Experimental and Numerical Study of Geogrid-Aggregate Interaction

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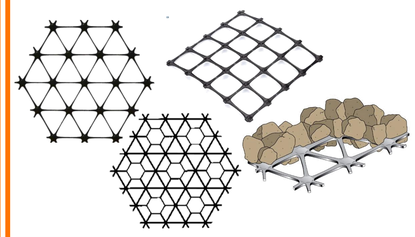
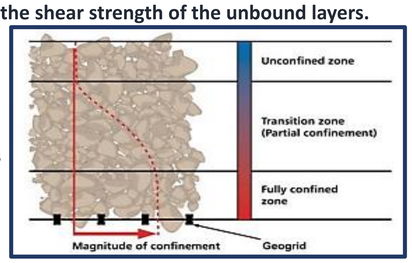
Tensar

1. Introduction

Geogrid Reinforcement:

- Reinforces/Stabilizes the base/subbase layers.
- Improves the load-deformation behavior of pavements.
- Decreases the settlement and increases the shear strength of the unbound layers.





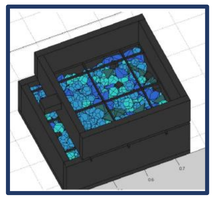
2. Background and Literature Review

❑ Direct Shear Tests on geogrid-reinforced aggregate layers showed:

- Better performance with biaxial geogrids than triaxial ones.
- Negligible effect of geogrid tensile strength on shear strength of layer.

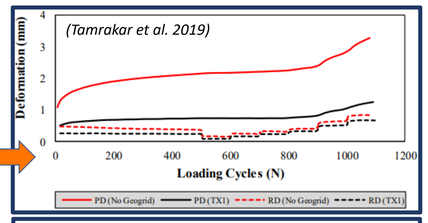
DE Modelling of DST

(Tutumluer et al. 2012)



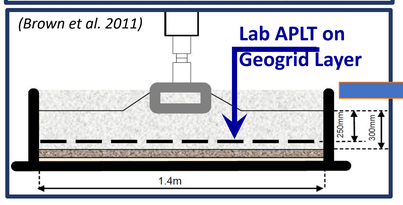
❑ Plate Load Tests on geogrid-reinforced aggregate layers showed:

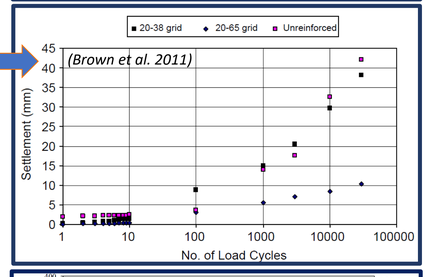
- Most optimal position of geogrid - nearest possible level to the footing.
- Optimal ratio of 0.8 to 1.6 between geogrid aperture size and aggregate size.
- Two layers of geogrid performed better than one layer.



(Brown et al. 2011)

Lab APLT on Geogrid Layer

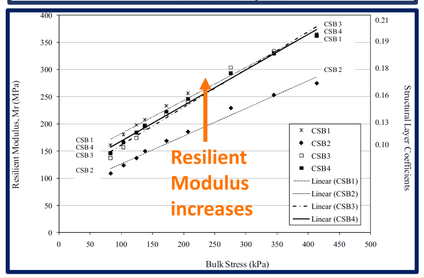




❑ Triaxial Tests on geogrid-reinforced aggregates showed:

- Increased stiffness.
- Significant increase in shear strength.

(Kang et al. 2020)



3. Motivation and Research Scope

Current Status

- ❑ Geogrid-aggregate interaction is correlated to index properties of geogrid and aggregate, individually.
- ❑ The interaction is not quantified based on composite behavior of geogrid-aggregate.
- ❑ Empirical Design methods are mostly used for design of composite geogrid-aggregate layers

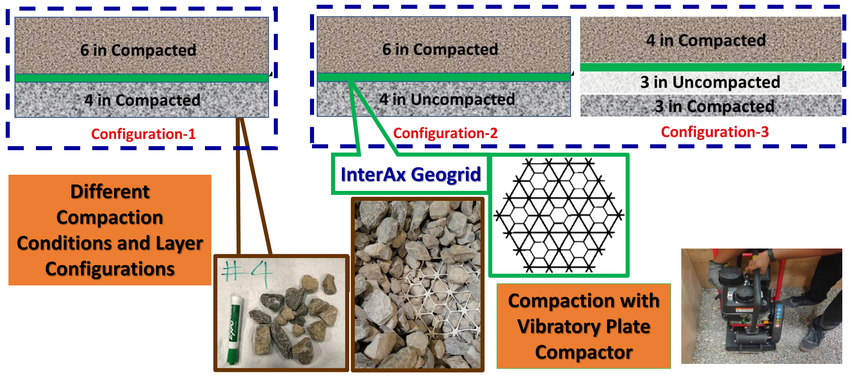
Path Forward

- ❑ Investigation into the behavior of new geogrid types (e.g. InterAx by TENSAR).
- ❑ Mechanistic Quantification of beneficial effects of geogrids using laboratory testing and numerical modeling

