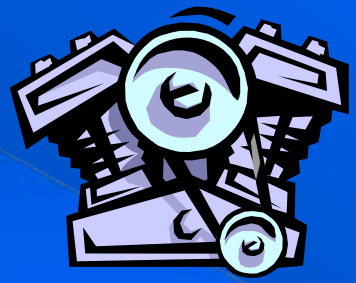
The Key AC Emphasis Areas for the Future

John D'Angelo
Office of Pavement Technology

Pavement Design

Loads and Layer Stiffness



Mechanistic Analysis

Layered Elastic Analysis

$E = \sigma/\varepsilon$

Strain Calculations at Critical Locations

Current Status of MEPDG

MEPDG Software Version 1.0

- Downloadable, must be connected to Internet to use
- Updated on NCHRP website: www.trb.org/mepdg
- Voted on by the SOM and SOD
- Next step AASHTO SCOH
- AASHTO to develop actual design software in 2010

FHWA Activities

DGIT & Office of Freight Management / Operations

Contract with Auburn University

- Models in M-E PD that deal with truck size & weight
- Assessing impacts of raising weight limits

FHWA cross-disciplinary cooperation team

- Identify methods to assign cost to infrastructure damaged by increased highway load limits
- Strive for official FHWA position on this topic

Future FHWA Workshops

National Highway Institute
NHI Course #131109
Pilot: April 2007

Analysis of New and Rehabilitated Pavement Performance with Mechanistic-Empirical Pavement Design Software

- Hands-on format with computers loaded with software
- Focus on user, not theory
- Objective is for audience to be capable of performing flexible, rigid, rehab designs

Future FHWA Workshops

- Local Calibration for M-E PDG models
  - Awaiting deliverables from NCHRP 1-40 B
  - Pilot planned for Fall 2008
  - Purpose: discuss Sensitivity of inputs & calibration, educate Pavt Designers & Pavement Managers

Asphalt Mix Performance Tester

The test can evaluate the rutting and fatigue response of the mix.

The equipment is relatively inexpensive and easy to use.

Provides input data for MEPDG

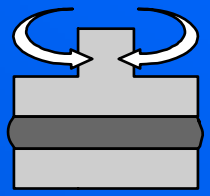
Can be used for Construction acceptance.

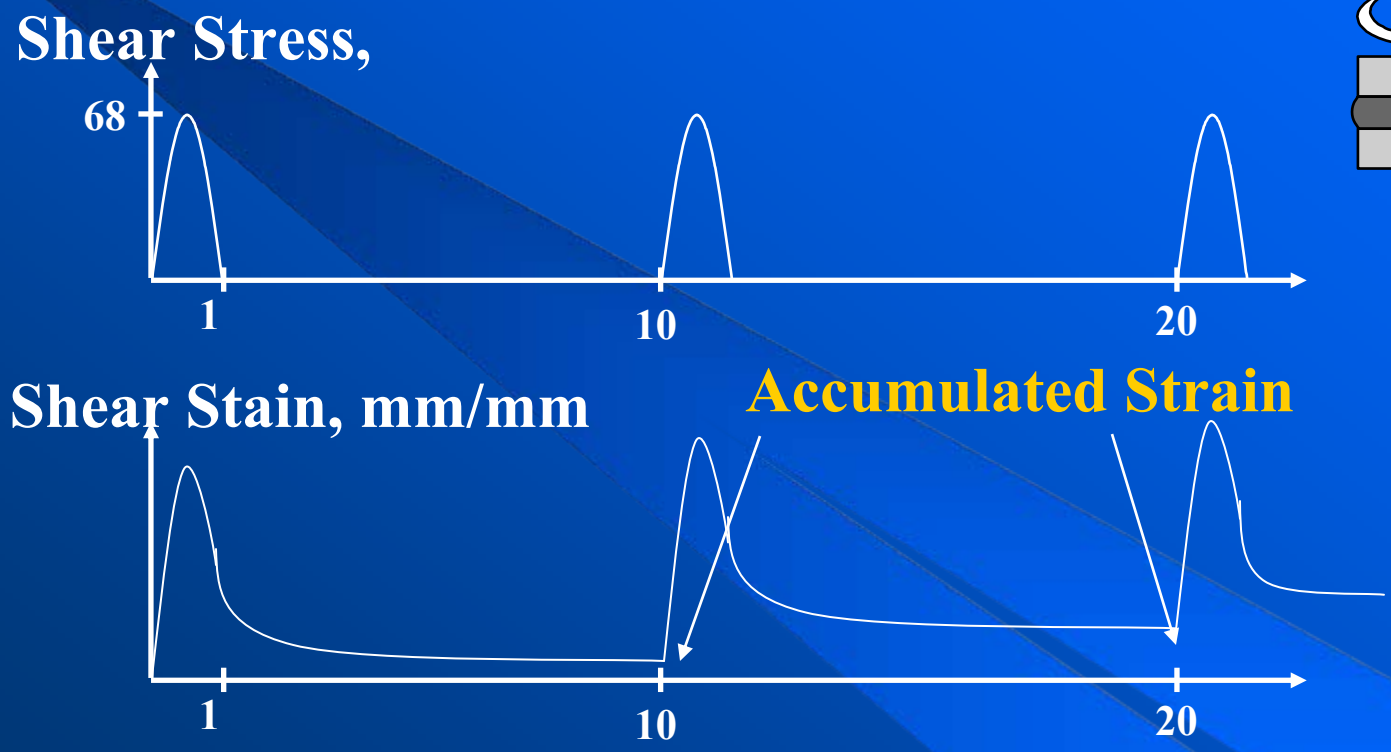
Asphalt Mix Performance Tester

- Develop new pooled fund for purchase of the equipment.
- Establishment of a technician training school for operation of the equipment.
- Develop precision and bias for test procedure.

