FHWA Asphalt Mixture Expert Task Group

Asphalt Mixture ETG Purpose
The primary objective of the FHWA Expert Task Group is to provide a forum for the discussion of ongoing asphalt mixture technology and to provide technical input related to asphalt mixtures design, production and construction.

A total of 72 individuals attended the meeting (20 members, 2 contract personnel, and 50 visitors). Attachment A is the meeting agenda, Attachment B includes a listing of the ETG members, and Attachment C is a listing of the Mixture Expert Task Group (ETG) members.

Members of the FHWA Asphalt Mixture and Construction ETG in attendance included:
Frank Fee, NuStar Asphalt (Chairman)
John Bukowski, FHWA (Secretary)
Ray Bonaquist, Advanced Asphalt Technologies (Co-chairman)
Howard Anderson, Utah DOT
Haleh Azari (Liaison), AASHTO-ARML
Shane Buchanan, Old Castle Materials
Mark Buncher (Liaison), Asphalt Institute
Audrey Copeland (Liaison), NAPA (represented/proxy by Heather Dylla)
Jo Daniel, University of New Hampshire
Ervin L. Dukatz, Jr., Mathy Construction Company
Georgene Geary, Georgia DOT
John Haddock, Purdue University
Kevin Hall, University of Arkansas
Gerry Huber, Hertiage Research Group
Reid Kaiser, Nevada DOT
Pamela Marks, Ministry of Transportation Ontario, Canada
Louay Mohammad, LTRC/Lousiana State Univeristy
James Musselman, Florida DOT
Timothy Ramirez, Pennsylvania DOT
Nam Tran (Liaison), National Center for Asphalt Technology

Meeting Coordinator: Lori Dalton (SME, Inc.)
Meeting Technical Report: Harold L. Von Quintus, (ARA, Inc.)

Members of the ETG not in attendance:
Mike Anderson (Liaison), Asphalt Institute
Tom Bennert, Rutgers University
Audrey Copeland (Liaison), NAPA
Adam Hand, Granite Construction, Inc.
Edward Harrigan (Liaison), NCHRP
Richard Kim, North Carolina State University
Todd Lynn, Thunderhead Testing, LLC
Allen Myers, Kentucky Transportation Cabinet
David Newcomb, Texas A&M Transportation Institute

"Friends" of the ETG that were in attendance included:

Chris Abadie, Louisiana DOT	Gayle King, GHK
Tim Aschenbrener, FHWA	Bob Kluttz, Kraton Polymers
Gaylon Baumgardner, Paragon Tech. Services	Pavel Kriz, Imperial Oil
Lyndi Blackburn, Alabama DOT	M. Emin Kutay, Michigan State University
Phillip Blankenship, Asphalt Institute	Ashley Lovasik, Sonneborn, LLC
Mark Blow, Asphalt Institute	Barry Moore, Louisiana DOT
Sandy Brown, Asphalt Institute	Gale Page, King of Asphalt Consulting
Doug Carlson, Liberty Tire Recycling	Sebastian Puchalski, Kraton Polymers
John Casola, Malvern Instruments	Roger Pyle, Pine Instruments
Andrew Cooper, James Cox & Sons	Ali Regimand, InstroTek, Inc.
Sam Cooper, Jr., LTRC	Gerald Reinke, Mathy Construction
Matthew Corrigan, FHWA	Delmar Salomon, Pav't. Preservation Systems
John D'Angelo, D'Angelo Consulting	Hassan Tabatabaee, Cargill
Heather Dylla, NAPA	Shauna TecleMarian, U.S. Oil & Refining
Bart Fernando, IPC Global	Kevin VanFrank, CME
Gary Fitts, Shell	Scott Veglahn, Mathy Construction
Jean Paul Fort, COLAS USA	Chao Wang, North Carolina State University
Lee Gallivan, FHWA	George Way, RAF
Danny Gierhart, Asphalt Institute	Randy West, NCAT
Nelson Gibson, FHWA	Jeff Withee, FHWA
Amir Golalipour, Anton Paar	Haifang Wen, Washington State University
Matt Groh, Associated Asphalt	Tim Yasika, Sonneborn, LLC
Elie Hajj, University of Nevada at Reno	Fujie Zhou, Texas Transportation Institute
Andrew Hanz, WHRP	Doug Zuberer, Zydex
Brian Johnson, AASHTO	
David Jones, UC Pavement Research Center	

