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Experimental Evaluation on Response of Polyester Biaxial Geo-Grid proportioned Cement Concrete

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Abstract: ***Behaviour of concrete under tensile forces is very week because of poor ductility. Steel reinforcements have been used to improve the ductile characteristics of concrete members. The steel shows significant enhanced strength but at the same time it affected by environmental parameters and leads to cause corrosion. Recent studies have shown that several alternative materials used to alternative for steel for reinforcements in concrete structures. The Geo-grids is a material having high tensile strength and high ductility. Geo-grids are widely used in several applications like Soil stabilization, Pavements, Retaining walls and also used in several concrete structural applications. In this present study the polyester Bi-axial Geo-grids are evaluated by proportioning concrete elements like Cubes and prisms. Study shows that enhance in strength and ductility of concrete materials. Further this study helps to conclude Polyester Biaxial Geo-grids are replacing reinforcements (Tensile and Shear) in concrete structures.***

Keywords: ***Tensile force, Environment, Polyester, Ductility, Concrete***

I. INTRODUCTION

The concrete is a brittle material and it can take very high compressive loads but fails to take tensile loads. To avoid this failure concrete members are reinforced with steel bars but now days an extensive research has been taken place to enhance the tensile strength of concrete by adding replacing steel reinforcements by alternative materials. Geo-synthetics have been more extensively used in the field of Geotechnical engineering to enhance the properties of the soil material these materials are also used as reinforcing and stabilization materials in various civil and infrastructure works (Maxwel et all 2005). These materials further have extended to use in concrete pavements particularly stabilizing media in unbounded layers (Yu et all 2009). Recently the Flexural behavior of Different types of Geo-grids with Concrete structural members were studied and reported that all types of Geo-grids reinforcements provide a ductile post cracking Behavior, high fracture energy and flexural strength (F. EI Meski et all 2014). Further an experimental investigation has been carried out to study the behavior of plain cement concrete beams reinforced with two and three layers of uniaxial Geo-grid and biaxial Geo-grids the investigations shows that both Uniaxial and biaxial Geo-grids provide post cracking and ductile behavior like steel in beams (S Shobana et all 2015). The objective of the present research paper is to understand the basic structural strength properties of concrete at different age of 7,15 and 28 days with different volume of fraction of polymer Biaxial Geo-grids.

II. EXPERIMENTAL INVESTIGATION

A. Material Specifications

The plain cement concrete mix was prepared using Portland cement, natural sand as fine aggregate and maximum nominal size of 20mm crushed stone as coarse aggregate. The cement to fine aggregate to coarse aggregate by mass was 1:2:4 with water cement ratio of 0.5 and the concrete grade 53. The properties of coarse aggregate and fine aggregate are illustrated in Table-1 and in Table-2.

TABLE I PROPERTIES OF COARSE AGGREGATE

Property	Coarse Aggregate
Specific Gravity	2.74
Fineness Modulus	6.4
Bulk density (kg/m^3)	1500
Water absorption	0.8%

TABLE II PROPERTIES OF FINE AGGREGATE

Property	Fine Aggregate
Specific Gravity	2.74
Fineness Modulus	2.4
Bulk density (kg/m^3)	1700
Water absorption	1%

The Biaxial Strata Geo-grids are used in this study are stiff Geo-grids, nonwoven, punch-drawn Geo-synthetic material and made up of Polyesters. Variations exist in the aperture geometry and dimensions and in the physical and mechanical properties. The Strata Bi-axial Polyester Geo-grid used in this study has a tensile strength of 100 kN/m in both the direction and represented in Figure-I. The details of Polyester Bi-axial Geo-grids given by manufacturer STRATA INDIA presented in Table-III.

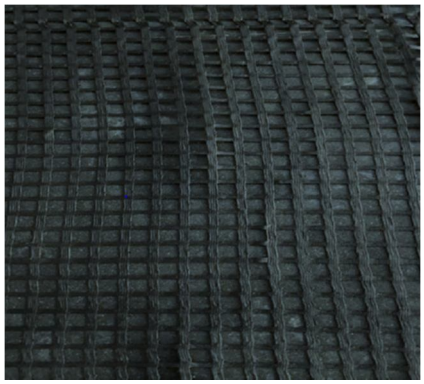

Fig. I. Polyester Bi-axial Geo-grid

TABLE IIII DETAILS OF POLYESTER BIAXIAL GEO-GRIDS (SOURCE: STRATA GEO-GRIDS INDIA)

Mechanical Properties	Units	Geo-grid Bx100
Tensile strength (ASTM D 6637-method A)	kN/m	100
Creep Reduction Factor	---	1.47
Creep Limited strength	kN/m	68.0
Partial factor-Installation Damage (ASTM D 5818)	---	1.07
Partial factor-Environmental Effects	----	1.10

The experimental evaluation using Polyester Biaxial Geo-grids conducted for different concrete elements. The Table IV gives the Details of specimens to be tested.