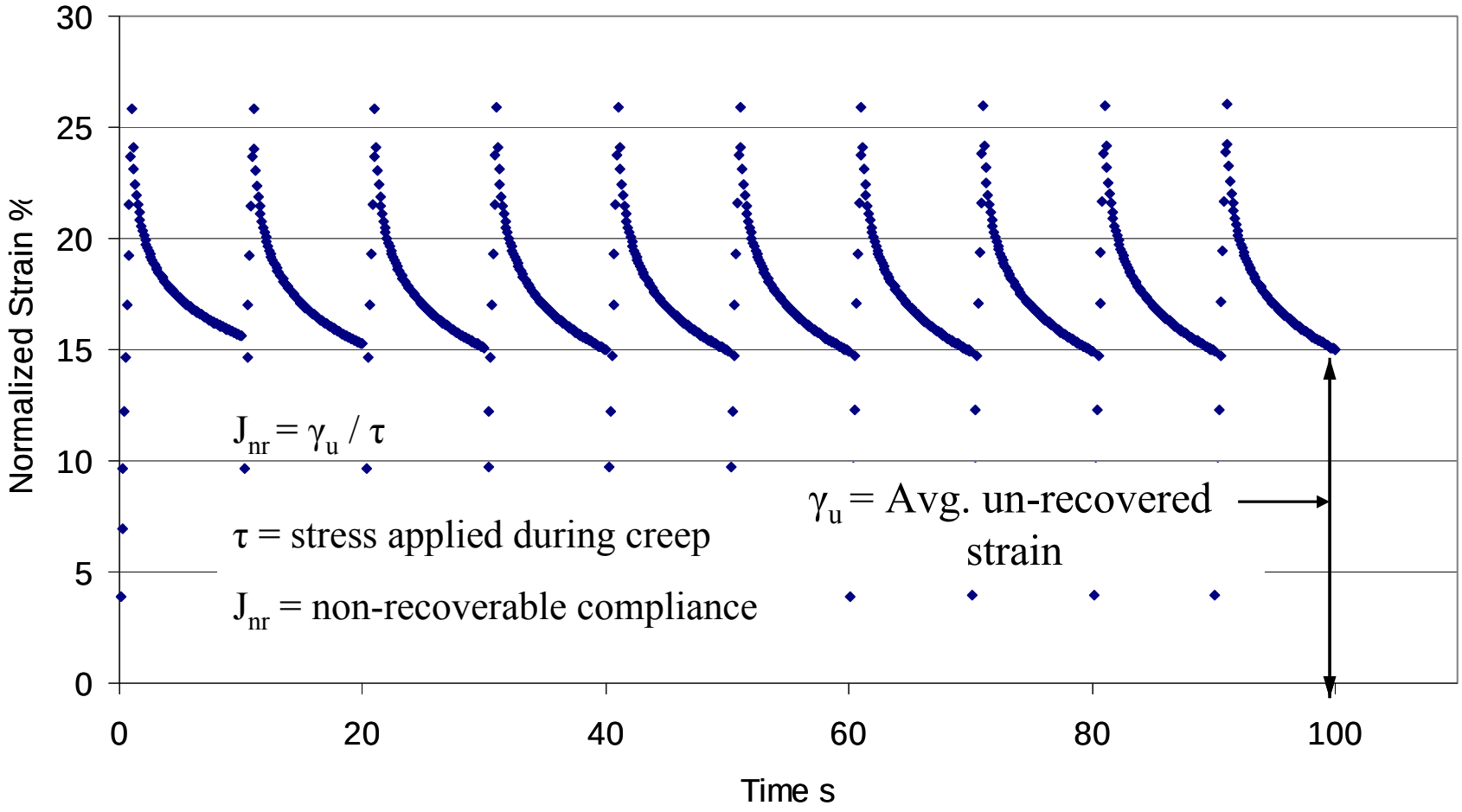

Binders

NCHRP 9-10 Rutting Test Repeated Creep Recovery Test





New High Temp Criteria Jnr



Laboratory Evaluation: Warm-Mix Asphalt Binder Additives

Warm Mix Task Group:

Gaylon Baumgardner

Gayle King

Gerald Reinke

Matt Corrigan

Chris Abadie

Experimental – Binder Testing

– Question: (RTFO , PAV or both?)

- Master Curve Development (DSR) – PTSi
- SuperPave™ True Grade (Through DTT) – PTSi
- Physical Hardening (30 days saturation at -12°C) Bending Beam Rheometry (BBR) - PTSi
- Multi-Step Creep Recovery (MSCR) – FHWA
- Glass Transition Tg (MDSC) – WRI/MTE
- Atomic Force Microscopy (AFM) –WRI
- Binder Stress Sweep Fatigue (Bahia UW Method) – PTSi/MTE

Mixture Issues

Superpave Gyratory Compactor Calibration

Making Superpave Mixtures Consistent

AASHTO Designation: T 312-03 Preparing … Specimens by … SGC

4.1

Superpave Gyratory Compactor – … an average internal angle of 1.16° ± 0.02°

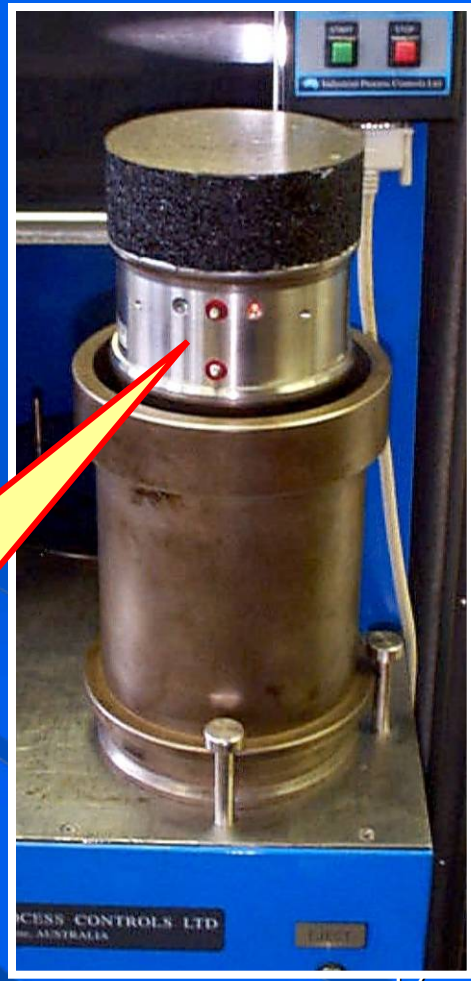
…..

(only internal angle with simulated mix measurement)