DAY 1: Wednesday, April 17, 2014

1. Call to Order—Chairman Fee (Frank Fee, LLC) called the meeting to order at 1:00 PM.
Welcome and Introductions – Frank Fee and John Bukowski welcomed everyone to the meeting. Louay Mohammad welcomed everyone and overviewed the LTRC facilities. Lori Dalton noted the sign-up sheets are being distributed for the ETG members and a separate sign-in sheet for friends of the ETG. Copies of the agenda were distributed prior to the meeting. Bukowski stated the technical report and presentations from the April 2014 meeting are available on data sticks.

Frank Fee thanked all members for attending the meeting and for their efforts over the years. Fee asked everyone to introduce themselves.

2. Review Agenda/Technical Report Approval & Action Items—John Bukowski (FHWA)

John Bukowski noted the technical report from the last meeting was sent out by e-mail prior to the meeting. Bukowski asked if there were any revisions or corrections to the technical report. No corrections or revisions were noted. Bukowski mentioned any corrections or revisions to the technical report should be sent to him. Bukowski announced Friends of the ETG can receive the Mix ETG technical report on request.

Bukowski reviewed the Action Items from the April 2014 Mixture ETG meeting. The following is a listing and status of the Action Items from the last meeting.

1. Louay Mohammed to provide update on progress on NCHRP 9-48 at next ETG meeting.
   Update: Item is on the agenda.

2. Matthew Corrigan to provide update on testing/evaluation of GTR field projects at next ETG meeting.
   Update: Item is on the agenda.

3. David Jones to provide update on ongoing work elements on GTR project by University of California at Davis/CalTrans at next ETG meeting.
   Update: Item is not on the agenda.

4. Emin Kutay to provide update on ongoing work elements on GTR project by Michigan State University at next ETG meeting.
   Update: Item is not on the agenda.

5. Lee Gallivan to provide additional RAS Task Group recommendations and language for proposed standard changes to ETG.
   Update: Item is on the agenda.

6. Lee Gallivan to provide additional RAP Task Group recommendations and language for proposed standard changes to ETG.
   Update: Item is on the agenda.

7. ETG participants to provide comments directly to Nelson Gibson on the importance/need to include artificial ageing work element on the FHWA ALF project.
   Update: Item is on the agenda.

8. Richard Kim to provide the E* IDT final report and an updated draft standard incorporating recommendations from the final report to the ETG.
   Update: Item is not on the agenda. Kim is not expected to attend this meeting, so this action item will be postponed until the next ETG meeting.

9. Ali Zenali to provide an update on the ongoing work elements on the AI fatigue testing evaluation at the next ETG meeting.
   Update: Item is on the agenda. Phil Blankenship will give the report.

10. Mike Anderson to send the AI fatigue testing evaluation work plan to the ETG for comment.

Update: Item is on the agenda.

11. Jeff Withee to explore any potential TP-79 notes or exceptions to incorporate the small scale geometry specimens for E* and S-VECD with the AMPT Task Force and provide recommendations to the ETG.
    Update: Item is on the agenda.

12. Jeff Withee to resend the AMPT Flow Number Task Force recommendations and testing protocol to run the single stress evaluation procedure and reemphasize the previous ETG request for volunteer labs that want to use this procedure and provide feedback to the Task Force and ETG.
    Update: Item is on the agenda.

13. Ali Zenali will provide results of the AI work on AMPT specimen preparation variables at the next ETG meeting.
    Update: Item is on the agenda. Phil Blankenship will give the report.

