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# Project Summary

*Technology Transfer Outreach Publication*


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## Sponsor
University Transportation Center-MiSTI


## Project Title
Recycled Concrete Aggregates (RCA): A Sustainable Material for Asphalt Highway Pavement

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# Creating a Sustainable Asphalt Road Construction Industry in Michigan

The future of Hot Mix Asphalt (HMA) will inevitably involve the use of recycled materials. This trend toward a sustainable asphalt highway design and construction system is due to the overall positive environmental impact that recycled materials have when used in HMA. Reclaimed asphalt pavement (RAP) and recycled concrete aggregates (RCA) have been identified as the most promising transportation materials for use in asphalt pavements. In pursuit of sustainable asphalt highway construction, many state Departments of Transportation (DOT) are sponsoring research to evaluate the feasibility of applying RAP or RCA in HMA. Such research initiatives are conducted to verify the mixes conform to the newly introduced Superpave™ specification criteria for HMA design.

The widespread availability in large quantities of RCA in Michigan makes it a valuable resource for the asphalt industry. Channeling RCA to asphalt construction will save the state million of dollars in truck haulage and site damping charges. This research project will evaluate the feasibility of creating a sustainable asphalt road construction industry in Michigan by utilizing the abundant RCA. Using RCA in asphalt mixes depends on the characteristics of the mixes to satisfy all the requirements of the current Superpave™ HMA Mix Design Specification criteria.

## Research Objective

The research objective is to investigate the viability of using RCA as a sustainable material in designing typical Michigan HMA mixes that satisfy all the specification requirements of the Superpave™ Mix Design.

## Methodology

In this research, the following tasks will be performed:

- Perform a literature review to identify and document the use of recycled concrete aggregate (RCA) as an alternative to virgin or natural aggregates as used by DOTs and transportation agencies worldwide.
- Test the fundamental and engineering properties of the RCA to assess the suitability of parameters such as specific gravity and absorption (AASHTO T84 and T85), fractured faces % (ASTM D 5821), flat & elongation % (ASTM 4791), uncompacted void content % (AASHTO T326) Los Angeles abrasion resistance (ASTM C535), Micro Deval degradation (AASHTO TP 58-00).
- Establish the textural and surface characteristics using the Automated Image Measuring System (AIMS) equipment.

*(continued)*

MiSTI U.S. DOT University Transportation Center for Materials in Sustainable Transportation Infrastructure

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University Facts

| | |
|---|---|
| Total Enrollment | 6,550 |
| Graduate Enrollment | 916 |
| Number of Faculty | 417 |
| Placement Rate | 95% |

*Michigan Tech is located in Houghton, MI on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.*

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## Methodology (continued)

- Utilize the RCA to design Superpave™ asphalt mixtures using design parameters and specification criteria adopted by the Michigan DOT, and the supplementary guidelines from the worldwide literature.
- Conduct detailed SPT laboratory testing on the designed RCA-HMA to ascertain the mixtures' performance rating in terms of : 1) Dynamic modulus (E*); 2) Creep compliance; 3) Flow Number (Fn); 4) Asphalt Pavement Analyzer (APA) Rutting Potential; 5) Tensile Strength Ratio (TSR).
- Statistically analyze the variation in Superpave™ Performance results between the control mix and the designed RCA-HMA.
- Prepare recommendation on the use of RCA as a viable aggregate material for HMA in Michigan.

Following these tests, the research team will undertake a comprehensive Superpave™ laboratory design, preparation and testing of typical Michigan HMA in using a blend of virgin aggregates (VA) and the RCA. Using varying % rates of VA and RCA, the rutting potential, moisture susceptibility, creep compliance and fatigue life will be assessed and evaluated.

## Research Findings

Upon completion of this RCA-HMA research, the research team will produce the following deliverables:

- A guiding protocol on how RCA can be incorporated in the design of Superpave™ HMA for the climatic conditions in Michigan's Upper Peninsula.
- The Superpave™ performance rating of RCA-HMA and its response to rutting, moisture susceptibility, thermal and fatigue cracking distress development in the mix.
- Recommendations of the impact of RCA reclamation processes and techniques on the production of suitable RCA for HMA with special focus on the aggregate strength properties.
- Life Cycle Assessment of a typical RCA asphalt pavement.

## Future Work

This research will provide a foundation for further research and a reliable database for exploring the potentials of RCA and RAP as aggregate materials in a designed HMA. In addition, the research team is planning to study the performance and distress behavior of RCA-HMA using the M-EPDG.

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