TABLE IV DETAILS OF SPECIMENS TESTED

Test	Compressive strength	Flexural Strength
IS Specifications	IS:516-1959	IS:516-1959
Specimen Type	Standard Cube 150X150X150 mm	Standard Beam 100X100X500 mm
Number of specimens	09	09

B. Specimen Fabrication

The Concrete behavior under compression is performed by testing Cubes, Flexure behavior is performed with Prisms and Split Tensile strength is performed with Cylinders by adding Different proportions of Biaxial Geo-grids at major yield locations in concrete members. The compressive strength criteria are studied with by 150mm*150mm*150 mm cubes. The flexure strength criteria performed with 100mm*100mm*500mm Beams. The Geo-grids were placed in layers at 30mm above the soffit of cube and Beam in one layer and 30mm soffit and top in cube and prisms in two layers.

C. Placing of Polyester Geo-grids

The Geo-grids placing plays a significance role to enhance the properties of concrete members. In this present work the Geo-grids are placed with reference to experimental investigation on control specimens. The Concrete members fail due to maximum load and failure due to formation of plastic hinges at specific regions. The failure regions are soffit of prisms. Also in case of cubes Geo-grids are placed above the soffit of member. In all the specimens Geo-grids are placed perpendicular to the loading of specimens.

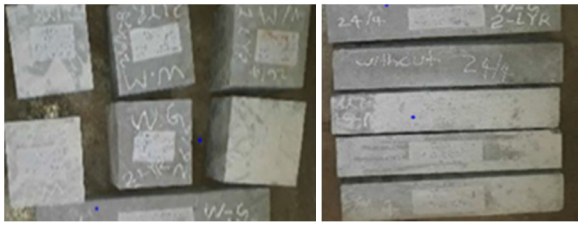

Fig. II Concrete Specimens used for Testing

III. RESULTS AND DISCUSSIONS

A. Compressive Strength of Biaxial Geo-grids

The compressive strength of concrete cube can be more significant in analysis because in this present study has been carried using Geo-grids in layers. To know the behavior of concrete with aging plays a significant role. Normally concrete is very strong in compression but in this present study helps to know the behavior of concrete even after addition of Geo-grids in single and double layers. It is noted that in initial age of concrete it is not having any significant change in strength but at middle age with Geo-grids shows decreasing by 3% to 4% compare with without Geo-grid specimens. After full age of 28 days it shows 9% incremental with two layers of Geo-grids it is shown that the homogeneity with Geo-grids are not attained at earlier age but after full strength of 28 days it attains significant homogeneity with concrete mix and helps to enhance the compressive strength also it is represented in Figure. III.

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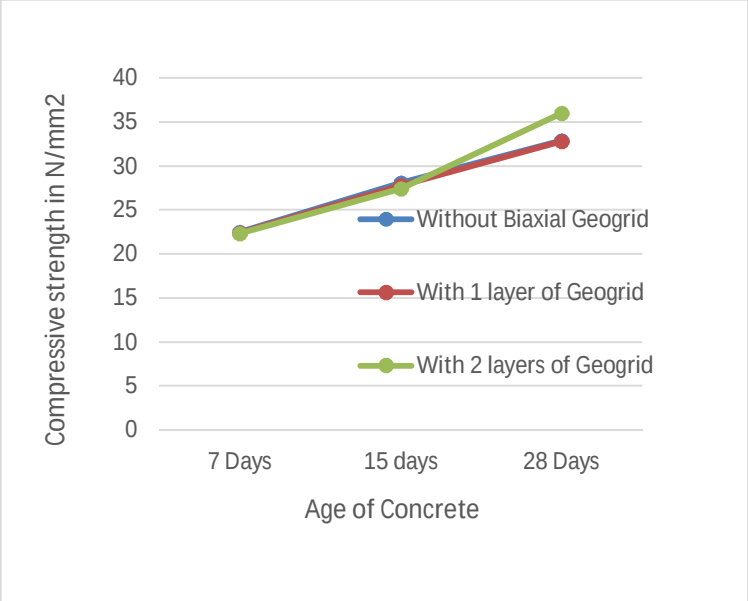

Fig. III. Variation of compressive strength at different age of Concrete

B. Flexure strength of Biaxial Geo-grids

The flexural strength of the concrete helps to find the behavior of prisms under Bending. The one-point flexure test is conducted to determine the failure load of each specimen. The flexure strength of one-layer Geo-grid shows 10% increase in strength compare with without Geo-grid specimen. The two layers proportioned Geo-grids shows nearly 15-16% increase in the flexure strength of the specimen at full age strength of 28 days. In early age also, it shows significant rise in one and two layers of proportioned specimens. The Figure.IV shows the Variation of Flexure strength at different age of Concrete.

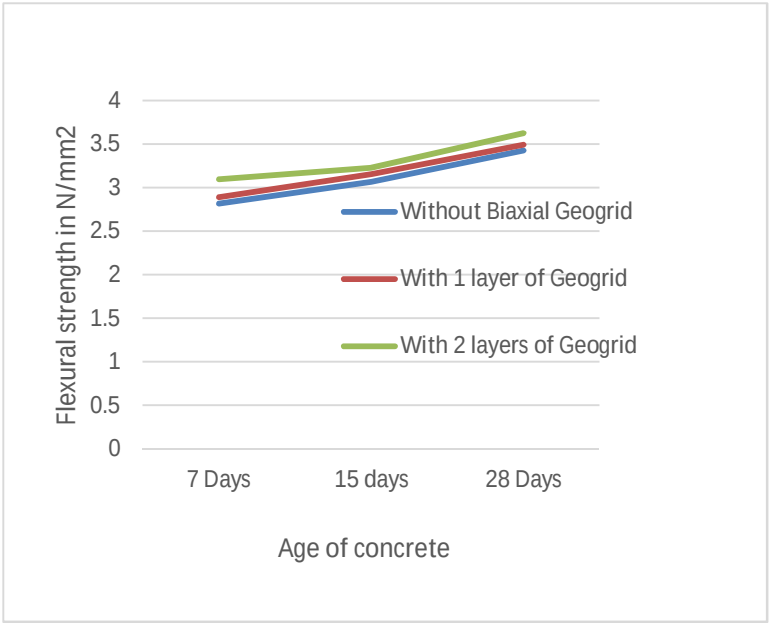

Fig. IV. Variation of Flexure strength at different age of Concrete

C. Load -Displacement Behavior of Prisms under Single Point LOADING

This study helps to determine the load carrying capacity of specimens with addition of Geo-grids with respect to displacement. Figure-V and Figure-VI it is clear that the displacement carrying efficiency is more in two-layers of Geo-grids and it represents the Geo-grids acts like reinforcing characteristics within the specimens.

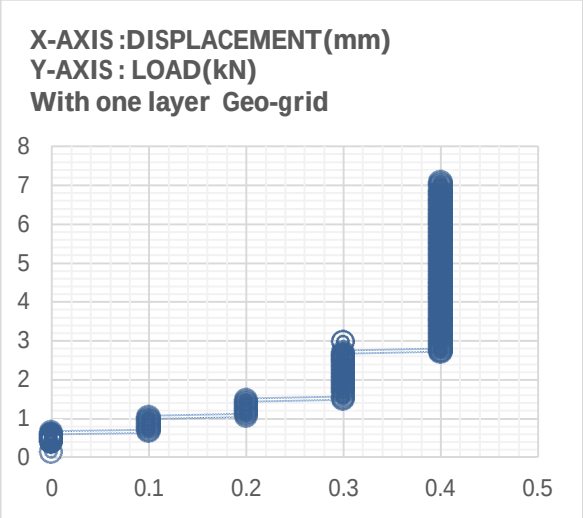

Fig. V. Load-Displacement of one-layer Geo-grid at age of 28 days curing

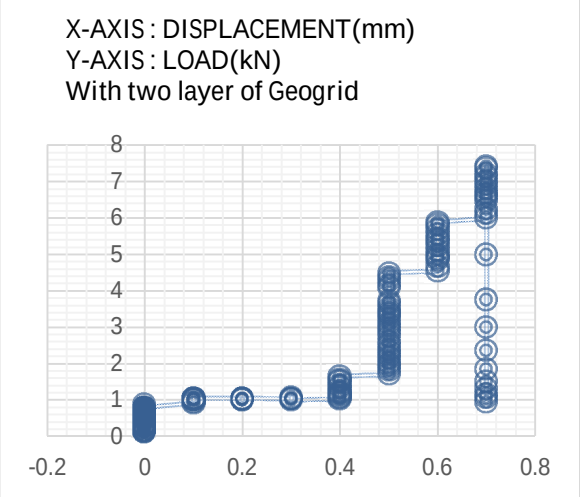

Fig. VI. Load-Displacement of Two-layer Geo-grid at age of 28 days curing

IV. CONCLUSION

An experimental investigation has been carried out to study the behavior of plain cement concrete prisms and cubes proportioned with one and two layers of biaxial Geo-grids. From flexure tests it has been found out those Geo-grids can take tensile forces when these are kept in plain cement concrete beams. The total experimental investigation can be summarized as follows.

A. The failure in Geo-grid concrete prisms due to initial failure of Geo-grids in specimens.
B. The compressive strength at full age of concrete get significant rise compared with controlled specimens.
C. The flexure strength also shows the significant increment with one-layer proportions compared with two-layer proportions of Geo-grids.
D. The load -Displacement analysis shows that the presence of Geo-grids in Concrete helps to make brittle nature of concrete to ductile one. Also, it shows the time taken to yield of specimen is high compare with normal conventional without Geo-grid specimen. Hence, With Biaxial Geo-grid specimen acts like reinforcements.

V. ACKNOWLEDGMENT

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