Internal Angle Measurement
with Hot Mix Asphalt

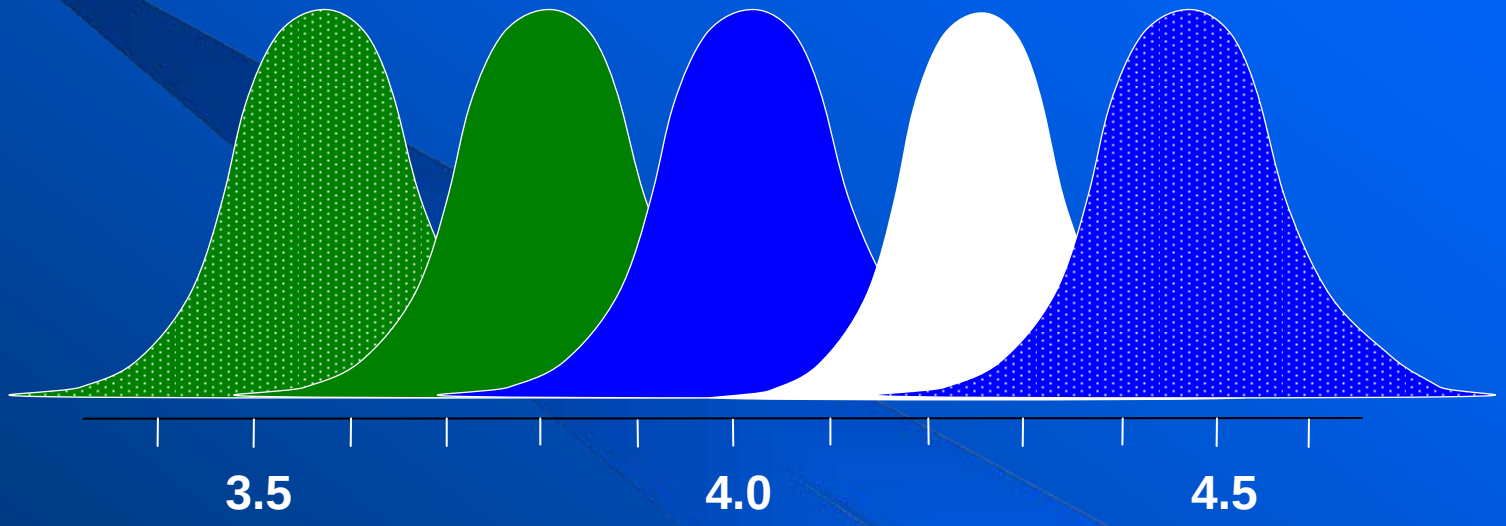
DAV on Top to measure α_T

DAV on Bottom to measure α_B



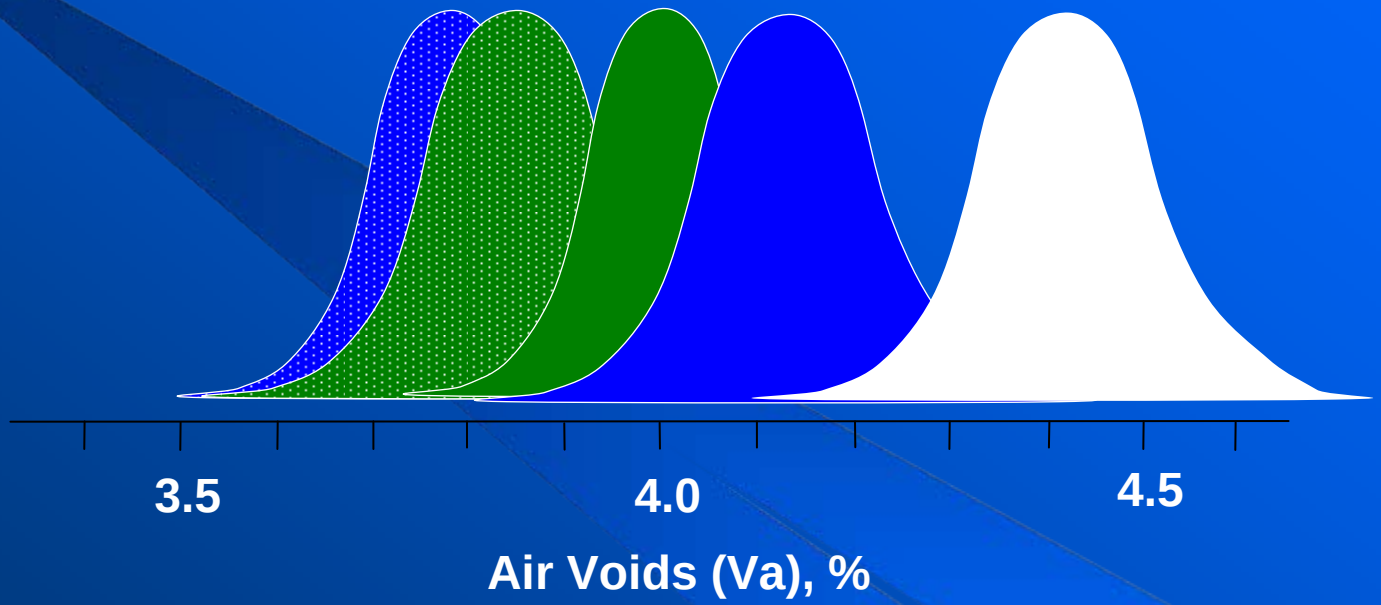
APAC

Calibrated to 1.25 degrees External



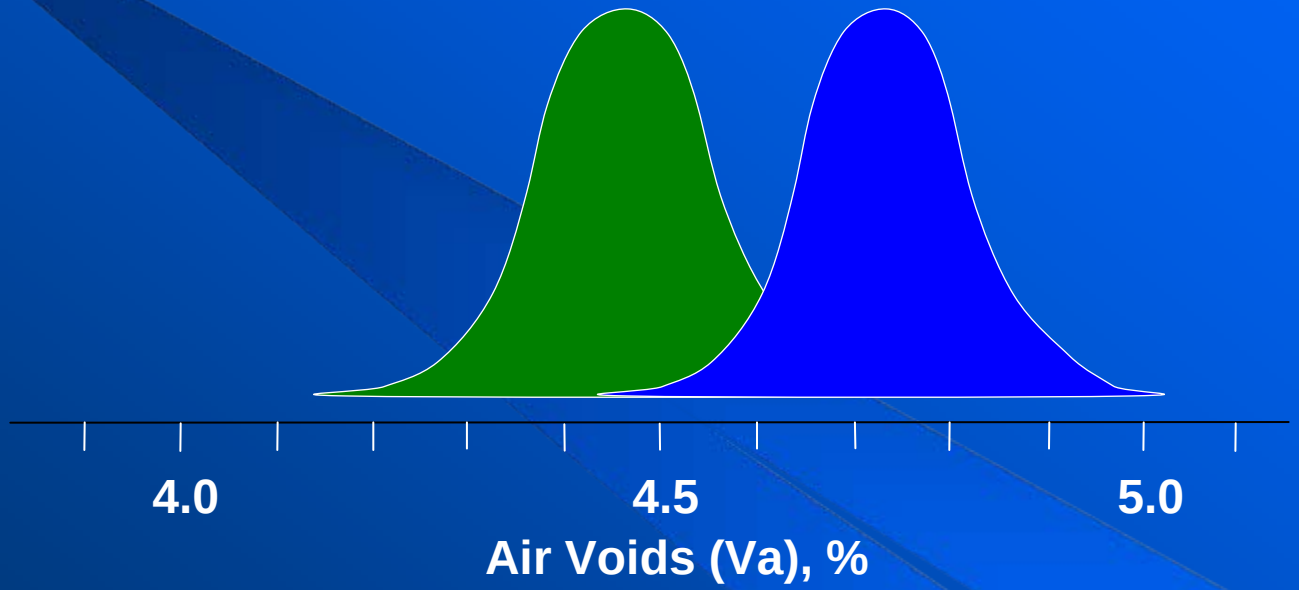
APAC

Calibrated to 1.16 degrees Internal



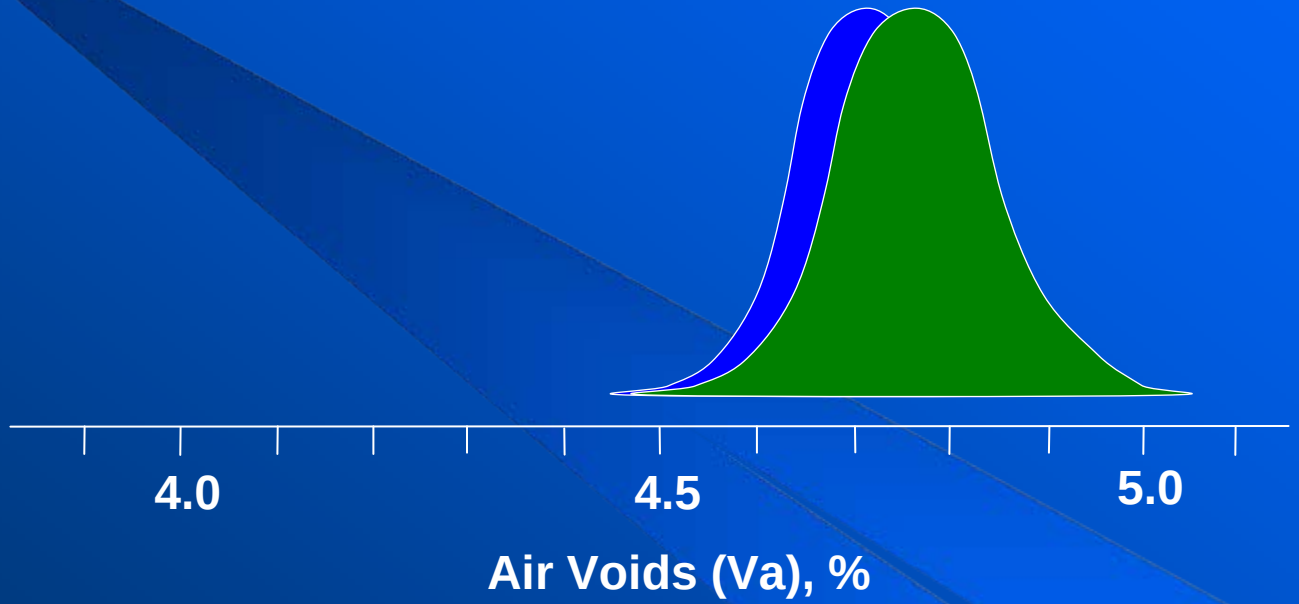
Asphalt Institute

Calibrated Externally at 1.25°



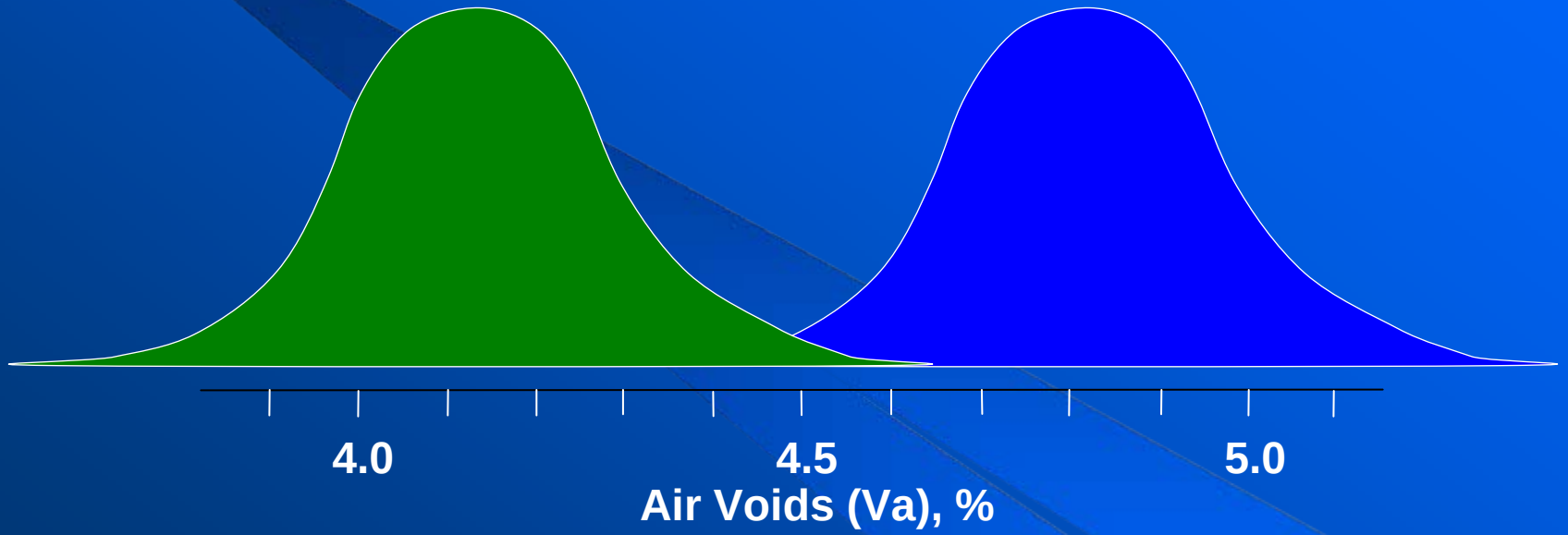
Asphalt Institute

Calibrated Internally at 1.16°



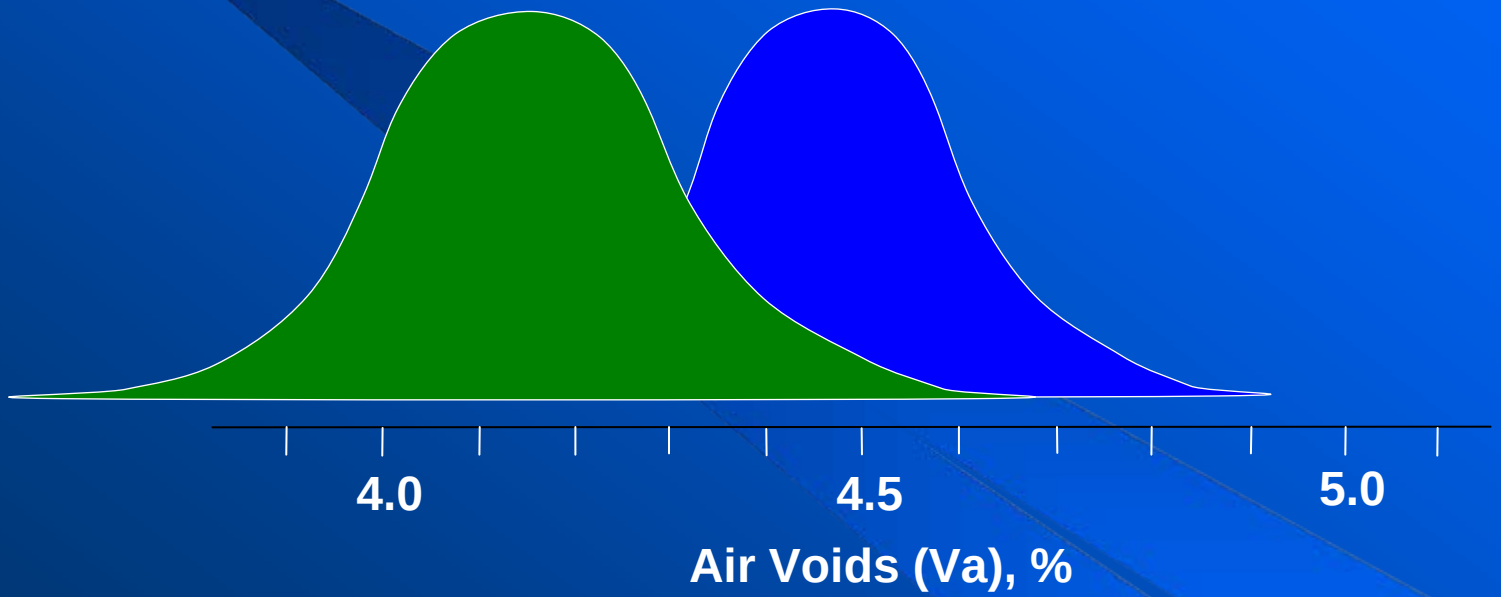
University of Arkansas

Calibrated Externally at 1.25°



University of Arkansas

