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EFFECT OF GEOGRID CONFINEMENT IN REINFORCED CONCRETE MEMBERS

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Abstract--The aim of the present study is to find the effect of using geo-grids on various places in reinforced concrete beams. The use of geogrid in concrete setup a new dimension for employing a geo synthetics in structural engineering. The purpose of examining the behaviour of geo-grids in structural members gives opportunity to observe benefit and feasibility of using geogrid in various points of RCC beams. These materials have characteristics such as increased ductility and low weight to reduce inertial forces as well as reduce cost. Different studies have been performed to obtain new solutions for the construction industry, which has shown increasing interest in geo-grids. Recently the Flexural behaviour 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 behaviour, high fracture energy and flexural strength. Hence the geo grid are examined in recent research studies. By that way geo-grid are to be test by placing at various positions a different spacing in RCC beam and it is compared with the conventional concrete beams. In this study one control beam and three biaxial geogrid beams are tested to check whether geogrid can be used in addition or alternate to steel in structural member. Geo grids are placed in addition to stirrups and the results are formulated.

Keywords: Reinforced concrete beams, biaxial geogrid, flexural strength.

I INTRODUCTION

Geo synthetic are generally a polymeric and sustainable material. Geo synthetic have long been used as reinforcement and stabilization elements in various heavy civil and infrastructure works particularly as it relates to geotechnical engineering. More recently, the use of geogrids as reinforcement elements has expanded into pavement systems, particularly as stabilizing media in unbound layers, reinforcing elements in asphalt layers and as interlayers in overlay applications Using geogrids as interlayers to mitigate reflective cracking in asphalt overlays of jointed plain concrete pavements (JPCP) has become widely used. Little research, however, has been performed on their use as reinforcement in thin Portland cement concrete (PCC) members and overlays in pavements and other structures where steel reinforcement cannot be placed due to constructability and durability limitations. The use of geogrid in concrete setup a new dimension for employing a Geosynthetic in structural engineering.One of the design capacity principles is to ensure that reinforced concrete (RC) buildings exhibit a ductile behaviour with the help of stirrups under the impact of earthquakes. Geo synthetic materials have characteristics such as increased ductility and low weight to reduce inertial forces as well as reduce cost. The geo-grid is a geo-synthetic material that has been widely used in research studies. Different studies have been performed to obtain new solutions for the construction industry, which has shown increasing interest in geo-grids. Recently the Flexural behaviour of differenttypes of Geo-grids with Concrete structural members were studied and reported that all types of Geo-grids reinforcements provide a ductile post cracking behaviour, high fracture energy and flexural strength. Further some reviews states that behaviour of plain cement concrete beams reinforced with two and three layers of uniaxial Geo-grid and biaxial Geo-grids shows that both Uniaxial and biaxial.The high demand and application of Geo- grids in construction are due to the fact that it is good in tension and has a higher ability to distribute load across a large area.

II FUNCTIONS

The geo-grids serve the function of holding or capturing the aggregates together. This method of interlocking the aggregates would help in an earthwork that is stabilized mechanically. The apertures in geo-grids help in interlocking the aggregates or the soil that are placed over them. The geo-grids as mentioned above helps in redistribution of load over a wider area. This function has made the pavement construction more stabilized and strong. It has the following functional mechanisms when applied for construction Tension Mechanism, improvement in bearing capacity, Lateral Restraining Capacity.

III OBJECTIVE OF STUDY

1. To investigate performance of geo grids used for enhancement of reinforcing concrete members.
2. To study about pre and post cracking behaviour of geogrid confined concrete members.

IV LITERATYRE REVIEWS

Ahmed Shaban Abdel-Hay Gabr [2019]Presented the study on strengthening of reinforced concrete slabs using different types of geo-grids. They used geo grid as strengthening material to one way slab and concluded that geo-grids are effective alternate material for strengthening of reinforced concrete slabs but the crack pattern observed in strengthen and unstrengthen slab are same. And also it is noticed that there is no bond failure between geo grid and slab. Geo-grid with high tensile strength had higher energy dissipation of slab and effective for resisting flexure tension. And from this study it is concluded that geo grids are good strengthening material when compared to conventional methods.

Aluri Anil Kumar Y. Anand Babu [2015] : Studied on Behaviour of Concrete Columns by Using Biaxial Geogrid Encasement. Here three type of model were casted and studied, one a conventional column, a column with geogrid (longitudinal bars) and pure geogrid reinforced columns, the geo grid reinforced columns fails when compared with conventional as the compressive strength of geogrid is low. The ultimate load carrying capacity of geogrid reinforced with longitudinal ties is 5% less when compared with conventional.

