

# NCHRP 09-46

## Improved Mix Design, Evaluation, and Materials Management Practices for Hot Mix Asphalt with High Reclaimed Asphalt Pavement Content

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# Project Tasks

- Phase I
  - Task 1 – Literature review
  - Task 2 – Propose mix design & analysis procedure
  - Task 3 – Lab work plan
  - Task 4 – Interim report (Tasks 1-3)
- Phase II
  - Task 5 – Conduct lab work plan
  - Task 6 – Compare RAP mixes to virgin mixes
  - Task 7 – Evaluate min. of 3 field projects
  - Task 8 – Propose changes to standards
  - Task 9 – Final report

# Phase I

- Completed

# Phase II

# Overview of Mix Design Approach

- Follow typical Superpave procedures for evaluating and selecting aggregate, aggregate blends, and asphalt content
- Begin with standard binder from a region and then evaluate back calculated binder properties
- Conduct additional mix testing

# Mix Testing

- Blended Binder Properties
  - Dynamic Modulus
- Moisture Susceptibility
  - TSR
- Permanent Deformation
  - Repeated Load Permanent Deformation
- Fatigue
  - Beam fatigue, AMPT Fatigue, or Overlay Tester
- Low Temperature
  - SCB and BBR with mix beams

# Status of Testing

- Dynamic modulus – completed
- Moisture Susceptibility – completed
- Flow Number – completed
- BBR and IDT – completed
- Fatigue Test – not selected

# Dynamic Modulus

- Sensitive to changes in binder grade and increased RAP
- Back calculation underway
  - Using virgin binder master curve to calibrate model



# Moisture Sensitivity

- Addition of RAP increased indirect tensile strengths
- TSR values decreased in several cases with the addition of RAP

**Recommendation:** If the conditioned indirect tensile strength is greater than 100 psi, the TSR can be as low as 70%

# Flow Number

- Sensitive to binder grade change and RAP increase
- Selected deviator stress was too low to induce tertiary flow

**Preliminary Recommendation:** Use a higher deviator stress than 70 psi, conduct test if history of permanent deformation