Calibrated Internally at 1.16°



HMS & RAM

Specification Recommendations

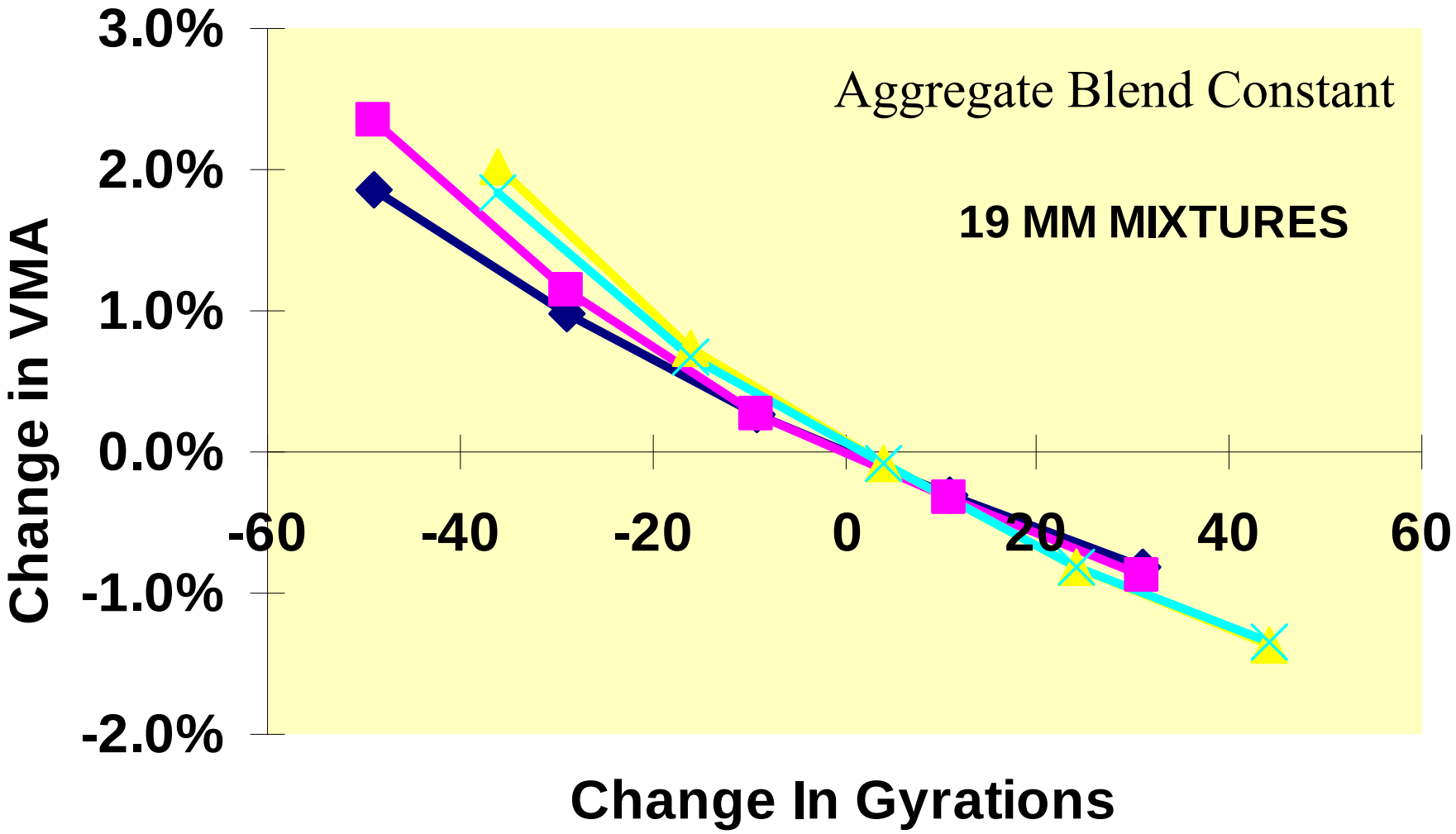
- Drop procedures related to use of HMA
  - drop reference in T312; eliminate TP48
- Implement new TP for simulated loading
  - add reference in T312
  - Precision: Troxler 4140 NOT INCLUDED
  - Refer to “manufacturers’ recommendations”
    - Applies to specific procedures for using various devices
    - Applies to hot-versus-cold question(s).
  - Inform users that RAM ~ DAV2/HMS
- Angle tolerance: move to +/- 0.03 deg

New Study Underway

- FHWA & University of Arkansas
  - Evaluate the effect of angle on density using internal angle measurements
