IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

EXPERIMENTAL STUDY ON SELFCOMPACTING RC BEAMS REINFORCED WITH GEOGRID AS TENSION REINFORCEMENT

[1]Reshma Suresh , [2] Amritha E. K.

[1] PG Student, Department of Civil Engineering, Universal Engineering College, Irijalakuda, Thrissur, Kerala, India,[3] Associate Professor, Department of Civil Engineering, Universal Engineering College, Irijalakuda, Thrissur, Kerala, India.

Abstract: This research looked into the behaviour of an SCC reinforced concrete (RC) beam with a biaxial geogrid as an extra reinforcement. The use of geogrid in concrete gave geosynthetics a whole new meaning in structural engineering. Geogrids are utilised in asphalt concrete layer stability, confinement, and strengthening, as well as to decrease reflective cracking in pavement applications. The purpose of examining the behaviour of geogrids in structural members gives opportunity to observe benefit and feasibility of using geogrid in thin concrete layers. One control beam (CB) and four geogrid reinforced concrete beams (GB) with variable geogrid layers from one to five are used in the experiment. The two-point stress on these beams was gradually increased until they collapsed. The first crack load, ultimate load carrying capacity and behaviour was observed till collapse occurred. The behavior and flexural strength of these geogrid beams were compared with that of a control beam that had the steel reinforcements alone. The results of the tests show that geogrid can be utilised as a substitute for steel in structural parts.

Index Terms - SCC (Self comapcting Concrete), biaxial geogrid, and flexural strength.

I. INTRODUCTION

Geogrid is geosynthetic material used to reinforce soils and similar materials. Geogrids are commonly used to reinforce retaining walls, as well as subbases or subsoils below roads or structures. Soils pull apart under tension. Compared to soil, geogrids are strong in tension. This fact allows them to transfer forces to a larger area of soil than would otherwise be the case. Geogrid are commonly made of polymer material, such as polyester, polyvinylalcohol, polyethllene or polypropylene. They may be woven or knitted fron yarns, heat-welded from strips of materials, or produced by punching a regular pattern of holes in sheets of materials, then stretched into grid.These geogrid can long be used as reinforcement and stabilization element in various heavy civil and infrastructure works , using geogrid as interlayers to mitigate reflective cracking in asphalt overlays of jointed plain concrete pavement (JPCP) has become widely used particularly as it relates to geotechnical engineering. More recently the use of geogrid as reinforcement element expanded to pavement systems, particularly as stabilizing media in unbound layers, reinforcing element in asphalt layers , and as interlays in overlay application [4]. Little research, however, has been performed on their use as reinforcement in thin Portland cement concrete members and overlays. The lack of conventional shear reinforcement in the concrete section with geogrid may be compensated with the use of steel fibers. The use of discontinuous, randomly oriented fibers has long been recognized to provide post cracking tensile resistance to concrete . The dispersed fibers act as effective shear reinforcement and increases shear-friction strength of concrete. They are more effective to arrest crack propagation. In steel fiber reinforced concrete , presence of randomly distributed steel fibers carries tensile stresses resulting from applied load and improves the tensile strength of concrete. Normaly concrete which is weak in tension so special care should taken for the improvement of flexural strenth in tension zone. Here Self Compacting (SC) reinforced concrete (RC) beam with biaxial geogrid as an additional Tension reinforcement can be studied. The use of geogrid in concrete setup a new dimension for employing a geosynthetics in structural engineering. Uniaxial geo-grids exhibit high tensile strength in their unidirectional ribs, while biaxial geo-grid ribs have tensile strengths in two directions and are often referred to as machine direction and cross direction. Tests conducted on biaxial geo-grids have shown that they cannot provide a uniform tensile strength when subjected to tension in different directions.The ultimate load carrying capacity of geogrid reinforced concrete beams and crack pattern of RC beams reinforced with geogrid materials was observed till collapse occured.

The use of self-compacting concrete (SCC) is steadily increasing, mainly in the precastindustry, and a large amount of research has been conducted on the fresh and hardened properties of SCC. However, relatively little research has been carried out on the structural behaviour of SCC.Self-compacting concrete is a fluid mixture suitable for placing in structures with congested reinforcement without vibration. Self-compacting concrete development must ensure a good balance between deformability and stability. Also, compactibility is affected by the characteristics of materials and the mix proportions ;it becomes necessary to evolve a procedure for mix design of SCC.The mix design of SCC can done As per IS.10262:2009 and EFNARC specifications. The test results for acceptance characteristics of self-compacting concrete such as slump flow, T_{50} cm slump flow test and L-Box are presented.

