“USE OF GEOCELL IN ROAD CONSTRUCTION”

Nitesh Ashok Bhanget, Priti Radhesham Nandagawali

1 Faculty, Civil Engineering Department, Government Polytechnic Bramhapuri, Chandrapur (MH)
2 M.Tech Geotechnical Engineering, RCOEM, Nagpur(MH)

ABSTRACT

In any civil engineering construction work there are two basic criteria’s which are to be followed, firstly the structure should be safe against any type of failure and second is that structure should be economical as far as possible. When the structure is constructed over loose or weak soil then it is very difficult to follow these basic criteria’s. Poor soil condition usually is the reason behind the lack of strength, and associated deformability. Unpaved road stabilization / reinforcement using 3d-cellular confinement systems stabilizes the material of road subgrade, acting like a semi-rigid slab, loads are distributed latterly reducing subgrade contact pressures and minimizing deformations and settlement. Soil stabilization with geocell in road, highway construction, improves load distribution characteristics on paved and unpaved surfaces. The experiment of use of geocell in road construction carried out at our government polytechnic Bramhapuri campus. The model has prepared for road pavement construction using geocell on weak soil filled with concrete. The result compare with road pavement without geocell with reference to cost, material required etc. The result shows use of geocell in road pavement is very economical as compare to concrete road and WBM road.

Keyword: Pavement, Geocell, Concrete, Weak Soil etc.

[1] INTRODUCTION

The Cellular Confinement Systems are popularly “Geocells” are strong, lightweight, three dimensional systems fabricated from ultrasonically welded High Density Polyethylene (HDPE) strips that are expandable on site a honeycomb like structure. Geocells are compact non cohesive soils which are confined within the cellular walls. The composite forms a rigid to semi rigid structure. The depth of the geocells size cellular unit can vary as per design requirements. Typical Geocell Generally, the infill is sandy or gravelly material. The surface of the geocell is textured soil geocell wall friction. The geocell wall is punctured in immediate dissipation of developed pore water pressures increased stresses within the infill of the individual cells.

Fig.1 geocell filled with concrete
Concrete road are durable and safe. They are apparently less wear and tear defects like rutting cracking stripping, less of texture and potholes occur with flexible pavement surface and also requires low maintenance but can’t be constructed on soft clayey soil. The field model of size 4mX2.5m show the comparison between the road concreted with geocell and CC road. Experimental as well as comparative study was carried out on the embankment supported with geocell and without geocell. A 4m x 2.5m field model was prepared for study. In that 2.5mx2m area was prepared with plan cc embankment and another 2.5mx2m area with geocell embankment. Geocell was direct placed on the levelled ground surface as the soil was strong and on the other hand proper subbase was prepared for CC road. The main aim and objectives of study is to determine the various property of embankment with geocell and cement concrete road. Then to make comparative study of the road reinforced with geocell and CC road. To study the various characteristics, load carrying capacity of pavement with geocell and simple CC road. Cement concrete of grade M25 was used as an infill material in the geocell as well as for preparing pavement.

[2] LITERATURE REVIEW

Strata Geosystems (India)

Several days of torrential rain in March 2016 completely destroyed a stretch of National Highway 44 (NH-44) in India. The roadway is the main throughway for commercial traffic to the State of Tripura. The failed road zone was located on the Assam side of the Assam-Tripura border.

Pokharel et al. (2009a)

Conducted an experimental study to evaluate the behaviour of geocell- reinforced bases under static and repeated loading. Two base course materials, Kansas River sand and quarry waste were used as the infill material. The test result showed that geocell confinement increased the bearing capacity and stiffness of the Kansas River sand by improvement factor of 1.75 and 1.5 respectively, under static loading However, geocell confinement had minor effect on the stiffness of the quarry waste under static loading due to the existence of apparent cohesion. The single geocell reduced the permanent deformation of the quarry waste base by a factor of approximately 1.5 compared to the unreinforced base. The Kansas River sand had a lowest percentage of elastic deformation as compared with the unreinforced and reinforced quarry waste due to the poor gradation, sub-rounded particles, and no apparent cohesion of the sand. The reinforced quarry waste had a higher percentage of elastics deformation than the unreinforced quarry waste due to the contribution of the geocell. Pokharel et al. (2009b) conducted another similar experimental study to evaluate the influence factors for single geocell-reinforced sands. This study found that the geocell placed in a circular shape had a higher bearing capacity and stiffness of the reinforced base than that placed in an elliptical shape.