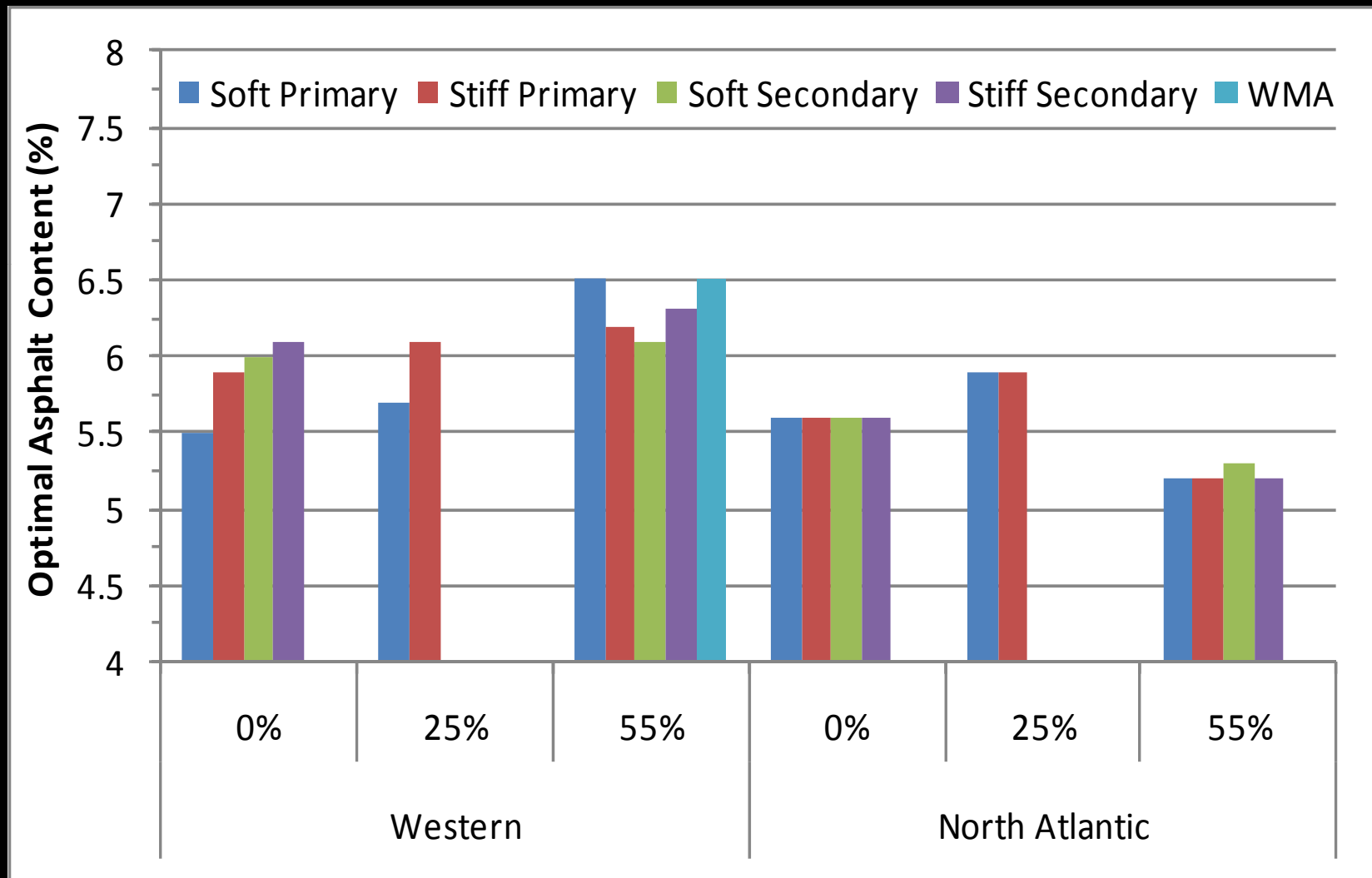
# BBR and Creep Compliance

- The data is in the process of being analyzed

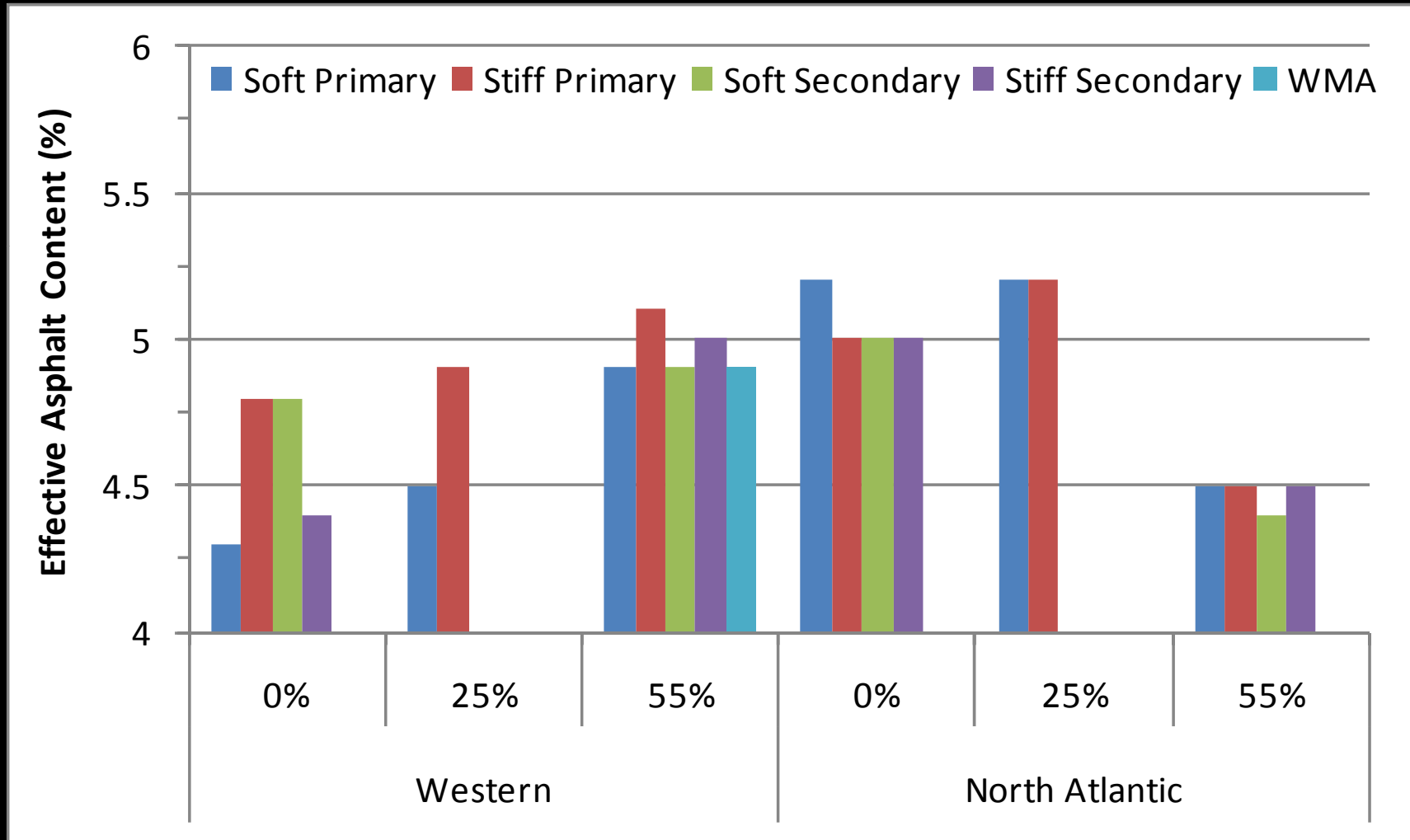
# Mini- Study: Effects of Binder Grade

- Evaluated if different binder sources and grades substantially affected volumetric properties
- Two RAP sources and four binders per RAP source