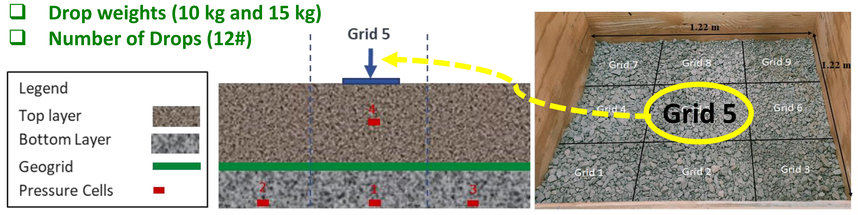
Research Scope

1. Intermediate Scale Testing in Wooden Box and Field Testing (LWD and APLT)
2. Numerical Modeling (Finite Element and Discrete Element Analysis)

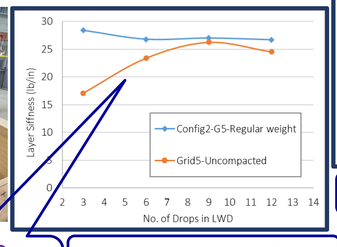
4. Laboratory Testing using LWDs



- ❑ Instrumentation
- ❑ Drop weights (10 kg and 15 kg)
- ❑ Number of Drops (12#)

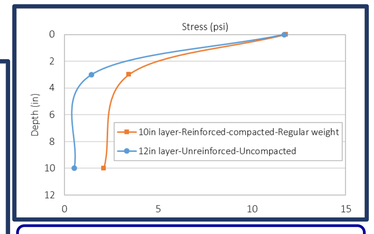


❑ Results for Configuration # 2



First 9 Seating Drops are required to 'Stabilize' the matrix

Estimated layer stiffness

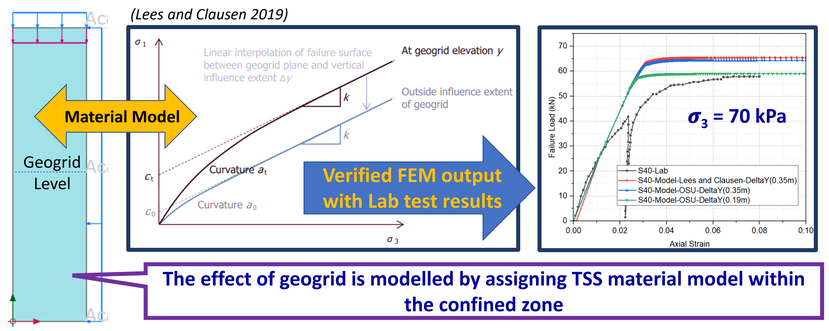


Vertical Stress Variation with Depth

5. Numerical Modeling – Finite Element Analysis

TENSAR Stabilized Soil Model (TSSM) was developed to represent the effect of geogrid during FE Analysis

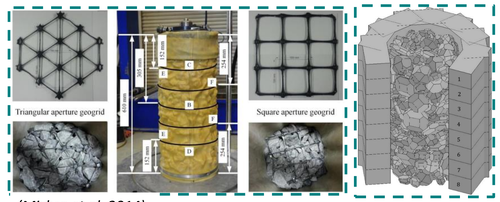
(Lees and Clausen 2019)



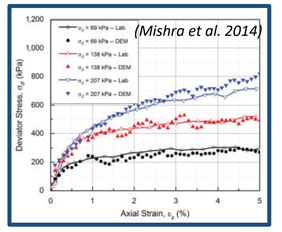
The effect of geogrid is modelled by assigning TSS material model within the confined zone

❑ Verification of TSSM in FE model with DEM numerical results (Ongoing)

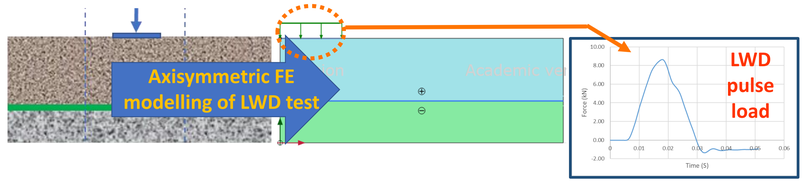
The DE model was developed and calibrated using large-scale triaxial test results



(Mishra et al. 2014)

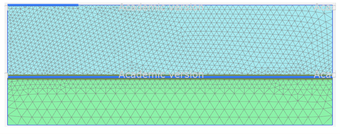


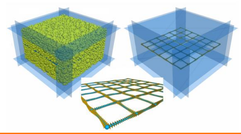
❑ Numerical modelling of laboratory LWD test with TSSM in FE model (Ongoing)



6. Future Work

- Intermediate Scale LWD Test and PLT in Wooden Box on geogrid-reinforced Specimens.
- Field Testing on Geogrid Reinforced Aggregate Layers.
- Numerical Modeling of Lab and Field Tests.
- Development of a mechanistic method to quantify the the benefit of geogrid-reinforcement during pavement design.





7. Acknowledgement

The support by TENSAR International Corporation is greatly acknowledged