GEOWEB Technology

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Abstract- In this paper, we discuss the Advancements in citizen sensing and geospatial big data have enabled new opportunities for government-citizen interactions and have played important roles in developing smart(er) cities. In addition to city governments and citizens actively using maps to communicate spatial planning issues, the increasing capabilities of citizens generating spatial data either actively or passively allow city governments to collect local spatial knowledge with unprecedented breadth at finer spatiotemporal resolutions. New methods for citizens collaborating with city governments are also emerging to enhance citizen engagement and to spur social innovation. GEOWEB system offers design flexibility for unpaved roadway surfaces, base stabilization, road shoulders as well as erosion protection of embankments and storm water drainage channels. The 3D GEOWEB structure offers strength improvements to the road base layer for asphaltic and concrete pavements far greater than delivered by geogrids. GEOWEB is a three-dimensional polymeric strip welded together to form a cellular confinement system which can be filled with granular materials such as sand, recycle asphalt and local soil. That prevents from movement of infill material and distributes load over wide area which increase stiffness and strength of the pavement layer.

Indexed Terms- GEOWEB, HDPE, NEOLOY, Geocell.

I. INTRODUCTION

This paper is a comprehensive account of the findings from a postdoctoral research project between 2009 and 2013 which was supported by the Brussels Institute for the Encouragement of Scientific Research (INNOVIRIS) and KU Leuven Faculty of Architecture. The project aimed at developing and testing alternative strategies and tools for facilitating participatory urban design and learning processes. The motivations for the study were threefold:

- The need for enabling affordable participatory urban design tools and strategies
- Exploring the potentials of geographic and social Web 2.0 (GEOWEB 2.0) technologies
- Understanding the use of alternative urban projects as a reflective resource the first motivation was based on a common observation: traditional participation models rely on meetings held at a fixed time and place that are often ineffective and inefficient which severely limits the number of stakeholders taking part.

The GEOWEB system is made up of High-Density Polyethylene (HDPE) and Neoloy as it delivers a perfect balance of strength and flexibility, allowing it to withstand the most demanding project applications. The GEOWEB system consists of a robust 3D structure housing a network of interconnected cells that confine and compact soil. The confinement action by GEOWEB system prevents erosion and improves the structural performance of the soil or aggregate infill providing an alternative to reinforced concrete or armour.

II. OBJECTIVES

- Responding to the industry's need for stronger designs and faster installations through ongoing testing and research.
- The result is product advancements and innovative, integral system accessories that offer completely engineered solutions.
- GEOWEB technology feeds all the needs, providing immensely numerous benefits with requirements and client's utmost satisfaction

III. WORKABILITY OF GEOWEB

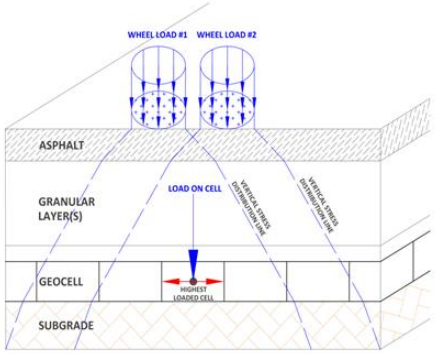
The GEOWEB system improves the load-deformation performance of granular infill materials due to the hoop strength of individual cells, the passive resistance of infill material in adjacent cells and vertical stress transfer to adjoining cells. This increases the shear resistance of lower quality aggregates (e.g., sand, gravel) to carry concentrated loads. The cellular structure also distributes concentrated loads to surrounding cells thus reducing the stress on the subgrade directly beneath the load and the required total thickness of the structure.

- This material provides high dynamic stiffness (elastic modulus), resistance to permanent deformation (creep) and tensile strength.
- Neoloy Geocells are a sustainable solution for road construction as they reduce the use of virgin aggregate.
- Stiff and Strong – very high tensile strength, up to 28 MPa, prevents fatigue
- Confinement – increases pavement layer strength (modulus) regardless of bearing capacity (CBR)
- Reinforcement – reduces layer thickness and wearing course by up to 50%
- Beam effect – improves load transfer and bearing capacity by up to 50%
- Improves elastic modulus – by factor of 2-5 for heavier traffic and longer pavement lifespan

IV. UTILITY

As Geogrids only control lateral movement in thin layers but the GEOWEB 3D system gives full depth protection, creating a firm, stable surface that increases cycle times and reduces tire wear, tire replacement and fuel consumption.

Maintenance of paved and unpaved roads and highways has been a major issue; Geocells in-filled with sand / metal as subgrade improve the strength of the pavement, reducing settlements, formation of reflective crack and pot-holes. Besides, use of geocells not only reduces the thickness of the pavement section but also significantly reduces downtime due to maintenance.