D. Chand Beebi , V.K. VisweswaraRao [2017]Investigated the flexural behaviour in geo grid reinforced concrete beams. In plain cement concrete beams the uniaxial and bi axial geo grids are arranged in form of different layers from one to three layers. As the result of the flexural tests it is observed that the geo grids can take the tensile force when these are kept in plain cement concrete beams, and also it is to be noted that flexural strength is more when three layers of uniaxial Geogrids are used when compared to bi-axial geo grid reinforced concrete beams. It is to be conclude from this study the post cracking and ductile behaviour of the geogrid reinforced beam is same as the steel reinforced beams.

F. EL Meski, G. Chehab[2017] Investigated about Flexural behaviour of concrete beams reinforced with different types of geogrids. The test parameters included three types of geogrids with different aperture shapes, physical and mechanical properties, and material composition. The inclusion of different types of geogrid in concrete beams subjected to flexural loading reveals significant improvement in flexural behaviour compared to plain concrete. Such improvement was detected in load-deformation response, flexural strength, and accumulated energy. Various possibilities could have caused the failure of concrete first followed by rupture of geogrids ribs.

Rakendu K , Anagha Manoharan [2017]Investigated about Flexural Behaviour of Concrete Beams Reinforced with Biaxial Geogrid. Here the experimental study consists of testing thirty four geogrid concrete beams and six control beam specimens under two-point loading. The geogrids are varied with number of layers, by performing two point load test the results were statement that load carrying capacity and flexural tests are only2.56% of the control beams. When geogrids are in addition to stirrups it shows increase in 4.4% of the control beams.

R. Siva Chidambaram, Pankaj Agarwal [2019]Made a research work in Shear resistance behaviour of geogrid-confined RC elements under static and cyclic loading. Here the test were performed for geogrids in between stirrups and the geogrids in beam column joints and concluded that the load deflection response of RC beams with grid confinement shows significant improvement in shear resistance and is further increased by adding small volume of steel fibres in concrete. There is about 50% enhancement in post-peak deflection with geogrid confined SFRC beam specimens than conventional beam specimens. The energy dissipation capacity is two times higher than conventional. The observed damage index and mode of failure prove that the geogrid confinement can resist up to peak load without severe damage in the joint region. The experimental results authenticate the influence of geogrid and steel fibre in increasing the shear resistance and show improvement in the damage tolerance capacity

V Properties of Geo-Grid

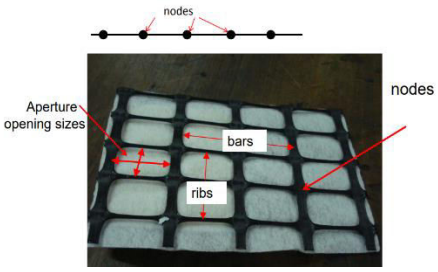

Fig .1. Biaxial Geogrid

Description	Unit	Value
Aperture Dimensions	mm (in)	25 (1.0)
Minimum Rib Thickness	mm (in)	0.76 (0.03)
Tensile Strength @ 2% Strain	kN/m	4.1
Tensile Strength @ 5% Strain	kN/m	8.5
Ultimate Tensile Strength	kN/m	12.4

Resistance to long term degradation	%	100
Resistance to UV degradation	%	100
Junction Efficiency	%	93

Table .1. Properties of biaxial geogrid

VI CASTING OF BEAM

In this study, Ultra tech brand Portland Pozzolana cement with specific gravity of 3.15 was used. The cement satisfied the requirements of Indian standards. M sand with Specific gravity 2.59 has been used.As per IS code specification, it was in the Zone III grading. Coarse aggregates of maximum size 20 mm and specific gravity of 2.85 has been used. M20 mix of 1: 1.54 : 3.5 with water cement ratio 0.5 is adopted. Top and bottom are reinforced with two numbers of 12 mm dia bars and stirrups are provided with 8 mm dia bars with 150 mm c-c

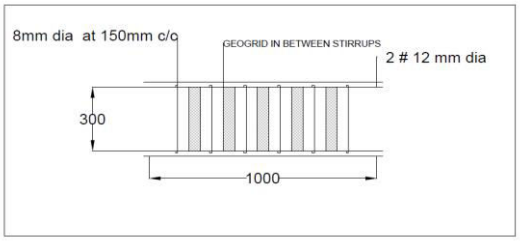

Fig .2. Details of Reinforcement

VII TEST SET UP

One control beam is compared with three Geo grid beams. All the beams were tested upto two point loads and the load is applied using hydraulic jack of 700 KN. Load at the first Crack , ultimate load and the deflection are measured by placing LVDT AT L/3 distance from two ends and also at centre.

