Research Project 9

Properties of Asphalt Mixtures Containing RAP

COMPLETE!

Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

The final report for Project 9 is available on-line at:
http://www.rmrc.unh.edu/Research/Rprojects/project9/p9finalreport.asp

Project Objectives

- To evaluate the effect of including RAP on the overall properties of asphalt concrete mixtures and how properties change as different percentages of RAP are added.
- To examine the variation in these properties when different sources (types) of RAP and virgin materials are used.
- To evaluate rheological properties such as dynamic modulus, phase angle, and creep compliance as a function of testing time or frequency and temperature to develop master curves.
- To evaluate the strength and fatigue resistance of the various mixtures through destructive testing.

Project Progress

Dr. Daniel worked with the New Hampshire Dept. of Transportation (NH DOT) to investigate some of the basic questions regarding the incorporation of recycled asphalt pavement (RAP) into new asphalt, while at the same time developing mix designs that NH DOT can actually use. Currently, NH DOT allows 35-50% RAP in base courses and up to 15% RAP in surface courses. However, it is still not clear as to how RAP changes the mechanistic and performance properties of the mix design. This is due to the complex interaction of the aged binder in the RAP with the new binder in the asphalt as well as the aggregate properties of the RAP compared to the aggregate in the virgin mix. The focus of this research is to improve the understanding of these issues.

Dr. Daniel started this research project by creating a master complex modulus and creep compliance curves for a Superpave 19 mm mix that contained RAP. The mix design was evaluated in the context of the AASHTO 2002 Design Guide and Superpave performance testing, including the Simple Performance Test. Mixes of 15%, 25% and 40% RAP as well as a 0% control mixture were evaluated. The 15% RAP mix showed increased stiffness and decreased ductility compared to the control mixture, which indicates a potential for thermal cracking susceptibility. Surprisingly, the 25% and 40% mixes were not significantly different from the control mixture. One would expect that the stiffness would increase with increasing amounts of RAP. As a result, work focused on the role of the RAP aggregate with regard to mixture stiffness. The aggregate was extracted from the RAP and compared to natural virgin aggregates to determine if processing affected the gradation and angularity, thereby changing the overall performance of the mixture. In addition, the affect of preheating was investigated using the 40% RAP mix to see if heating changed how the virgin and aged binder mixed. Results from both tests were inconclusive. The extracted aggregate did show a slight decrease in angularity, but was not significant compared to the virgin aggregates. Excessive heating of the RAP during preheating may cause accelerated aging of the binder, which would cause the RAP to act more like "black rock" and mix less with the virgin binder, but less heating may promote better mixing.

Project Partners

New Hampshire DOT

End Products

Input to the AASHTO 2002 Design Guide, Input to Superpave Performance Testing, Input to Simple Performance Test. The end-users of this research will be State DOTs and the 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.

Project Principal Investigator
Jo Sias Daniel, Ph.D.
University of New Hampshire
Dept. of Civil Engineering
236C Kingsbury Hall
Durham, NH 03290
Tel: (603) 862-3277
Fax: (603) 862-2364
Email: jo.daniel@unh.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