14. Geoff Rowe will provide an update on the efforts to modify the bending beam fatigue standard requirements with regard to load waveform at the next ETG meeting.
    Update: Item is on the agenda.

15. Jim Musselman to lead the development of a one page summary of additional testing, materials, and supplemental test sections to be provided to LTPP WMA project consultant in order to coordinate/communicate additional national needs to participating State agencies. Group consists of Jim Musselman (lead), Ray Bonaquist, Adam Hand, Georgene Geary, and Audrey Copeland.
    Update: Item is on the agenda.

16. Construction Task Force to provide construction issues to be addressed by ETG at the next meeting. The revised Construction Task Force membership: Erv Dukatz (lead), Jim Musselman, Kevin Hall, Gerry Huber, Adam Hand, Ron Sines, Audrey Copeland, and Tom Harman.
    Update: Item is on the agenda.

17. Audrey Copeland to provide NAPA cooperative agreement work elements specific to asphalt pavement construction at the next ETG meeting.
    Update: Item is on the agenda. Heather Dylla will give the report.

3. Subcommittee on Materials Updates/Comments: AASHTO Standards Update Report

Presentation Title: *AASHTO Standards Update*—Georgene Geary (Georgia DOT) and Chris Abadie (Louisiana DOT), liaisons for the AASHTO Subcommittee on Materials (SOM)

Summary of Presentation:

Georgene Geary reported on two technical sections under the Subcommittee of Materials (SOM), Technical Section (TS) 2c and 2d.

Geary reported the 2014 AASHTO Standards Book has been published and is now available. She also reported seven standards were updated/changed (T 245, T 283, T 312, T 321, PP 60, and R 35) and 5 new standards (MP 23, PP 78, TP 107, PP 77 and TP 108) were published within TS 2d. Under TS 2c, fourteen standards were updated/changed (M 156, R 47, R 59, T 30, T 37, T 164, T 269, T 275, T 287, T 305, T 319, T 324, T 329, and T 331).

Geary reported on the 2014 SOM TS 2d annual meeting. TS 2d identified stewards for all standards. Stewards will be identified for any future new standards under TS 2d. The spring TS letter ballot has been reviewed. Geary reported stewards have been assigned to each of the standards on the ballot. She also reported the AASHTO Manual for Soil Investigations is being updated because its last update was in 1988. She also reported the NCHRP 673 manual on design of hot mix asphalt mixtures may need to be updated.

The next part of Geary's report was on the 2014 TS 2d SOM ballot items. The ballot will be issued next month. The items identified in her report on the ballot are:

- Rutting Resistance of Asphalt Mixtures using iRLPD and Determination of the Voids of Dry Compacted Filler both of which are new provisional standards.
- T 245, split into 2 standards compaction method and test(s).
- R 35, Superpave Volumetric Design for Asphalt Mixtures, added clarification on Ps (Section 9) and blending procedure (Sections 6.5 and 6.7). Jim Musselman asked about changing the nomenclature of terms. Danny Gierhart replied the Asphalt Institute is changing the nomenclature for air voids in MS-2 and explained the reason for those changes. These changes are already in T 283. Gierhart reported the Asphalt Institute manual should be available by the end of the year. Geary suggested that information on MS-2 be provided to the SOM. Gierhart will send the document to Bukowski and Geary.
- MP 23, clarify Section 5.1 on the term "dry" shingles by adding " Gradation requirements apply to processed and dry shingle material prior to the extraction of the asphalt binder."
- T 79 (Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the AMPT) revisions to Section 6.2 and adding Appendix X.3 on small scale samples. The small scale specimen was discussed and concern voiced at the SOM meeting. It was decided to put it in as an appendix, which is not mandatory.

