

# Geogrid Reinforcement in Aerated Concrete

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**ABSTRACT:** Although the knowledge in structural engineering has advanced enormously in last decades, structure collapses still occur with significant frequency. The significance of Load bearing capacity of beam and slab is its high-quality mortar and steel reinforcement. However when subjected to seismic or any other loading of high intensity they will behave as brittle structural elements. Hence in order to improve their lateral resistance and ductile behavior, beam and slab are reinforced with steel. But the continuous use of steel will create scarcity of steel in the next 20 years. Over the years the introduction of sustainable development to overcome the issues of steel depletion has gained increased attention. The main objective of this project is to address the potential use of Geogrid as a material for reinforcement in lightweight concrete for construction of high intensity load resisting beam and slab. Former test results prove that geogrids are considerably strong in tension, hence its replacement by steel will further account to the improvement in ductile nature of walls which is the main property required for any civil structure. Thus by reducing the susceptibility of the structure to these unforeseen events is a key aspect in increasing the safety of buildings.

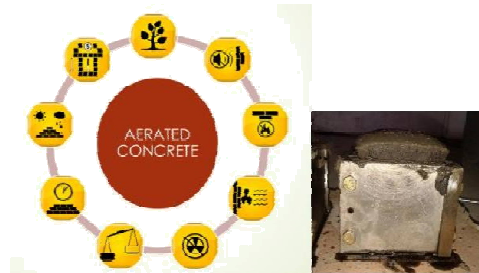
**KEYWORDS:** Advancement in structures, Aerated concrete, Beam, Eco-friendly, Geogrid as replacement for steel, Highly economical, Improved load bearing structures, Increase in safety, Slab.

## I. INTRODUCTION

Geosynthetics 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, as stabilizing media in unbound layers, reinforcing elements in asphalt layers, and as interlayers in overlay applications. 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. Such limitations include physical constraints of placing the reinforcing steel bars in thin sections, in addition to extensive time for construction and concerns of steel corrosion. Therefore, the need arises for alternatives to replace the reinforcing steel bars. The objective of this project is to completely understand the behavior of aerated light weight concrete with geogrids.

## II. AERATED CONCRETE

Aerated concrete is either a cement or lime mortar, classified as lightweight concrete, in which air-voids are entrapped in the mortar matrix by means of a suitable aerating agent. Broadly speaking aerated concrete falls into the group of cellular concrete (microporite being the other). Its lightweight economizes the design of structures.



**Fig 1. Aerated concrete advantages and casting.**

### III. GEOGRID

Geogrid is a polymeric material made up of many polymers like polyethylene, polyvinyl alcohol, polypropylene etc. As in steel, Geogrid will not corrode due to the presence of PVA which helps in resisting corrosion as well as fire. Geogrid consist of two axis, horizontal axis line is called as machine direction and the other one is called as cross machine direction. In biaxial geogrid, the strength in each direction will be of equal magnitude. This helps to attain high strength when combined with concrete.

#### 3.1. Physical and Mechanical Properties of the Biaxial Geogrids Used

##### Component Description Unit:

Tensile strength at 2% Strain 14 KNm

Tensile strength at 5% Strain 28 KNm

Maximum tensile strength MD/CMD 40=40 KNm

Elongation at nominal strength MD/CMD 11=10KNm

**Note:** MD = machine direction; CMD = cross machine direction.



**Fig 2 Biaxial Geogrid**

### IV. DESIGN MIX

The concrete mix contained required proportions of various materials which are cement, sand, lime powder (admixture) and in some cases cement and sand were replaced by Class C and Class F Flyash respectively, Conplast SP and aluminium powder. Different mix proportions were tried out which yielded different strength values and the most suitable result-yielding aerated concrete mix was taken for reinforcement with geogrid. The most suitable mix ratio is as follows:

The size of mould used is 0.07x 0.07 x 0.07m.  
Volume of the mould is 0.00034 m<sup>3</sup>.

Considering 20% wastage, V=0.0004116 m<sup>3</sup>.  
Density of concrete is 1150 kg/m<sup>3</sup>  
Cement : Sand = 1:2

20% of cement was replaced by class C Flyash, (i.e.) 0.032kg.  
Sand was replaced by class F Flyash (i.e.) 0.064 kg

Water cement ratio=0.5

The result (compressive load) obtained from the 1:2 mix ratio = 26KN



Fig 3. Cube Casting



Fig 4. Beam Casting

### V. ADMIXTURES USED IN MIX DESIGN

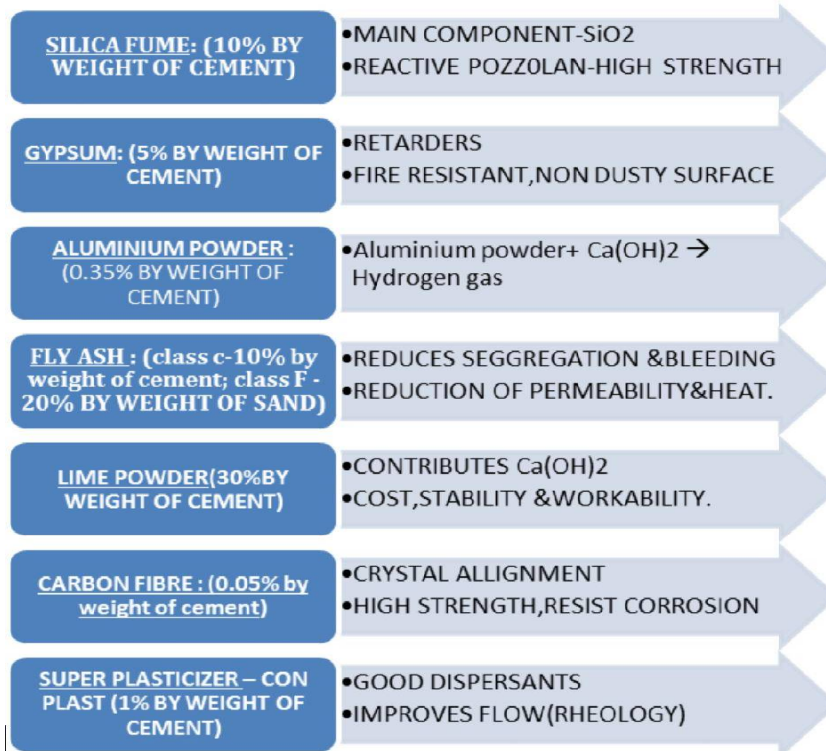
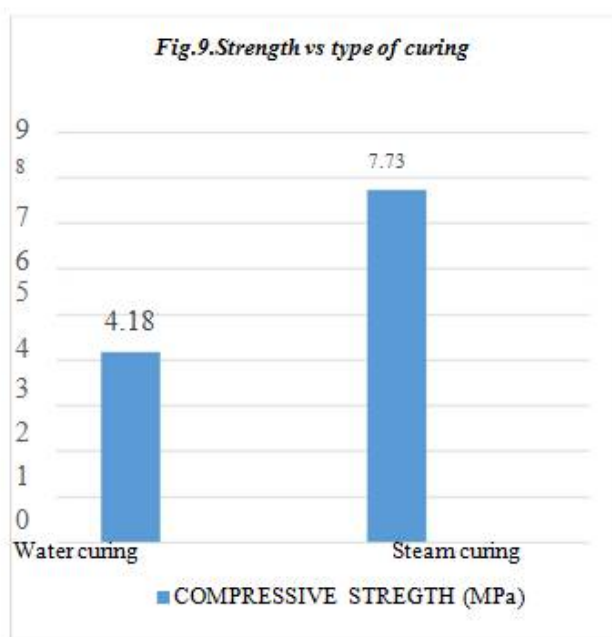
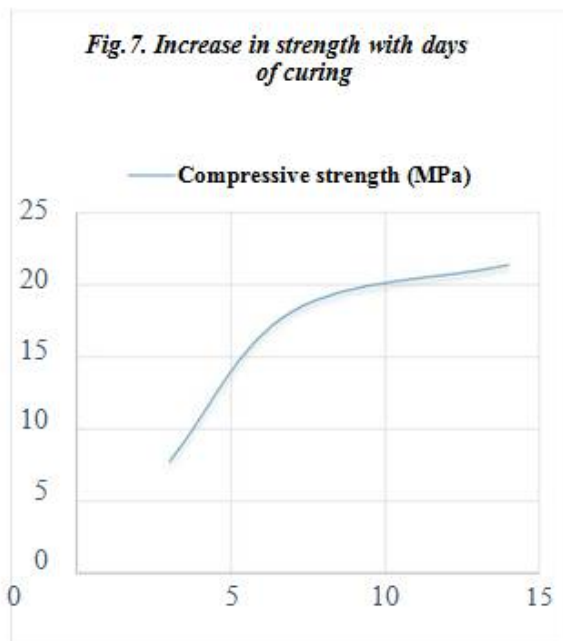
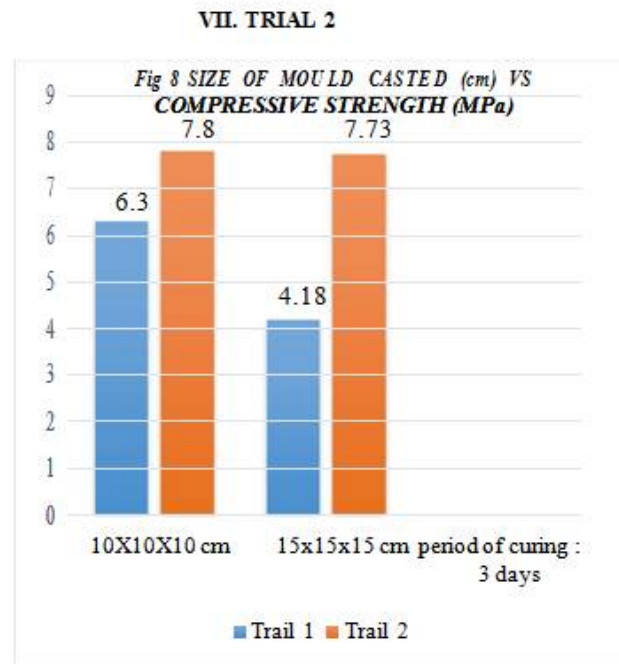
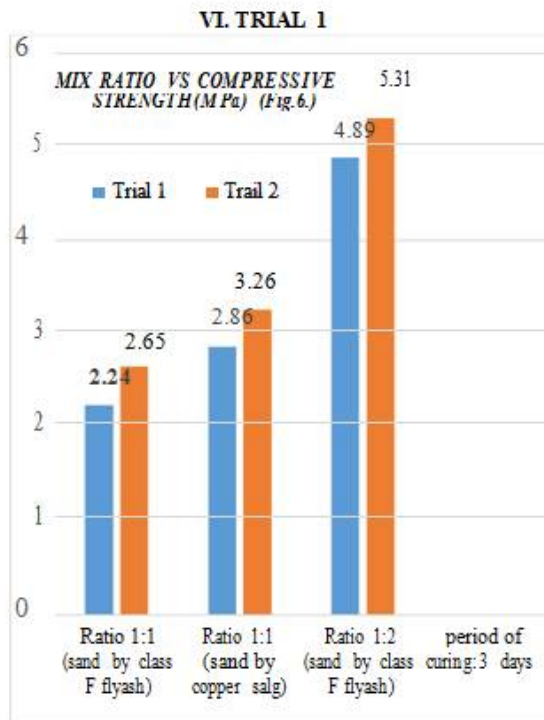
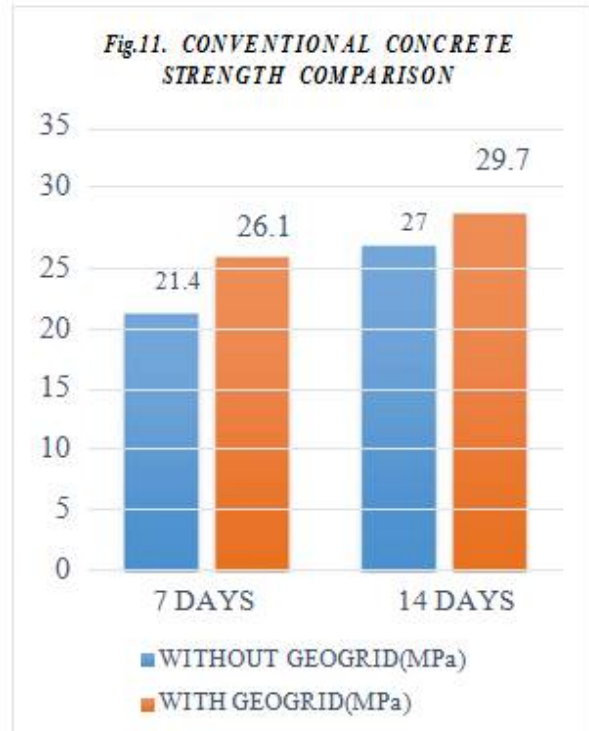
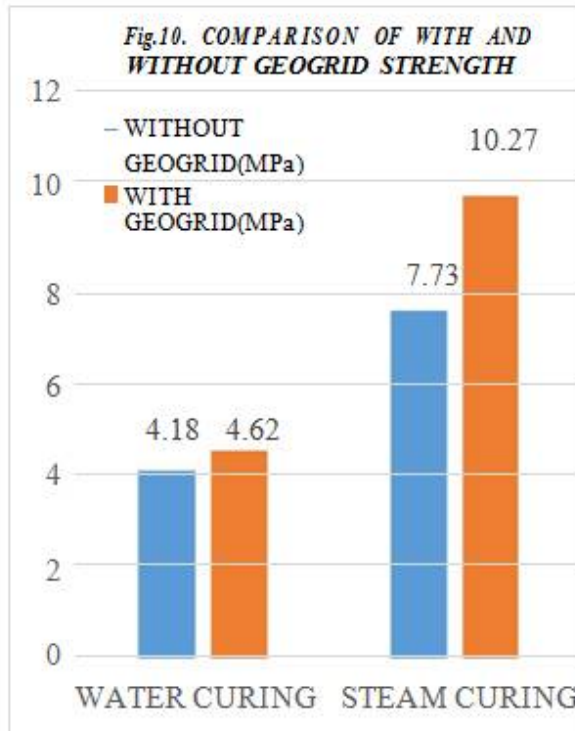


Fig 5. Cube Testing in CTM for trial 1 and 2 cubes





### VIII. MIX RATIO FOR CONVENTIONAL CONCRETE

In order to check if geogrid works the same way as in aerated, we made a test in conventional concrete of the below mentioned grade and mix. We did the testing as we did for aerated in CTM to study the load analysis. Water curing was done. The test was done for 7 and 14 days of cubes reinforced with and without geogrid in order to show the variations in their compressive strength.

- (i) RATIO ADOPTED : 1:1.85:3.02
- (ii) WATER CEMENT RATIO: 0.5
- (iii) GRADE OF CONCRETE : M30
- (iv) COARSE AGGREGATE : 20mm – 72%,  
10mm – 28%
- (v) ADMIXTURES USED : Lime Powder-30%, Gypsum-5%, Flyash (Class C)-10%, Silica Fume-10%,  
Super Plasticizer-1%, Carbon Fibre-0.05%.

### IX. FLEXURAL STRENGTH

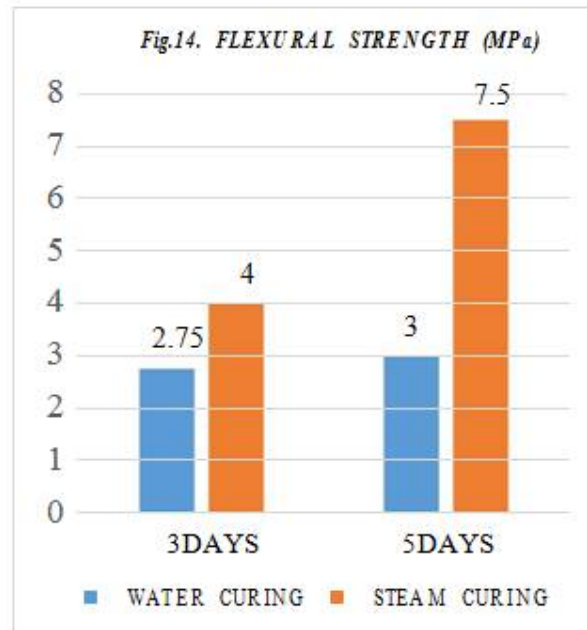
Flexural strength is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete beam or slab to resist failure in bending. It is measured by loading a concrete beam with a span length of at least three times the depth. Flexural MR is about 10 to 20 percent of compressive strength depending on the type, size and volume of coarse aggregate.

Fig.12. Tested Beam Sample



Fig.13. Placement of Geogrid in the tested sample

Fig.14. FLEXURAL STRENGTH (MPa)



## X. CONCLUSION

Thus the physical and mechanical properties of Geogrid were found to considerably increase the Compressive and Flexural strength of Aerated light weight concrete mix. Its implementation in conventional concrete was found to enhance its structural properties. As it can resist high load forces, the reinforcement of geogrid as a replacement for steel is recommended thereby reducing the overall economy of construction, thus serving as the best alternative construction material for steel.

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