- 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

E2b: HMA with RAP

- Research Team:
  - UNR
  - UWM
  - WRI
  - AAT
  - Granite Construction
- Duration: 5 years

E2b: HMA with RAP

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

Compatibility of Binders

- Wetting of new Binder onto RAP Particles Surfaces

- Mutual Miscibility (mixing) of Molecular Species

Impact of RAP on Properties

- Impact of RAP on Fundamental Properties and Resistance to Distresses

  - Fundamental properties

  - Performance models

Fundamental Properties

- Evaluate the impact of RAP on the dynamic modulus master curves

  - Short-term aged

  - Long-term aged

Performance Models

- 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

Performance Models

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

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

Coordination

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

Coordination

- 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

E2d: Thermal Cracking

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

- Duration: 5 years

E2d: Thermal Cracking

- 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

Evaluation System

- 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

Modeling of Thermal Cracking

- 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

E2c: Critically Designed HMA

- **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

Conduct Mixtures Evaluations

- Repeated Load Triaxial Testing
  - Permanent def. characteristics
  - Frequency sweep
  - Temperature sweep

- Develop a process to identify the critical combinations from lab testing