2. METHODOLOGY

2.1 Material properties

The various materials that are used in this study and its material property tests are carried out as per IS specification. The material that are used in this study are Ordinary portland cement of 53 grade of 3.04 specific gravity, M sand as fine aggregate with 2.54 specific gravity, crushed granite of 20mm size as coarse aggregate with 2.64 specific gravity, The flexural reinforcement of all beam considered of two steel bars of 8 mm diameter in the tension side and two steel bars of 8 mm diameter in the compression side. Shear reinforcement is adopted 6 mm steel bar having 100 mm spacing. The cement to fine aggregate to coarse aggregate proportions by mass were 1:1.6:0.9 with a water-cement ratio of 0.25 for Self compacting concrete. It is special type concrete. The mix design of SCC can done As per IS.10262:2009 and EFNARC specifications. The test results for acceptance characteristics of self-compacting concrete such as slump flow, T_{50} cm slump flow test and L-Box are presented. Further, compressive strength at the ages of 7, 28, and 90 days was also determined .Slump flow value is 600mm and T 50 cm slump flow value is 6.18 sec. L-Box test is used to determine the passing ability of concrete. The value obtained is 0.9.

Fig. 2.1 Slump Flow Test

Fig. 2.2 L-Box Test

2.2 Specimens

Cubes of sizes 150x150x150 mm were utilized to investigate the compressive strength of concrete. The beam specimen consists of a conventional SCC beam with, beam with distributed steel fiber as reference beam .Beam reinforced with one layer of geo-grid with the addition of steel fiber as specimen 1, Beam reinforced with two layer of geo-grid with the addition of steel fiber as specimen 2,Beam reinforced with three layer of geogrid with the addition of steel fiber as specimen 3 and similarly 4 layer. Based on the cube test result, super plasticizers is added as 1.167 % of binder content. The properties of the beam used are as follows: Beam specimen size : 1.2 m x 15 m x0.2 m .

Fig. 2.3 Reinforcement details

2.3 Test setups

The shear strength of the beam is tested as a two point loading system using a hydraulic jack attached to the loading frame. The behaviour of beam is keenly observed from beginning to the failure. The loading was stopped when the beam was just on the verge of collapse. The first crack propagation and its development and propagation are observed keenly. The values of load applied and deflection are noted directly and further the plot of load vs. deflection is performed which is taken as the output. The load in kN is applied with uniformly increasing the value of the load and the deflection under the different applied loads is noted.The applied load is increased up to the breaking point or till the failure of the material.

Fig. 2.4 Experimental Setup of Testing

3. EXPERIMENTAL RESULTS AND DISCUSSION

The control beam and geo-grid reinforced beam were casted. The ultimate load and the corresponding ultimate deflection at the mid span for all the tested beams have been determined. The experimental test results of all specimens will be discussed in this section with respect to their strength, load deflection response curves, failure modes and crack patterns.

3.1 Load Vs Deflection Behaviour

After the testing of different specimens under loading frame machine, different test results are obtained. During testing, the load corresponding to the crack point is noted as well. The loading frame machine automatically tabulates the test results in the system associated with the machine. From these data the failure load and the corresponding deflection for each specimen is noted down and is shown in Table 3.1.

Table 3.1: Test Results

Deflection (mm)	Load (kN)				
Mix	S25	SGR1	SGR2	SGR3	SGR4
0.1	30	56	60	73	80
0.2	56	68	73	80	89
0.3	62	78	80	98	100
0.4	74	80	100	120	137
0.5	98	97	108	130	151
0.6	110	100	120	143	163

S25 represents Control Specimen SGR1,SGR2,SGR3 and SGR4 represent Selfcompacting concrete with layers from 1 to5.

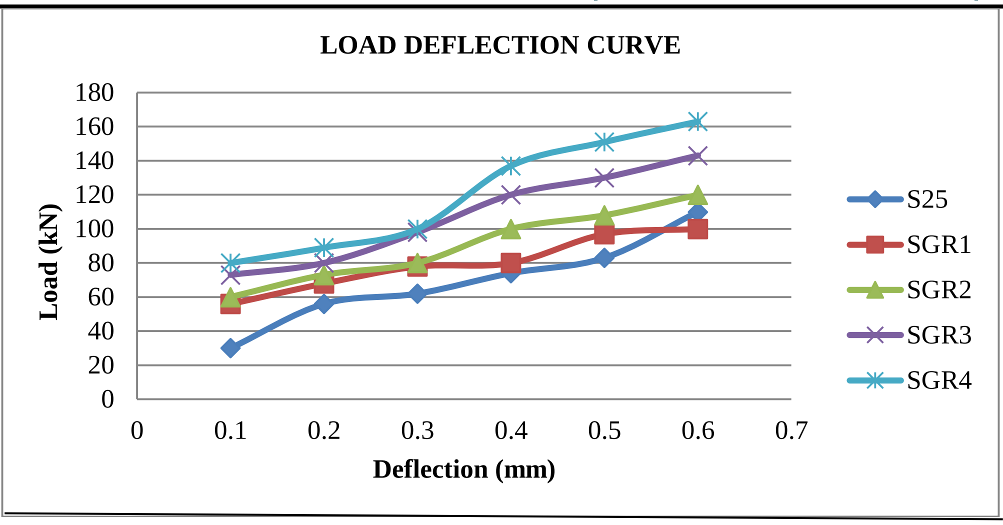

Fig. 3.1 Load – Deflection Graph

Load vs. Deflection graph for each specimen is plotted fig. 5 based on the results obtained from loading frame machine. From these plotted graphs, the comparison graph between each specimen is done.

3.2 Ultimate Load

The ultimate load of all beams were recorded . The ultimate load carrying capacity of geogrid beams were found to increase as the geogrid layer was increased, because of contribution by geogrid layer in load carrying capacity. As compared with conventional beam the geogrid beam attain more strength. Ultimate load carrying capacity of SGR 5 beams was 35% higher strength than S25.

3.3 Crack Propagation

It is observed that only flexural cracks were formed in all beams. In case of geo-grid beams the cracks were initiated from the bottom of the beam and cracked all the way to the top of the specimen. These cracks appeared only in the middle section of the beam. SGRI has wide crack than SGR 3. For SGR1 crack width ranges from 1.2 to 0.7cm from bottom to top. In SGR2 crack width ranges from 1.2 to 0.5cm from bottom to top. SGR3 has crack width ranges from 1-0.3cm from bottom to top and SGR 4 has crack width of 0.8 to 0.3.The reinforced beam with more layers remained intact as the crack initiated and cracked all the way to the top of the specimen. Geo-grid beam reinforced with one layer has wide crack failure of concrete. Layered geo-grid with distributed steel fiber reduce the propagation of crack.

4. CONCLUSIONS

The behavior of selfcompacting reinforced concrete beams with geogrids was investigated in an experimental research. As an additional layer, one conventional beam and four geogrid beams were cast with one, two, three, and four layers of geogrids. Two-point loading was used to test these beams.

- Geogrids also carry tensile forces when they are kept in tension zone of reinforced concrete beams
- The number of geogrid layers used in reinforced beam play a major role in flexure behaviour , ie Flexural strength of geogrid beam is increases when the layer of geogrid increased.
- Because the geogrid layer contributes to load carrying capacity, the ultimate load bearing capacity of geogrid beams was found to rise when the geogrid layer was raised. SGR4 beams had a 35 percent higher ultimate load carrying capacity than standard beams.
- When compared to steel reinforced concrete beams, beams reinforced with additional layers of geo-grid show better results in crack formation and deflection. It has the ability to decrease cracks and only occurs in the mid-span of the beam. The deflection of a geo-grid reinforced beam is lower than that of a steel reinforced concrete beam
- For SGR1 crack width ranges from 1.2 to 0.7cm from bottom to top. In SGR2 crack width ranges from 1.2 to 0.5cm from bottom to top. SGR3 has crack width ranges from 1-0.3cm from bottom to top and SGR 4 has crack width of 0.8 to 0.3.
- Geogrid is also utilised as a supplementary reinforcing material in RC beams when increased strength and reduced deflection and cracking are required.

V. **REFERENCES**

[1] **Athira Bhaskaran et. al** (2019), " Experimental Investigation of Flexural Behaviour of Geo-Grid Reinforced Concrete Beam with Distributed Steel Fiber", IJARET, 14(12), 15-19.

[2] **M.NKrishna et al,**(2012)Mixdesignprocedureforselfcompactingconcrete,*I*OSRJournalof Engineering,2(9), 33-41.

[3] **Prarthita Basu et. a**l (2018), "Mix design of self-compacting concrete-A new approach" Leonardo Electronic Journal of Practices and Technology, (33), 15-38.

[4] **S. Ramakrishnan et. a**l (2018), "Strength and Behaviour of Geogrid Reinforced Concrete Beams", IJCIET,9(6), 1295- 1303.

[5] **Subhrasmita Majumder et. al** (2020), "Experimental and numerical investigation on cyclic behaviour of RC beam column joints reinforced with geogrid material", Science Direct, Engineering Structures, 2(6), 1-9.

[6] IS 10262:2009 [Mix Design]

[7] IS 456:2000

[8] IS 4031-1988[Standard consistency of cement]

[9] IS 2720 (Part III) [Specific gravity of cement]

[10] IS 12269-1987 [Fineness of cement]

[11] IS 2386 (Part III)- 1963 [Fineaggregate]

[12] IS 383: 1970 [Sieve analysis]

[13] IS 2386 (Part III)- 1970 [Coarse aggregate]

[14] EFNARC- Specification and guideline for selfcompacting concrete.