



# Project Summary

Texas Department of Transportation

## 0-6084: Cement Treated RAP

### *Background*

Each year, enormous amounts of reclaimed asphalt pavement (RAP) are generated from deteriorated roads in the U.S. The primary use of RAP has been reintegration into new hot-mix, warm-mix and cold-mix pavements. Nonetheless, a large quantity of RAP remains unused and its further uses yet to be explored. The use of RAP as base course materials has been encouraged by both FHWA and TxDOT to reduce waste and to provide a cost effective alternative for base course construction of flexible pavements. This is particularly true for projects that require long-hauling distances for disposal of waste material or projects for which the availability of suitable aggregate is limited. With proper treatment, RAP could produce base courses having a desired combination of strength, stiffness and moisture resistance for long-term performance.

### *What the Researchers Did*

The main objectives of this research were to examine the feasibility of using mixes of high RAP content for base course applications and to provide guidelines for their laboratory testing and mix design process. To achieve these objectives, a number of tasks were proposed and completed. These tasks included:

- Literature review and statewide information search for RAP used in base course construction.
- Collection of RAP and granular base materials from six TxDOT districts to use for the baseline study.
- Evaluation of the variability of RAP materials in terms of gradation, asphalt content and sand equivalency.
- Evaluation of cement-treated RAP mixes in terms of moisture-density characteristic, strength, modulus, moisture susceptibility and permanent deformation. Mixes containing 100%, 75% and 50% RAP were considered. For mixes of 75% and 50% RAP, both virgin and salvage base materials, when available, were used. Four levels of cement content (0%, 2%, 4% and 6%) were utilized for all mixes. The optimum cement content was statistically determined for a given level of RAP content in a mix according to the results from this comprehensive evaluation program.
- Advanced studies on those cement-treated RAP mixes passing the minimum strength requirement by TxDOT Item 276 to ensure their durability or long-term performance. This study involved wetting/drying, leachate and mineralogical tests.
- Field trials to verify the mix design models obtained from laboratory testing.

### *Research Performed by:*

The University of Texas at El Paso (UTEP)  
The University of Texas at Arlington (UTA)

**Research Supervisor:**  
Soheil Nazarian, UTEP

**Researchers:**  
Deren Yuan, UTEP  
Laureano R. Hoyos, UTA  
Anand J. Puppala, UTA

**Project Completed:** 8-31-10

## What They Found

The findings and recommendations from this research project are as follows:

- Constructing high quality cement-treated bases with up to 75 to 80% RAP is quite feasible.
- The gradations of un-fractionated RAP from different stockpiles lack fine aggregates that are necessary for appropriate stabilization. RAP blended with granular base material containing relatively higher fine content can mitigate this problem.
- The use of salvage base or quarry screenings passing No. 40 sieve, as opposed to transporting new base from quarries, can be a cost effective way to build cement-treated bases with high RAP content.
- Asphalt content in RAP does not seem to have a considerable impact on strength and modulus of RAP mixes.
- Given a requirement of 300-psi unconfined compressive strength (UCS), the preliminary optimum cement contents are about 4%, 3% and 2% for mixes of 100% RAP, 75% RAP and 50% RAP.
- Corresponding to a 300-psi USC, the indirect tensile strength, seismic modulus and resilient modulus are approximately 40 psi, 1000 ksi, and 250 ksi.
- Results from initial field tests confirmed the mix design process and model developed in this research project.

## What This Means

The use of cement-treated bases with high RAP content has great potential for reducing waste, saving natural resources and thus providing a cost effective alternative for roadway maintenance, rehabilitation and reconstruction. The increased use of cement-treated RAP with salvaged base or new base material should be encouraged in all TxDOT districts.

### *For More Information:*

Research Engineer - German Claros, TxDOT, 512-416-4730  
Project Director - Jimmy Si, TxDOT, 512-506-5901  
Research Supervisor - Soheil Nazarian, UTEP, 915-747-6911

### *Technical reports when published are available at:*

<http://library.ctr.utexas.edu/index.html>

[www.txdot.gov](http://www.txdot.gov)

keyword: research



Research and Technology  
Implementation Office  
P.O. Box 5080  
Austin, Texas 78763-5080  
512-416-4730

This research was performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement.