC	2.4	2.7
GG	3.1	3.5
GT	2.5	3.1

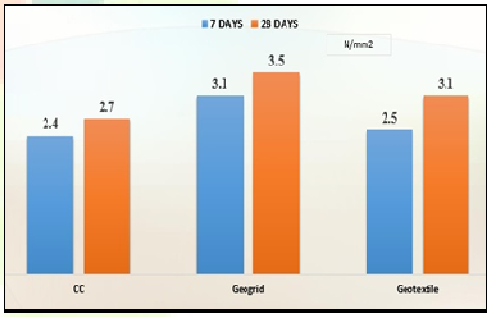

Fig.4 – Split tensile Strength chart

C. *Flexural strength test on Prisms*

The test is done on 7th, 28th day of curing to determine their Flexural strength. size of the prism is 50cm length, 10cm width and 10cm depth. Polypropylene GG & Polyester GT was placed as a layer at the distance of 20mm from the bottom

Flexural strength on prism was computed by,

$$F_t = Pl / bd^2$$

Where,

F_t = Flexural strength in N/mm^2

P=Applied load in kg

l = span length in mm

d = depth of the specimen in mm

b = breadth of the specimen in mm

Table IX – Flexural Strength Results

Specimen	Flexural strength (N/mm^2)	
	7 days	28 days
CC	4	4.6
GG	4.8	5.5
GT	4.3	4.9

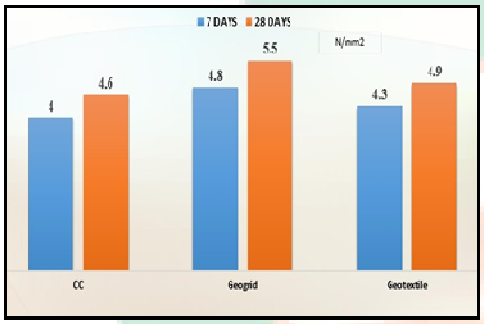

Fig.5 – Flexural Strength chart

Discussion

- Compressive strength of the concrete is increased 7.41 % in the provision of Polypropylene geogrid layer
- Compressive strength of the concrete is increased 3.26 % in the provision of Polyester Geotextile layer
- Tensile strength of the concrete is increased 23 % in the provision of Polypropylene geogrid layer
- Tensile strength of the concrete is increased 13 % in the provision of Polyester Geotextile layer
- Flexural strength of the concrete is increased 16 % in the provision of Polypropylene geogrid layer
- Flexural strength of the concrete is increased 6 % in the provision of Polyester Geotextile layer

V. CONCLUSION

Compare the two materials through its strength properties Geogrid have good strength compare to the geotextile.Flexural and tensile strength of the geogrids 10% greater than geotextile.Both materials are have good durability to withstand corrosive and acid attack. Because they have polymeric properties.So we adopt these geosynthetics materials instead of steel to improve small amount of tensile strength .So it is suitable for Rigid pavement

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