

- Category E2: Design Guidance

- Work Elements led by UNR containing fundamental properties work and modeling**

- E2b: Design System for HMA Containing a High Percentage of RAP Material
 - E2d: Thermal Cracking Resistant Mixes for Intermountain States
 - E2c: Critically Designed HMA Mixtures

- Research Team:
 - UNR
 - UWM
 - WRI
 - AAT
 - Granite Construction

- Duration: 5 years

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- Evaluate the Properties of RAP Materials
 - **Compatibility of RAP and Virgin Binders**
 - Mix Design
 - **Impact of RAP on Performance**
 - Field Trials

- Wetting of new Binder onto RAP Particles Surfaces
- Mutual Miscibility (mixing) of Molecular Species

- Impact of RAP on Fundamental Properties and Resistance to Distresses
 - Fundamental properties
 - Performance models

- Evaluate the impact of RAP on the dynamic modulus master curves
 - Short-term aged
 - Long-term aged

- Resistance to Moisture Damage:
 - short-term and long-term aged
 - ARC developed models

- Resistance to Fatigue:
 - long-term aged
 - Flexural beam fatigue
 - ARC developed models

- Resistance to thermal cracking
 - Long-term aged
 - TSRST
 - ARC developed models

- Resistance to permanent deformation
 - Short-term aged
 - Triaxial repeated load

- With Other ARC Activities
 - Years 1-3 materials properties and mix design
 - Years 3-5 models from ARC research

- With NCHRP Activities:
 - Project 09-46 [anticipated]
 - Contacted Ed Herrigan:
 - distribute ARC RAP work plan to Panel
 - add Sebaaly as interested member to Panel
 - will insure full cooperation and no overlap

- Research Team
 - UNR
 - UWM
 - WRI
 - A&M (Charles Clover)
 - Claine Petersen
 - Granite Construction

- Duration: 5 years

- Identify Field Sections
- Identify the Cause of the Thermal Cracking
- **Identify an Evaluation and Testing System**
- **Modeling and Validation of the Developed System**
- Develop a Standard

- Binder Aging System for Intermountain Region
- Past and Present WRI Work on Binder Aging
- Impact of Fillers, Air-Voids, and Absorptive Aggregates on Mix Aging
- Develop a Thermal Cracking Test for HMA Mixtures

- Develop a Model for Thermal Cracking of HMA Mixtures in the Intermountain Region
- Pat and Present WRI Work on Thermal Properties of Binders
- Validate the Model
- Expand for other Regions in the U.S.

E2c: Critically Designed HMA



- Every HMA Mix has a critical combination of temperature and loading rate
- Loading conditions beyond the critical combination will lead to premature catastrophic failures
- HMA mix components influence the critical combination

- **Identify the Critical Conditions**
- **Conduct Mixture Evaluations**
- Develop a Simple Test
- Evaluate the Impact of Mix Characteristics

Identify the Critical Conditions



- Theoretical modeling of flexible pavements
- Various loading conditions: speed, load level, configurations
- Various temperatures

- Repeated Load Triaxial Testing
 - Permanent def. characteristics
 - Frequency sweep
 - Temperature sweep
- Develop a process to identify the critical combinations from lab testing