Critical literature review:-

The soft soil often poses design, construction and maintenance hazards to civil engineering structure founded on them. Construction of embankment over soft soil or weak soil is very difficult work. Some soils are so weak that they can’t take the load of construction equipment’s. Problem may arise during the construction stages due the inability of the soft soil to provide adequate support to the construction equipment’s. Post construction, the excessive settlement and insufficient bearing capacity of the soft subgrade may lead to loss of stability of the overlying structures. Rotational slip failure of embankment, cracking and differential settlement of soil under embankments are some of the failure associated settlement of soil under embankments is some of the failures associated with construction of structure on soft soils. In such condition generally upper layer soil removed and some strong soil is used.
[3] METHODOLOGY

Step followed during preparing model on comparisons between geocell road and cement concrete road.

**STEP-1:** Site clearance and layout marking for both geocell road and cement concrete road of (2.5Mx2M) each.

**STEP-2:** Placing bolder on cement concrete road and 40mm aggregate on geocell road.

**STEP-3:** Placing moorum on both the side of 200mm thick layer.

**STEP-4:** Compacting and spreading water alternately on both the side of road.

**STEP-5:** Placing aggregate on cement concrete road and compacting it.

**STEP-6:** Applying formwork for cement concrete road.

**STEP-7:** Spreading and fixing the geocell confinement on the prepared sub-base course.

**STEP-8:** Preparing concrete of grade M25 and filling geocell web evenly with it. Also pouring concrete in prepared formwork for cement concrete road.

**STEP-9:** Removing formwork after 24 hr of cement concrete road.

**STEP-10:** Curing for 28 days two times a day.

**Laboratory Test**

**Compression Strength Test**

It is mandatory to have at least 3 specimens for testing from different batches. The mean of compressive strength achieved by this specimen is used to determine actual strength of the batch.

**Test Procedure:**

Place the prepared concrete mix in the steel cube mould for casting. Once it sets, After 24 hours remove the concrete cube from the mould. Keep the test specimens submerged underwater for stipulated time as mentioned the specimens must be kept in water for 7 or 14 or 28 days and for every 7 days the water is changed. Ensure that concrete specimen must be well dried before placing it on the UTM. Weight of samples is noted in order to proceed with testing and it must not be less than 8.1 Kg. Care must be taken to prevent existence of any loose material or grit on the metal plate of machine or specimen block. Testing specimens are placed in the space between bearing surface. The concrete cubes are placed on bearing plate and aligned properly with the centre of thrust in the testing machine plates. The loading must be applied axially on specimen without any shock and increased. Due to the constant application of load the specimen starts cracking at a point & final breakdown of the specimen must be not noted.

*Fig 3 Compressive strength tested cubes*

[4] RESULTS AND CONCLUSION

Test result from numerous research initiatives confirms the benefits of confined aggregate within the geocell system vs. unconfined aggregate. Reduces thickness and weight of structural support element by 50 percent or more. Allows subgrade material to withstand more than 10 time the number of cyclic-load applications before accumulating the same amount of permanent deflection. Provides over 30 percent stress reduction when supporting aggregate under the pavement. As we
have studied the geocell in road construction we come across the challenges it has to face for implementation of the system. Also we have studied the advantages and disadvantages of the geocell in road construction. There are two major challenges were pavement drainage and subgrade strength, strata proposed strata-web geocell-supported pavement section.

The literature involving, laboratory and numerical study result. Which shows that the geocell material can used as reinforcement, pavement can be improve by providing geocell at one-third to the base of the pavement. Geocell helps in the less permanent displacement in the subgrade layer by distributing the traffic load over a large Area of the subgrade. Approximate half of the base reduction from geocell reinforcement by interlocking when it is placed. Design result that about 20% to 40% thickness reduction is possible by geocell in pavement design, grater thickness reduction stronger subgrade material.

**Compared to traditional concrete pavements, Geocell reinforcement concrete pavement deliver the following .**

- Reduce overall cross section 15-25%- even more than where concrete costs are high and resource are limited.
- Relieves hydrostatic pressure & manages surface water.
- Eliminates formwork and need for further reinforcement.
- Control cracking with no need for expansion joints.
- Assures exact concrete depth.
- Easier installation with shorter construction.

**[5] REFERENCE**

3. Ansgar Emersleben and Norbert Meyer,“THE USE OF GEOCELLS IN ROAD CONSTRUCTIONS OVER SOFT SOIL” Institute of geotechnical engineering , Jan 2011,pp.132.