V. LITERATURE REVIEW

Sanat Kumar Pokharel, S.M. ASCE, Department of Civil, Environmental, and Architectural Engineering, the University of Kansas, 1530 W. 15 street, Lawrence, KS, Geosynthetics have been used for base reinforcement since 1970s. Numerous researches has already been carried out for planar geosynthetic reinforcement but limited research has been conducted for three-dimensional geocell reinforcement. Literature review has also demonstrated a significant gap between the applications and theories of geocell reinforcement outlining the need for more research. This study was to investigate the behavior of reinforced bases using a single geocell under static and repeated loads on a loading plate. The experimental results show that the single geocell could increase the stiffness by approximately 50% and the maximum load by 100% as compared with those of the unreinforced base. The repeated test shows that the geocell-reinforced base had the percentage of elastic deformation increase with the number of cycles of the repeated load up to 95%.

- Rajagopal K, Krishnaswamy NR, Latha GM (1999) Behavior of sand confined with single and multiple geocells.

This paper studies the influence of geocell confinement on the strength and stiffness behaviour of granular soils. A large number of triaxial compression tests were performed on granular soil encased in single and multiple geocells. The geocells were fabricated by hand using different woven and nonwoven geotextiles and soft mesh to investigate the effect of the stiffness of the geocell on the overall performance of geocell–soil composite. In general, it was observed that the granular soil develops a large amount of apparent cohesive strength due to the confinement by the geocell. The magnitude of this cohesive strength was observed to be dependent on the properties of the geosynthetic used to fabricate the geocell. The results have shown that using three interconnected cells in the testing programme is adequate to simulate the performance of geocell reinforcement layer consisting of many interconnected cells. A simple methodology has been presented in the paper to estimate the magnitude of the apparent cohesive strength developed by the granular soil as a function of the geometric and material properties of the geocell.

- Mhaiskar SY, Mandal JN (1996) Investigation on soft clay subgrade strengthening using geocells

In the last two decades geotextiles are being increasingly used as tensioned/tensile members. When used for reinforcement functions, a geotextile has to yield high resistance at low strains, especially for structures where allowable rut depths are low and the life span of the structure is long. This necessitates the use of high modulus geotextiles with adequate roughness. The present study aims at investigating the efficacy of the geocell alternative and the effect of the cell geometry and relative density of the backfill. Experimental and finite element procedures have been adopted to study the above parameters. Soft saturated marine clay was used as subgrade while sand was used as backfill material. Monotonic loading was applied in plate load tests. The experimental results were simulated in a three-dimensional finite element (fe) procedure using ANSYS, a general-purpose package. Considerable improvement in the load and reduction of settlement was observed from the experimental results. The results of the fe analysis were used to study the improvement in stiffness and stress distribution.

VI. METHODOLOGY

Following steps are to be adopted

- Selection of GEOWEB.
- Test on filler Material.
- Analysis of base reduction and load distribution.

Test on Filler material

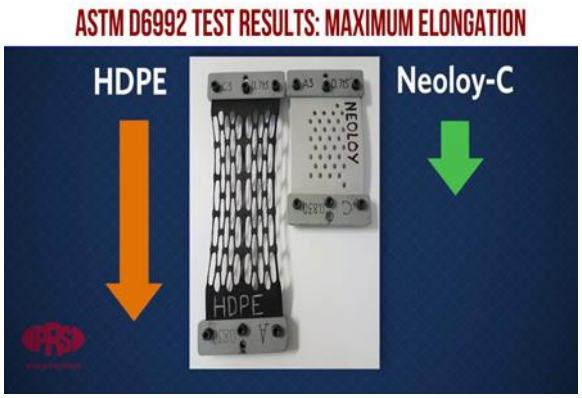
1) Impact Test. Impact Value= 23.68%
2) Crushing Test. Crushing Value= 28.14%
3) Los Angeles Abrasion Value Abrasion Value= 12.4%
4) Water Absorption Test on Aggregate Water Absorption Value =0.81%
5) Specific Gravity Specific Gravity Value =2.64
6) Flakiness & Elongation Test. Combined Flakiness & Elongation Index = 23%

VII. ANALYSIS AND COMPARISONS

HDPE geocells are unsuitable for long term applications, particularly when subject to heavy duty cyclical loading and elevated temperatures. Neoloy

Geocells maintain their engineering properties over time, under heavy loading and under high temperatures. This has been confirmed by numerous plate-load tests, numerical modeling and full-scale trafficking tests. Neoloy has demonstrated greater improvement in stiffness, bearing capacity, stress distribution and reduced deformation, when compared with conventional HDPE geocells. The high modulus and tensile strength of Neoloy make it the most suitable geocell for long-term use in motorways, railways and earth retention. Compared to HDPE Geocells, Neoloy Geocells maintain greater stiffness, bearing capacity and stress distribution, while reducing deformation. Not all geocells are the same. While HDPE Geocells have relatively low tensile strength, high creep and low dimensional stability, Neoloy Geocells have high modulus and tensile strength, making them suitable for long-term applications.

