Research Project 18

Fatigue and Durability of Recycled Stabilized Base Course

COMPLETE!

Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

The final report for Project 18 is available on-line at:

http://www.rmrc.unh.edu/Research/Rprojects/Project18/P18finalreport.asp.

Project Objectives

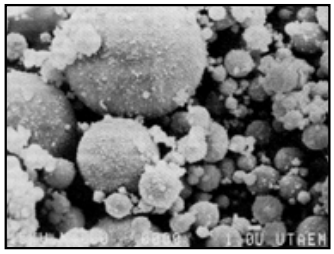
- Evaluate the mechanical behavior of stabilized recycled aggregate base course under compression, split tension, flexure and repeated loadings.
- Assess the durability of this primarily waste composite under cyclic/fatigue loading and quantify the damage accumulation process.
- Evaluate the effectiveness of recycled plastic fibers in enhancing the mechanical performance.
- Determine the resilient modulus of the composite· Compare the performance of the new composite with other traditional stabilized base materials.

Project Progress

This project evaluated the performance of a cement-stabilized pavement base course material consisting of recycled concrete aggregate, ASTM Class C fly ash, and waste plastic (high-density poly ethylene) strips obtained from post-consumer water and milk containers. The primary focus of the study was to systematically characterize the new composite base course under both static and dynamic (fatigue) loading conditions to gain some insights into the long-term durability of the material.

Reclaimed concrete.

To achieve these goals, a coordinated experimental program was undertaken that consisted of the following four Phases: Phase I - Selection of initial mix-design, Phase II - Instrumented split tensile test program, Phase III - Static flexural test program, and Phase IV - Flexural fatigue test program. Since a stabilized layer within a pavement structure is subjected to repeated tensile (flexural) stresses due to dynamic traffic loadings, the experimental program primarily involved material characterization under split tensile or flexural modes. The main objective of utilizing plastic strip reinforcement was to inhibit the propagation of tensile cracks, and thus improve the overall toughness and fatigue resistance of the material. The cement content in all mixes used in this study was either 4% or 8% by total dry weight of the mixture implying that at least 92% of the base course composite consisted of waste or recycled materials. It was found that a mixture containing only 4% cement, 4% fly ash, and 92% recycled aggregate (by weight) achieved a compressive strength of about 5 MPa (725 psi), a split tensile strength of about 0.75 MPa (109 psi), and a flexural strength of about 0.95 MPa (138 psi), indicating a moderately strong stabilized base course material.



Coal fly ash.

Flexural fatigue tests conducted on the same mixture reinforced with 1.25% (by weight) of recycled plastic strips (51 mm long and 6.3 mm wide) showed that the performance of the composite base course was comparable to or better than other traditional stabilized material used in pavement construction.

Waste plastic.

Significant results from the repeated load test program include: a) the relationship between the stress ratio and the number of cycles to failure (S-N curve), b) the resilient modulus, c) fatigue endurance limit, and d) damage accumulation characteristics in the material due to cyclic loading.

The study concluded that the new composite base course consisting primarily of waste products holds considerable promise as an alternative material for the construction and rehabilitation of highway pavements.

Project Partners

New Mexico State Highway and Transportation Department

Further Information

The Recycled Materials Resource Center (RMRC), a cooperative agreement between the University of New Hampshire and the Federal Highway Administration, is a national center that promotes the appropriate use of recycled materials in the highway environment. Its focus is on the long-term performance and environmental implications of using recycled materials. Please visit http://www.rmrc.unh.edu.

Investigating Institution
New Mexico State University
Las Cruces, NM

Principal Investigator's Current Contact Information
Khaled Sobhan, Ph.D.
Assistant Professor
Department of Civil Engineering
Florida Atlantic University
777 Glades Road, P.O. Box 3091
Boca Raton, FL 33431
Tel: (561) 297-3473
Fax: (561) 297-0493
Email: sobhan@civil.fau.edu

RMRC
University of New Hampshire
Gregg Hall, 35 Colovos Road
Durham, NH 03824
Tel: (603) 862-4704
Fax: (603) 862-3957
http://www.rmrc.unh.edu