

# RMRC



## Recycled Materials Resource Center



THE UNIVERSITY  
of  
**WISCONSIN**  
MADISON

### Project Principle Investigators

Tuncer Edil, Ph.D., P.E., DGE

☎ : (608) 262-3225

✉ : tbedil@wisc.edu

Department of Civil Engineering  
University of Wisconsin-Madison  
Madison, WI 53706

### RMRC

University of Wisconsin-Madison  
Engineering Centers Building  
1550 Engineering Drive  
Madison, WI 53706

☎ : (608) 890-4966

✉ : angela.pakes@wisc.edu

## Research Project #81

# Recycled Unbound Materials

### Project Objectives

- To characterize the properties of crushed recycled concrete (RCA) and asphalt pavement (RAP) as unbound road base course without stabilization.
- To assess how RCA and RAP behave in the field and determine how pavements can be designed with RCA and RAP.

### Project Summary

Extensive testing on both RCA and RAP were conducted to better understand the properties of both unbound materials. Samples of RCA and RAP were obtained from eight states: California, Colorado, Michigan, Minnesota, New Jersey, Ohio, Texas and Wisconsin. These were compared to conventional Class 5 base course as well as a 50/50 RCA/Class 5 blend. These materials were characterized with respect to grain size distribution, fines content, asphalt content (RAPs), mortar content (RCAs), specific gravity, absorption and impurities.

Throughout the study, the following tests were conducted to compare stiffness, freeze-thaw and wet-dry durability, toughness, water absorption and retention characteristics, temperature sensitivity, plastic deformation as well as their typical compositional and mechanical properties:

- Modified Proctor test to determine compaction characteristics
- pH and leaching characteristic tests
- Several years of field data collection at a field test section beyond the project duration.

of RCA and RAP.

- Resilient modulus tests on:
  - The effect of brick content on RCA characteristics.
  - The effect of RCA and RAP composition on resilient modulus.
  - Samples at optimum moisture content (OMC) and maximum dry unit (MDU) weight.
  - Samples with varying compaction.
  - Large Scale Model Experiments (LSMEs) with cyclic loading and compared to laboratory equivalent.
  - Samples exposed to freeze-thaw cycling and wet-dry cycling.
- Unsaturated hydraulic conductivity tests to generate soil-water characteristic curves.
- Falling Weight Deflectometer (FWD) tests on base course material RAP, RCA, 50/50 RCA/ Class 5 blend and Class 5.

### Project Partners

California, Michigan Minnesota, Ohio, Texas and Wisconsin Departments of Transportation.

### End Results

Test results showed that RCA and RAP are suitable for unbound base course applications. Performance characteristics displayed that RAP and RCA were equal or superior compared to natural aggregates for stiffness, freeze-thaw and wet-dry durability and toughness. Resilient moduli of RAP and RCA are higher than natural aggregates. It should be considered in the design that RAP is more sensitive to temperature change and this should be considered in the design to avoid rutting. Samples from the eight different states showed similar characteristics.

### Further Information

The Recycled Materials Resource Center (RMRC) is a national center that promotes the appropriate use of recycled materials in the highway environment. It focuses on the long-term performance and environmental implications of using recycled materials