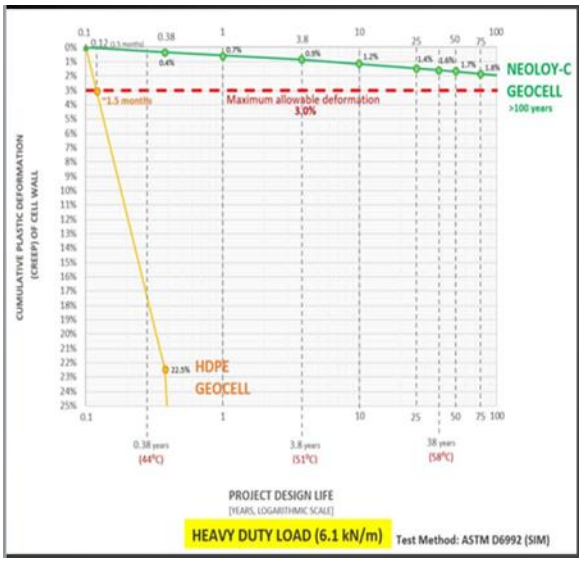
When neoloy geocells are deployed and compacted with soil/aggregate, a composite structure is created from the geotechnical interaction of the material, soil and geometry. Soil confinement retains infill material in three dimensions providing high tensile strength on each axis. Under loading neoloy geocells cells generate lateral confinement while soil-to-cell wall friction reduces vertical movement. The high hoop strength of the cell walls, together with the passive earth and passive resistance of adjacent cells, also increases soil strength and stiffness. Aggregate abrasion is minimized by the cell confinement, thereby attrition of the base material. Vertical loading on neoloy geocells with compacted infill creates a semi-rigid slab or "beam effect'' in the structure. This distributes the load evenly and effectively over a wider area, thereby increasing bearing capacity.

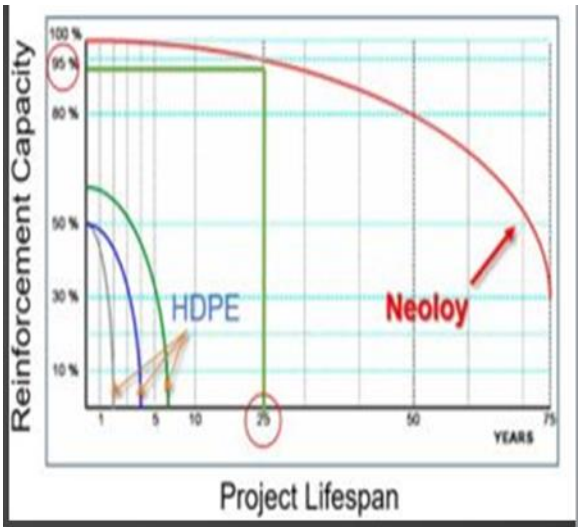


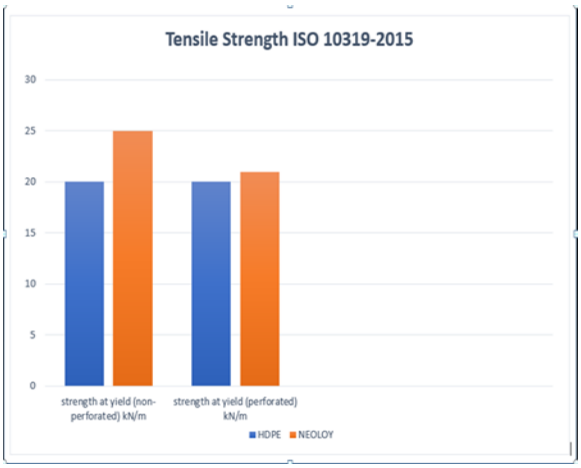
VIII. COMPARISON BETWEEN THE MARKET POTENTIAL OF HDPE AND NEOLOY

	EASY LOGISTICS / INSTALLATION	USE LOCAL MARGINAL SOIL	LONG-TERM LIFESPAN	HIGH STRENGTH & STIFFNESS	LOW ENVIRONMENTAL IMPACT
PRS NEOLOY GEOCELLS	+	+	+	+	+
HDPE GEOCELLS	+	+	−	−	−

IX. GRAPH SHOWING WHY NEOLOY IS BETTER THAN HDPE







X. ENVIRONMENTAL BENEFITS

- Reduce stormwater runoff and receive environmental Low Impact Development (LID) benefits by infiltrating and storing stormwater on-site.
- With permeable infill, the GEOWEB system saves the cost of traditional stormwater collection/storage systems by performing as an on-site stormwater retention/detention "basin".
- Permeable pavements are cooler pavements that reduce the heat island effect of traditional hard-surfaced pavements.

CONCLUSION

The literature involving, laboratory and numerical study results which shows that GEOWEB materials can be used as reinforcement, pavement can be improved by providing GEOWEB at the one-third to base of pavement. GEOWEB helps in less permanent displacement in the subgrade layer by distributing the traffic load over a large area of subgrade. Approximately half of the base reduction from GEOWEB reinforcement by interlocking when it is placed, design results that about 20% to 40% thickness reduction is possible by GEOWEB in pavement design, greater thickness reduction stronger subgrade materials. efforts are needed to establish the guideline for placement of GEOWEB in the pavement.

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