  - Mix-less angle measurements.

N DESIGN EFFECT OF DESIGN COMPACTION on MIX PROPERTIES

Effect on VMA

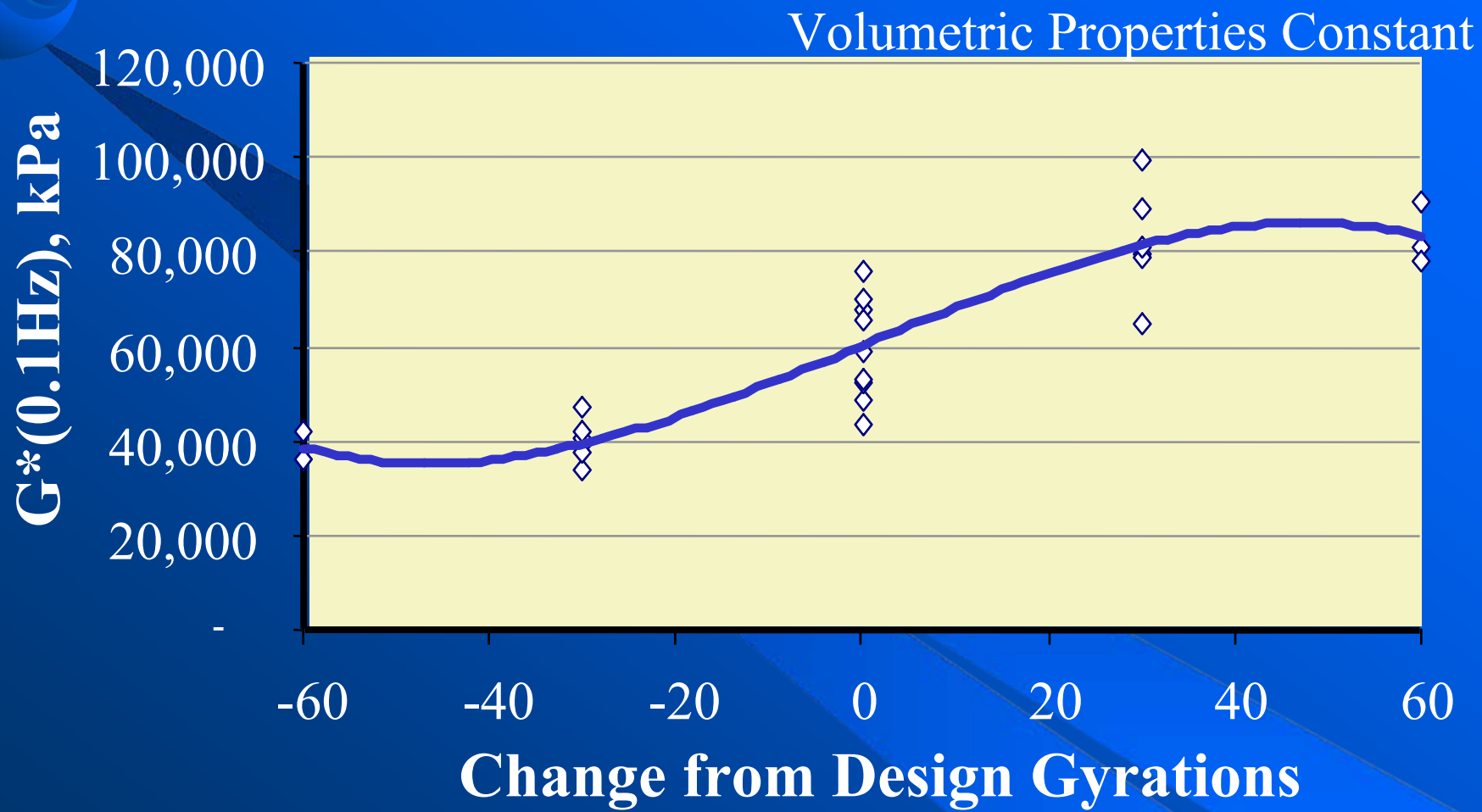


Effect of Design Gyrations

Aggregate Properties Constant (gradation, CAA, FAA)

LAB		ROAD
N design		% Asphalt
high		low
low		high

Effect on Stiffness



Effect of Design Gyrations

Volumetric Properties Constant (air voids, VMA, VFA)

LAB		ROAD
N design		Skeleton
high	→	strong
low		weak

What Should Design Gyrations Be?

- 20-30 gyrations changes
  - VMA by 1%
    0.4% asphalt content
  - Mixture stiffness by 25 to 30%
    about one PG high temp grade difference
  - SO . . . . . .


Estimated Design Traffic Level (Millions[1] ESAL
Compaction Parameters
N
9
125
205
Revised Table

Influence of N_{design} on Mix Properties

Property	Increased N_{des}	Decreased N_{des}
Stiffness	increase ↑	decrease ↓
Compaction	difficult ↓	easy ↑

In Superpave (Marshall too)

- Air voids and VMA specified
  - Controls asphalt content
- Gradation is not
  - SO . . . . to change asphalt content, change VMA requirement

Effect of Design Gyrations

Volumetric Properties Constant (air voids, VMA, VFA)

LAB		ROAD
N design		Skeleton
high	→	strong
low		weak

CONCLUSIONS

- Density at end of service life not appropriate to define N design
- N-design does not influence asphalt content
- N-design in Superpave is “in the ball park”
- Performance testing as final criteria

Recommended Ndesign Table

9-9 (1) Proposed Ndesign Levels

20-Year Design Traffic, ESALs	2-Year Design Traffic, ESALs	Ndesign Unmodified	Ndesign PG 76-22
< 300,000	< 30,000	50	NA
300,000 to 3,000,000	30,000 to 230,000	65	50
3,000,000 to 10,000,000	230,000 to 925,000	80	65
10,000,000 to 30,000,000	925,000 to 2,500,000	80	65
> 30,000,000	> 2,500,000	100	80

Fine Aggregate Specific Gravity Issues

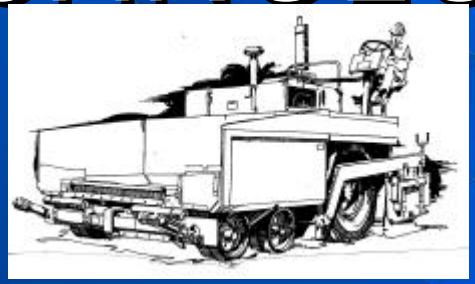
Mix ETg Task Group Objectives:

- Identify problems/issues with current standard AASHTO T 84
- Evaluate alternate methods
- Make recommendations regarding changes and/or new methods
- Additional scope -- Mixture gravity determination issues T 209

NCHRP Projects

- 9-38: Endurance Limit of HMA Mixtures to Prevent Fatigue Cracking
- 9-39: Determining Mixing and Compaction Temperatures of PG Binders in HMA
- 9-45: Development of Specification Criteria for Mineral Fines Used in HMA
- 9-46: Mix design procedure for RAP mixes up to 50%

WARM MIX ASPHALT TECHNOLOGY



44th Annual Idaho Asphalt Conference

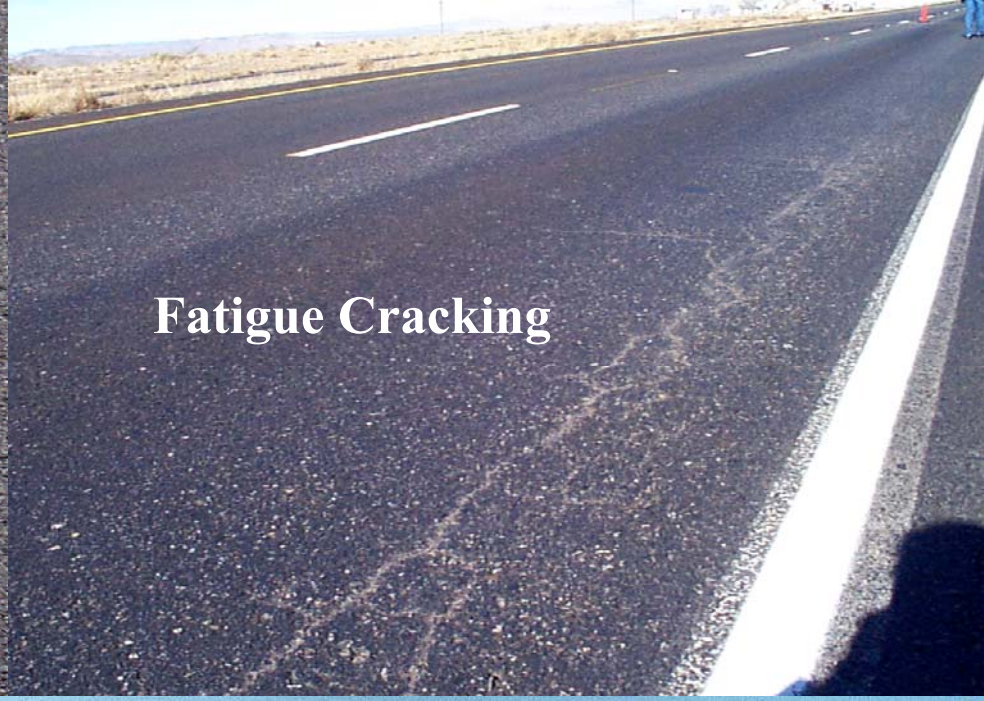
October 21, 2004

Moscow, Idaho

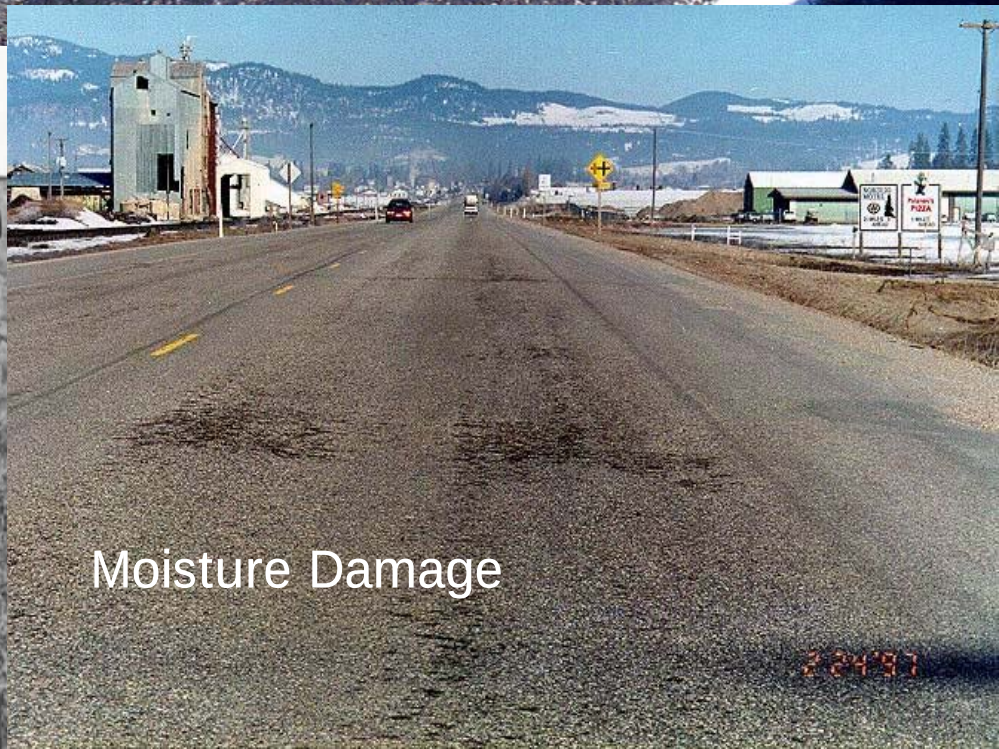
U.S. Department of Transportation
Federal Highway Administration


Recycling
MACK
1476


Rutting


Fatigue Cracking


Low Temperature Cracking


Moisture Damage

Key Points Of FHWA Recycling Policy

- Recycled materials should get first consideration in overall materials selection.
- Recycling can offer engineering, economic and environmental benefits.
- Engineering and environmental properties are important.
- Life Cycle Cost benefits assessment is warranted.
- Restrictions prohibiting recycled material that are without technical basis should be removed.

Barriers & Challenges

- AASHTO Specifications
- Recognized as beneficial not waste
- Suppliers and users – full agreement
- Research needs addressed
- Case Studies

FHWA Plan on Current Status of Pavement Recycling

- Do an analysis of the current market and practices to determine appropriate level of FHWA activities in pavement recycling.
  - Where are the issues?
  - Construction processing, Workability, durability,

FHWA Plan on Current Status of Pavement Recycling

- Re-emphasize FHWA recycling policy
  - Develop “Pavement Recycling Notebook”
  - Support and tools for Divisions, RC and State DOT’s
    - Point out economic & engineering reasons for recycling (materials & technology)
    - Emphasize need to increase recycling and assist DOT to establish goals and provide technical support

FHWA Plan on Current Status of Pavement Recycling

- What work being done
  - A RAP Technical Working Group has been established.
  - This group includes government, industry and academia.
  - They will be used to guide the many activities to be accomplished.
  - pavement evaluation


Construction

Quality Assurance Program FHWA Requirements

- Acceptance Program
  - State's Verification Testing
  - Inspection
  - May use Contractor test results
  - Dispute resolution
- Qualified Technicians
- Accredited / Qualified Labs
- Independent Assurance Program
- Materials Certification

33 States using Contractor Test Results in the Acceptance Decision

U.S. Department of Transportation
Federal Highway Administration

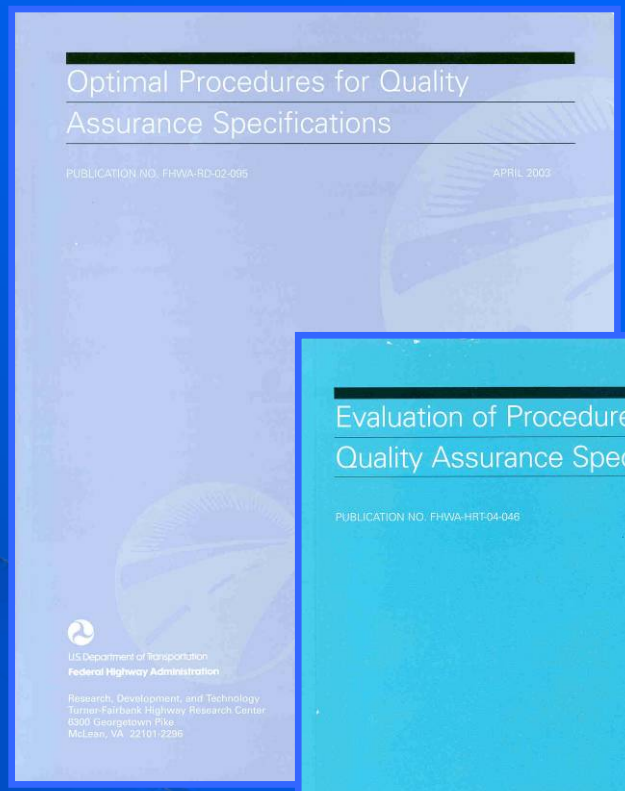
Where We Are Now …

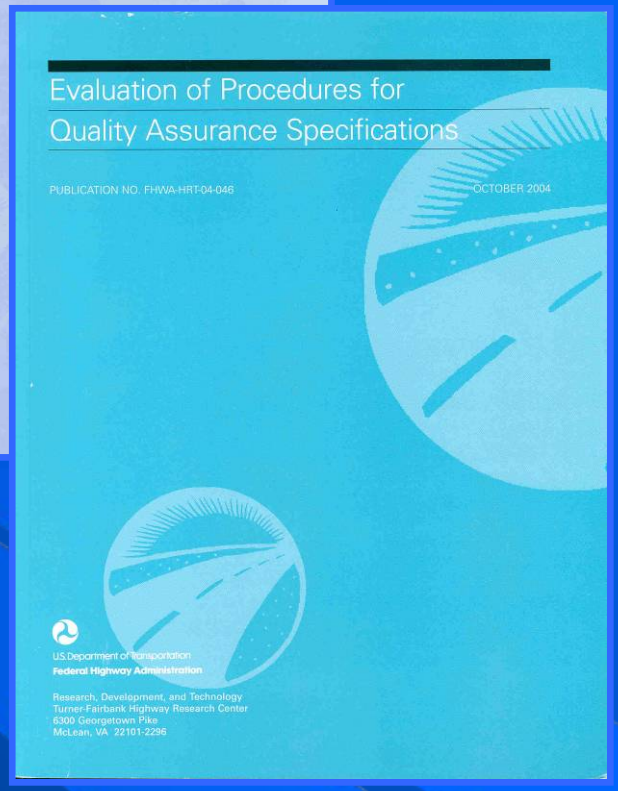
- Not enough State Verification Testing
- Not enough State personnel
- Reluctance to spend money on construction engineering – not even for consultants
- Ineffective validation procedures
- Increasing volume of projects/workload

Resources

- FHWA-RD-02-095 “Optimal Procedures for Quality Assurance Specifications”
- FHWA-HRT-04-046 “Evaluation of Procedures for Quality Assurance Specifications”

(Burati, Weed, Hughes, Hill)





Resources

- NHI Course 134042: Materials Control and Acceptance - Quality Assurance
- FHWA Basic PWL Workshop
- SPECRISK software (SPRING 2008)
- NHI Course 134059: Quality Assurance Specification Development and Validation Course (end 2008)
- 2003-2007 Summary Report
- www.fhwa.dot.gov/pavement/materials/stewardreview2006.cfm

