TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Minnesota DOT

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)*	**Transportation Pooled Fund Program - Report Period:** ☐ Quarter 1 (January 1 – March 31) ☐ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☑ Quarter 4 (October 1 – December 31)

Project Title: Recycled Unbound Materials		
Name of Project Manager(s): Tuncer Edil	**Phone Number:** 608-262-3225	**E-Mail** edil@engr.wisc.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:** 6/4/2008
Original Project End Date: 6/30/2011	**Current Project End Date:** 11/30/2012	**Number of Extensions:** 1

Project schedule status:

☐ On schedule ☑ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$349,909	$186,034	53%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
14,995, 4.3%	14,995	51%

Project Description:

The objective of this project is to characterize the properties of crushed recycled concrete pavement (RCA) and asphalt (RAP) as unbound base without being treated or stabilized, to assess how RCA and RAP behave in the field and to determine how pavements can be designed using RCA and RAP. Issues to be considered include variability in material properties, purity of material and how to identify and control material quality. This project will include laboratory studies, examination of existing field sites and evaluation of data from MnROAD test sections. Anticipated results from this project include a suite of tests and/or protocols that may be used to identify the critical characteristics of these recycled materials, as well as optimum design criteria and best construction practices needed for a durable base that meets the properties proposed for layer design. The three cells will be constructed using recycled materials in the granular base layers at the MnROAD test facility. One test section will include 100% RAP, another 100% RCA and the third a 50/50 blend of RCA/natural aggregate. The material properties will be monitored during construction and throughout the pavement life by others, especially the variation with changing seasons and moisture regimes in order to determine their effects on pavement performance. The cost of the instruments and installation will be covered under a different program; however this project will analyze the data being generated from the test sections in conjunction with other data from the project.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

A testing apparatus has been designed and constructed to test the recycled materials' resilient modulus at various temperatures. This apparatus uses the same design as all previous tests run for the project, but contains quarter inch copper tubing inside the plexi-glass to regulate the sample temperature by running temperature regulated water through the tubing. The apparatus has been calibrated using Class 5 natural aggregate compacted at 95% of optimum moisture content for 7°C, ~23°C (room temperature), 30°C, and 40°C sample temperatures. Resilient modulus tests using this apparatus have begun.

Wet/dry cycling for 2 RAPs, 2 RCAs, and 2 natural aggregates have begun. There is no available standard for unbound materials. The following procedure was developed to serve the intent. The aggregates being used are California RCA, Texas RCA, Texas RAP, New Jersey RAP, Minnesota Class 5, and a basalt aggregate available in the laboratory. The Class 5 and basalt are both natural aggregates available to UW-Madison and are used as control material. After wet/dry cycles, particle size distribution and micro-deval tests will be completed on the aggregates to determine the amount of particle degradation. All samples are compacted at 95% modified proctor into six inch diameter by 12 inch high cylinders, wrapped in a nonwoven geotexile to allow for moisture flux and provide support to the unbound aggregate. The samples are in between two metal plates with holes drilled through to allow for moisture movement and provide stability to the compacted unbound aggregate. The samples are being submerged in water until their weight equilibrates (approximately one hour). Once "saturated" the samples are dried in a drying oven until the weight of each sample does not change (approximately 24 hours). This 25 hour cycle of wetting and drying of the specimens is deemed one cycle. 30 cycles will be completed on the six samples and particle degradation will be evaluated. If a significant percentage of loss (~10%) is experienced through 30 cycles in either particle size distribution or micro-deval tests, the aggregates may be exposed to fewer cycles such as 5 and 10 cycles.

Anticipated work next quarter:

Temperature effects on three RAP, three RCA, and one natural aggregate will be analyzed. The three RAPs selected will be Colorado, New Jersey, and Texas due to their asphalt content spectrum. The three RCAs to be studied will be California, New Jersey, and Texas because of their grain size spectrum. The natural aggregate to be tested will be Minnesota Class 5 aggregate provided by the Minnesota DOT from the MnRoad test section. Resilient modulus tests will be conducted on these materials at four different temperatures: 7°C, ~23°C (room temperature), 30°C, and 40°C. All samples will be compacted at 95% of optimum moisture content. Results will be analyzed to determine if temperature has an effect on the resilient behavior of these seven materials. Tests will begin in January, 2012.

The field sampling for MnRoad and Lot 60 will be going on in this quarter. The mineralogy of MnRoad RCA will be determined by using X-Ray powder diffraction. Column tests on MnRoad RCA will continue until 50 PVF is reached. pH-dependent test and serial batch test on UW Lot 60 RCAs will be conducted to characterize the leaching behavior under various leaching pH and rain event cycles. This field experiment was started in September 2011 to explore early pH response that was not captured in the MnRoad lysimeters.

Batch leaching tests will continue according to the toxicity characteristic leaching procedure (TCLP), but TCLP solution will be used as a leaching fluid. Heavy metal in leachate will be analysis with Inductively Coupled Plasma. Column leaching tests will start.

Batch testing of RAP and control samples for PAHs has been completed and the results are being analyzed. This is a difficult procedure and it took considerable time to develop.

Significant Results:

Two articles have been submitted based on the project results to TRB and GeoCongress. They will be presented in January and March, 2012, respectively. These articles will be submitted also to appropriate archival journals.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Potential Implementation: