Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

Research Project 5

Concrete Mixtures with Inclusions to Improve the Sound Absorbing Capacity of PCC Pavements

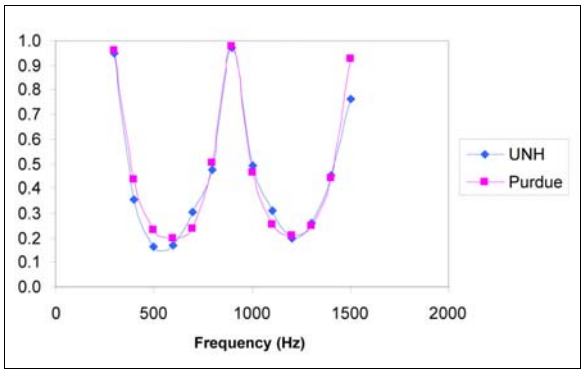
Project Objectives

- To develop a cost-effective solution to pavement noise generation, by potentially incorporating recycled materials such as plastics, tire rubber, and light-weight synthetic aggregates with porous and/or flexible properties as aggregates in PCC.
- To overcome potential problems associated with high-porosity pavements, such as constructability, reduced durability and potential for pore clogging, while achieving noise reduction characteristics.
- To develop guidelines on PCC mixture compositions in order to optimize mechanical, durability and acoustical pavement properties.

Project Progress

Most of the active research phase of this project was completed last year and the results were presented in the 2002-2003 RMRC Annual Report. To summarize, the investigators were able to vary pavement thickness, cement paste content and aggregate type to maximize sound adsorption at 950 Hz. This was important because the frequency range of the most annoying road noise has been identified as 900 Hz to 1100 Hz. The aggregates used during the initial set up and testing were steel, glass, and plastic balls in order to verify that the system operated properly before testing more complicated recycled material aggregates. The basic hypothesis of this research is that inclusions with porous and/or flexible characteristics will act as tiny "sponges," absorbing sound energy in the pavement. It is thought that these inclusions will complement conventional (viscous and frictional damping) mechanisms of sound absorption.

To test this hypothesis, 200 mm thick PCC pavement samples were made with local blue rock aggregate, a synthetic lightweight aggregate (SLA) made from coal fly ash and recycled plastics, recycled aggregate (RCA), Newmarket gravel, and blast furnace slag (BFS). An additional sample was a composite with 75 mm of 2.36 mm BFS over 125 mm of 4.75 mm BFS. One set of samples was tested at UNH using an impedance tube, and another set was sent to Purdue for verification following the ASTM E 1050 protocol.



Comparison of UNH and Purdue University sound damping results for a 200 mm thick PCC pavement sample with 10% paste and RCA aggregate. The data shows the ratio of sound absorbed to initial sound as a function of frequency. A value of unity represents total mitigation.

All of the samples were cast at UNH and rapidly cured in an oven for 24 hours to ensure that curing time was not a factor. The results are still being analyzed, but an initial review of the data showed that UNH and Purdue obtained similar results for all of the samples, which confirms the validity of the conclusions derived from these tests and other results generated at UNH. The final report for this project is currently being written, and it is anticipated that the project will be completed in August 2004.

Project Partners

Indiana DOT, International Tire & Rubber Association, Purdue University

End Products

This research will provide guidance in choosing PCC pavement additives that will decrease road noise often associated with PCC pavements. The plans for a sound impedance tube will also be provided. The end users of this research will be State DOTs and FHWA.

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.

For detailed quarterly progress reports for Project 5, as well as all RMRC-funded research projects, please see: http://www.rmrc.unh.edu/Research/researchlevel2.asp.

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