Evolution…

QA Specs

Performance Specs

Design Build
Warrant Maintain

Intelligent Compaction

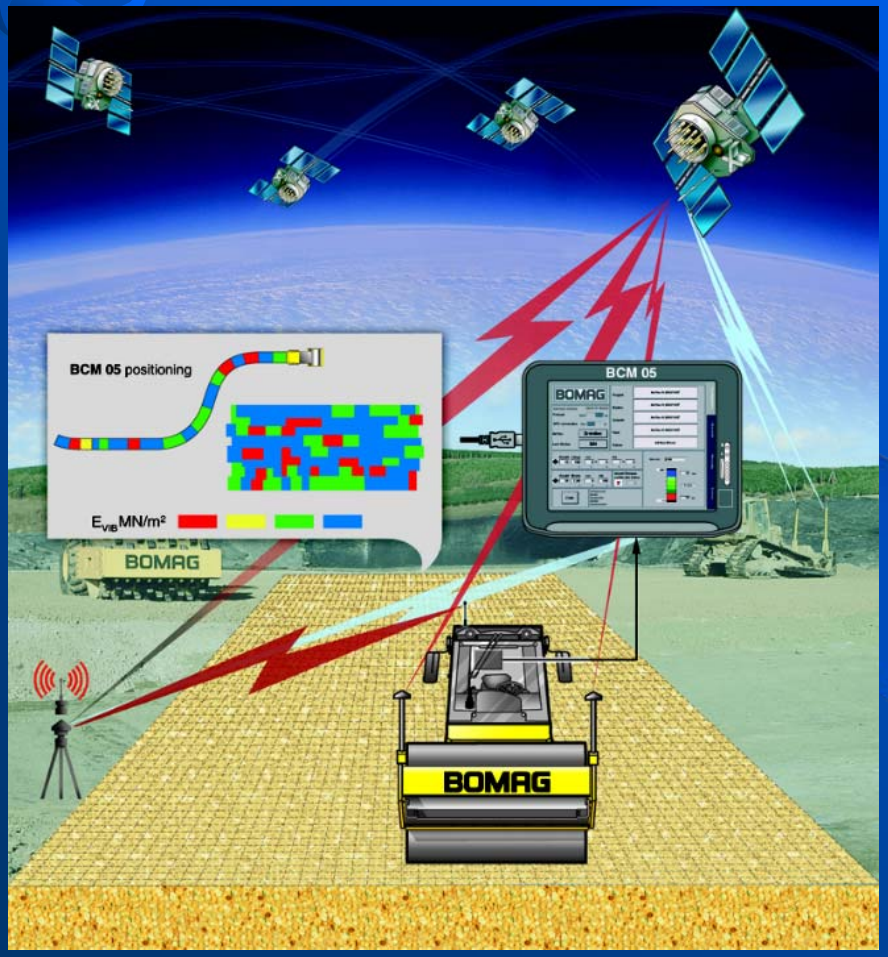
GPS antenna

GPS reference station

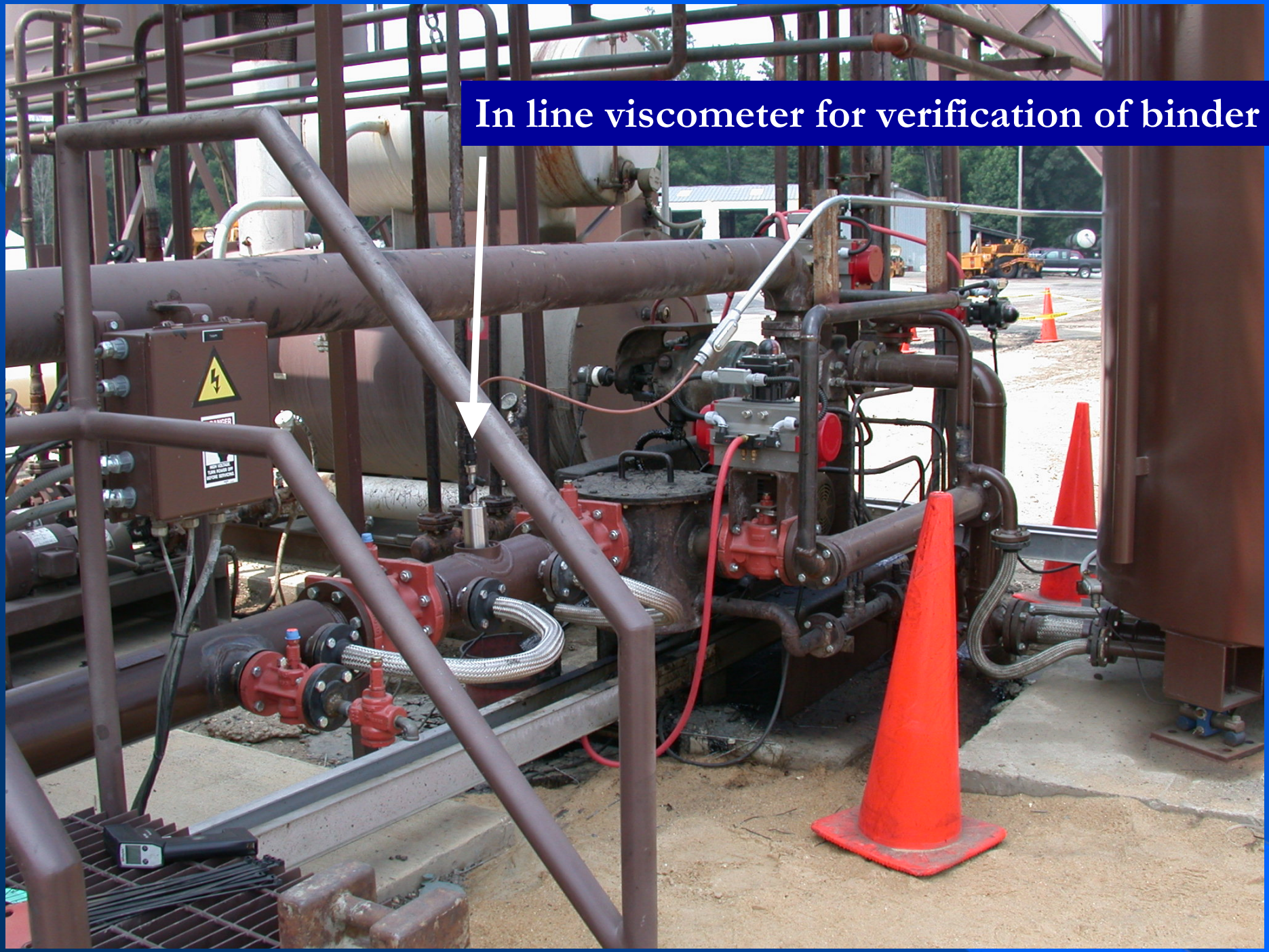
What is intelligent compaction?

- Automatic adjustable compaction equipment
- Selection of the most suitable equipment

GPS / positioning with reference station



At the mix plant are there other process that can be part of a QA program?


In line viscometer for verification of binder

No more dials and knobs in the modern plant.

Computer recordation

QA of the Future

- The QA will all be tied to Internet.
  - Direct down load of info to the owner.
  - Posting of data immediately to all parties.
  - Faster review and resolution of discrepancies.

Where We Are Going ... Long Term

- Domestic Scan of other industries
- Move toward Quality Management Systems by all contractors and suppliers
  - Beyond ISO 9000 – sector specific requirement
    - Aerospace – AS9100
    - Automotive – ISO/TS16949
- Quality Based Selection and Procurement
- Design Build Warrant Maintain

Design Build Warrant Maintain - The Final QA?

- Long Term Warranty
  - Performance based contract
  - Guarantees product integrity
  - Contractor responsible for repair of defects or replacement
- Warranty Period
  - Pre specified for repair defects
- Present Warranty workshops to states.

… and beyond!

- Cannot continue on same path of regulate and enforce
- Cannot continue to police contractors trying to catch them in the act
  - System needed to match contractor's priorities in-line with agency's
  - Quality and long term performance

Trust Fund Mid-session Review

- What changed?
  - Highway Account receipts for FY 2007- FY 2009 are a total of $3.7 billion lower than the receipts included in the 2008 President's Budget for the same time period.
  - It appears the American public is responding to the sustained high price of fuel.
    - VMT down in 2007, for the first time ever. (Average annual VMT growth rate from 1980 through 2005 was 2.7%.)
  - FY 2009 cash shortfall now estimated at approximately $4.3 billion (assuming RABA).

Highway Trust Fund Balances

Highway Trust Fund Cash Balances
FY2004 - FY2011
FY 2008 Mid-Session
($ in billions)

	Actual			Estimated Balances				
	2004	2005	2006	2007	2008	2009	2010	2011
Highway Account								
Cash Balance (Beginning of Year)	13.0	10.8	10.6	9.0	6.8	1.5	-3.8	-9.2
Receipts	29.8	32.9	33.7	33.6	34.6	35.3	36.0	36.5
Outlays*	32.0	33.1	35.3	35.8	39.8	40.7	41.4	42.2
Cash Balance (End of Year)	10.8	10.6	9	6.8	1.5	-3.8	-9.2	-14.9
Mass Transit Account								
Cash Balance (Beginning of Year)	4.8	3.8	2	6.2	6.9	6.1	3.9	0.7
Receipts	4.9	5	4.9	4.9	5	5.1	5.2	5.2
Flex Funding Transfer**			1.4					
Outlays	6	6.8	2	4.2	5.9	7.2	8.4	8.3
Cash Balance (End of Year)	3.8	2	6.2	6.9	6.1	3.9	0.7	-2.3
Highway Trust Fund								
End of Year Cash Balance (Total)	14.6	12.5	15.2	13.7	7.6	0.1	-8.5	-17.2

* Includes Flex Funding Transfer to MTA
** Flex Funding in FY2006 and FY2005 was fully outlayed to the General Fund
Note: FY2008 Highway Account outlays do not include RABA

July 11, 2007

Would All Spending Stop If The Highway Trust Fund Ran Out Of Cash?

- No. Spending on programs would continue as new receipts are received (an average of $3 billion per month).
- Payments may not be timely. Very problematic for States, who rely on prompt reimbursements.

Senate Finance Committee Proposal

- Retroactively fund $3.3 billion in Emergency Relief appropriations since 1998 from the general fund
- Raise the point of taxation for gasoline to the refinery level (one-time benefit of $848 million)
- Pay refunds and credits for fuel tax exemptions from the general fund for 6 months ($745 million)

Reauthorization Guiding Principles

- Increased state flexibility
- Simplification of federal programs
- Decisions based on merit
- Encouragement of innovation
- Public-Private Partnerships
- Direct pricing of road use
- Empowering customers

Preparing for Reauthorization

- FHWA Initiative
  - More state control
  - Smaller Federal Aid Program
  - No new taxes
  - Public Private Partnerships

Thank You

Questions