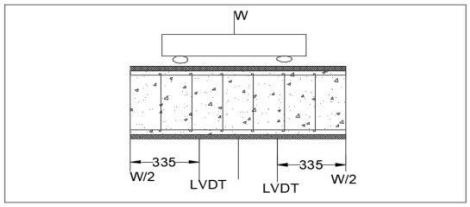

Fig .3. Schematic of Test Set up

Fig.4. Control Beam (CB)

Fig.5. Geo Grids Wrapped Around Beam (GGB1)

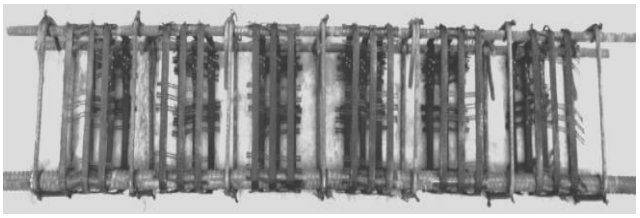

Fig.6. Geogrid between stirrups (GGB2)

Fig.7. Geogrid be used as stirrups without steel stirrups (GGB3)

VIII EXPERIMENTAL RESULT

Beam Designation	First crack load	Ultimate load	Deflection at 50 KN
CB	37	82	3.1
GGB1	38	85	3.0
GGB2	43	98	2.5
GGB3	36	81	2.9

Table .2. Observed data

Ultimate load carrying capacity is good for GGB2, and if the stirrups are completely replaced by geogrid material with low spacing it shows the result near to control beams.

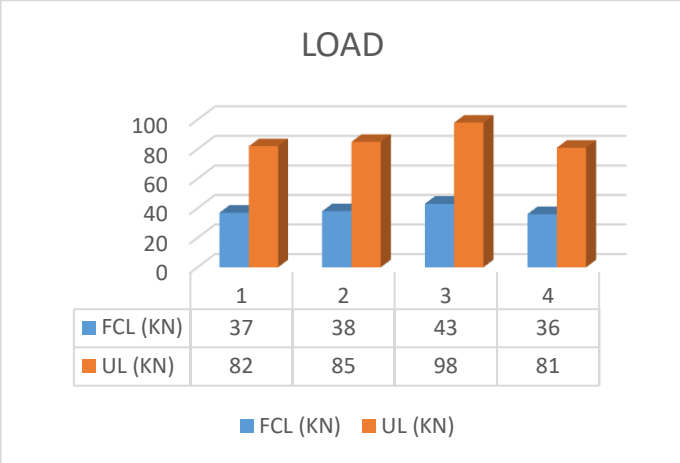

Fig .8. Load comparison chart

IX CRACK PATTERN

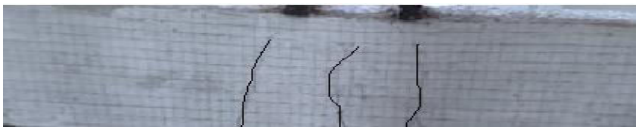

Fig.4. Control Beam (CB)

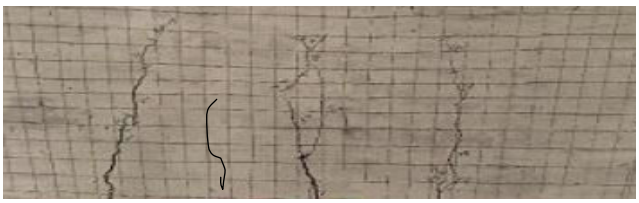

Fig.5. Geo Grids Wrapped Around Beam (GGB1)

Fig.6. Geogrid between stirrups (GGB2)

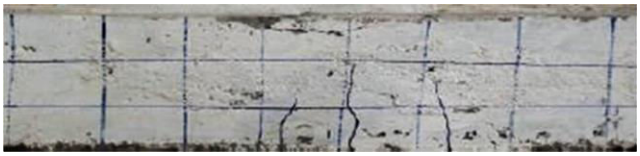

Fig.7. Geogrid be used as stirrups without steel stirrups (GGB3)

X CONCLUSION

The experimental study is carried out for three cases and compared with control beam. From the flexural study following results have been observed,

- The Pre cracking and Post cracking behaviour are same for control beam and the Geogrids are used as stirrups without steel stirrups.
- The Flexural strength and ductile properties are higher when geogrid is added as additional stirrups (when geogrid are added without any spacing)
- From this it observed that geogrid can used in additional to conventional members but it cannot be as replacement material in structural component
- Increasing the units of geogrid increase the load carrying capacity in less percentage
- Geo grid can be added in addition to steel stirrups where there is more dynamic load.
- The buildings near airport and railway stations prone to continuous dynamic forces which results in severe cracking and damage to structures, with further studied and results the geogrids can be used as additional component which reduces cracks as it have lateral restrain capacity
- Geo grids are economical and good composite material.

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