Tran-SET
Transportation Consortium of South-Central States

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Key Points

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Lead Institution:
University of Louisiana at Lafayette

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Tran-SET

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$89,148

Soil-Recycled Aggregate-Geopolymer Road Base/Subbase Mixtures- Step Towards Sustainability

Brief Project Description

This study focuses on the development and evaluation of sustainable Soil-Recycled Aggregate-Geopolymer (Soil-RAG-GP) mixtures for road bases and subbases. The developed "green" Geopolymer-based soil base/subbase materials will exhibit durability, high performance, energy efficiency, and environment friendly, and sustainability characteristics. Several materials will be selected and tested including various types of Class F fly ash, soil types, and activation agents. Unconfined Compressive strength, elastic and dynamic modulus, flexural, durability and shrinkage characteristics will be evaluated. In addition to mechanical testing, oxide analyses and SEM micrographs will also be studied. Strength and modulus tests results will be compiled and a preliminary statistical model will be developed. The model will assist in sensitivity analysis of variables and determining the optimum mix design parameters.

Problem Statement

Cement stabilized road base for flexible pavement provides substantial support to the overlaying hot mix asphalt (HMA) layer. Such bases reduce stresses on subgrade soil, minimize vertical deflection, and provide resistance against freeze-thaw action. Additionally, the use of soil-cement becomes cost-effective in areas that are deficient in aggregate resources.

However, there is one drawback in that soil-cement causes shrinkage cracks in the base layer, which reflects through the HMA layer. Such cracks are responsible for poor ride quality and affect the long-term performance of pavement. Hence it is imperative to utilize the advanced alternate cementing technologies and available recycle aggregates such as recycled concrete and reclaimed asphalt pavements to cost-effectively mitigate reflective cracking. One such alternate binding materials is known as Geopolymer binders/cements. Geopolymer materials represent an innovative class of "green" technology, which mainly rely on industrial by-products (coal fly ash, Ricehusk/sugarcane ashes, some clays, etc) to significantly reduce its carbon footprint.

Objectives

The specific objectives of this study are to:

- Review existing practices in stabilizing soil bases using RAP, RCA and geopolymer binders
- Determine the effect of various Soil-RAG-GP mixture constituents such as: the soil types, FA content and RAG content, Alkali ratio, curing period, and curing temperature, on the UCS of the mixtures.
- Evaluate and compare mechanical and durability characteristics of Soil-RAG-GP and conventional soil-cement mixtures by their unconfined compressive strength, resilient modulus, and durability
- Disseminate the results of the research through educational and outreach activities.

Intended Implementation of Research

Workforce Development

During the course of this study a graduate student will be trained in the development of Soil-RAGGP mixtures, laboratory experimentation, and mechanical characterization. Additionally, one/two undergraduate students will assist the graduate student in this study through the research apprentice program at the college of engineering. Findings of this study will be presented to engineers and researchers at Louisiana Transportation Research Center to expose and educate them regarding the benefits of the alternate cementing and stabilization technique used.

Education

Findings will be created into teaching and education materials. Such materials will consist of presentation slides and teaching modules with short, hands-on laboratory exercises. These exercises will be taught in two civil engineering courses at the University of Louisiana at Lafayette (ULL).

Outreach

Project-based activities will be developed for high school students including students in underrepresented minority groups. This will be built on existing efforts through ULL's GEAR UP program to introduce high school students to engineering as well as several other high school STEM events held at ULL. Publishing research findings in peer reviewed journals and conference presentation will be a part of this study.

Anticipated Impacts/Benefits of Implementation

This study will provide a cost-effective approach to enhance the durability and sustainability of pavement soil-base/subbase by utilizing RAG and alternate cementing materials such as Geopolymer binders. It is believed that developed mixtures will possess high compressive strength, durability, long-term performance along with positive environment impact with respect to utilization RAG and low carbon emissions as appose to ordinary cement.

Weblinks:

http://transet.lsu.edu/research/research-in-progress/

https://rip.trb.org/View/1505427