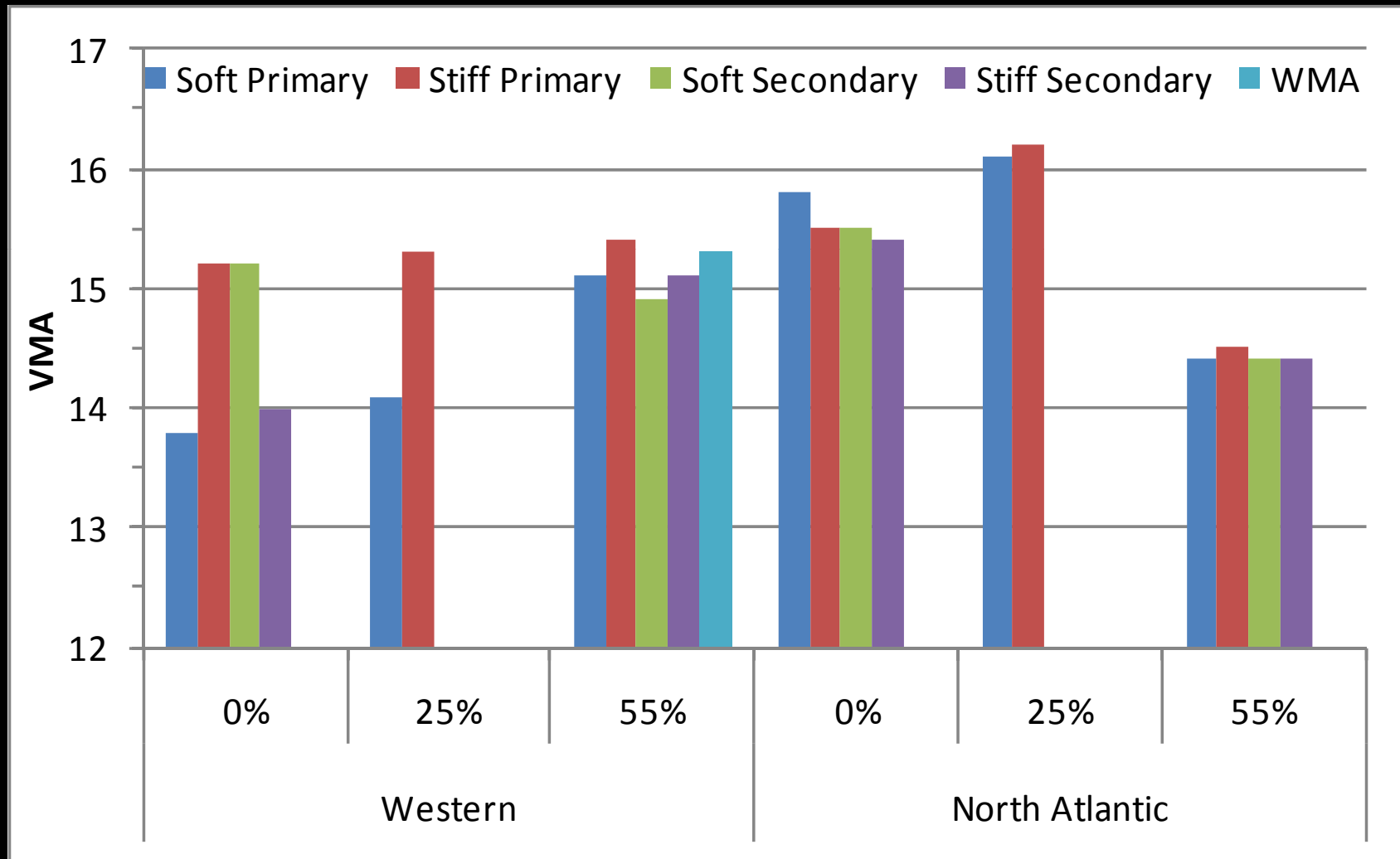
# Optimal Asphalt Content



# Effective Asphalt Content



# VMA



# RAP Management Best Practices

- Crushing
  - Minimize creating additional fines
- Stockpiling
  - Minimize moisture content
  - Minimize segregation
- Plant Operations
  - In-line crusher should only be used to break up agglomerations
  - RAP feed calibration
  - Superheating
  - Emissions
  - Warm mix asphalt technologies
- Processing and stockpile management should not be a method specification such as requiring fractionation



# Questions and Comments