The next part of Geary's report was on the 2014 TS 2c SOM ballot items, which included:

- Proposed new standard, Sampling Asphalt Mixtures after Compaction (Obtaining Cores). WAATC submitted this proposed new standard.
- T 30, Mechanical Analysis of Extracted Aggregate, modification to Notes 2 and 7.
- T 209, Theoretical Maximum Specific Gravity (G_{mm}) and Density of Hot Mix Asphalt (HMA): major revisions to annex and elimination of water temperature adjustment.
- T 319, Quantitative Extraction and Recovery of Asphalt Binder from Asphalt Mixtures, modification to Section 13.1.2 to improve definition of constant mass.
- T 329, Moisture Content of Hot Mix Asphalt (HMA) by Oven Method, added wording to address material used to line sample container and change formula for calculating moisture content.

- Proposed new standard, In Place Density of Asphalt Mixtures by Nuclear Methods.
- New provisional method, Determine Interlayer Shear Strength of Asphalt Pavement Layers.
- New provisional standard for measuring the adhesion of tack coat materials - Determine Tack Coat Quality of Asphalt Pavement in the Field or Laboratory.

Kevin Hall asked when will the web-based versions be available. Geary responded they are still in "hard copy" form. She does not know of a date for the release of the web-based version. Bukowski asked if during the ARML laboratory certification process are physical copies of the standards required to be in the laboratory. Brian Johnson noted AASHTO does recognize the electronic copies are allowed as a substitute in the laboratory.

Geary reviewed the schedule for the next ballot. SOM ballot items to be issued in October 2014 with a 30-day ballot review. Every technical section has a webinar.

Geary reviewed the status of the SOM website. Members and friends are listed in the website. Fee asked how to be recognized on the AASHTO friend list. Geary replied, just e-mail the technical section chair and asking to become a friend. Geary reported the 2015 SOM Annual Meeting will be in Pittsburgh, PA. Geary thanked everyone for their contribution over the years. This ETG input is critically important to the AASHTO SOM.

4. Update on Related NCHRP Projects—Edward Harrigan (NCHRP)
Edward Harrigan was not in attendance, so John Bukowski gave the report.

Summary Presentation: *NCHRP Update – September 2014*
John Bukowski reported he will not cover all of the NCHRP projects, but only those that have impact on current ETG topics.

- NCHRP 9-48, Field versus Laboratory Volumetric and Mechanical Properties. This project was completed by Louisiana Transportation Research Center in December 2013.
- NCHRP 9-49, Performance of WMA Technologies, Stage I – Moisture Susceptibility. This project has been completed by Texas Transportation Institute (TTI).
- NCHRP 9-49A, Performance of WMA Technologies: Stage II – Long Term Field Performance. Washington State University is the prime contractor and it is scheduled for completion by July 2016.
- NCHRP 9-52, Short-Term Laboratory Conditioning of Asphalt Mixtures. TTI is the prime contractor and it is scheduled for completion by November 2014. The objective of this project is to develop procedures and associated criteria for short term laboratory conditioning of asphalt mixtures that simulate (1) plant mixing and processing to the point of loading in the transport truck, and (2) the initial period of field performance.
- NCHRP 9-53, Properties of Foamed Asphalt for Warm Mix Asphalt Applications. TTI is the prime contractor and it is scheduled for completion by December 2014. The two objectives of this project are (1) determine the key properties of foamed asphalt binders that significantly influence the performance of asphalt mixtures, and (2) develop laboratory protocols for foaming of asphalt binders and laboratory mixing procedures.

- NCHRP 9-54, Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction. North Carolina State University is the prime contractor and it is scheduled for completion in May 2016. The objective of this project is to develop and validate a laboratory procedure to simulate long term aging of asphalt mixtures for performance testing and prediction.
- NCHRP 9-55, Recycled Asphalt Shingles in Asphalt Mixtures with Warm Mix Asphalt Technologies. NCAT is the prime contractor and it is scheduled for completion by September 2016. The objective of this project is to develop a design and evaluation procedure for acceptable performance of asphalt mixtures incorporating WMA technologies and RAS, with and without RAP, for project-specific service conditions.

Bukowski also noted the fiscal year 2015 projects:

- NCHRP 9-58, Effects of Recycling Agents on Asphalt Mixtures with High RAS and RAP Binder Ratios. Bukowski reported this project has been awarded, and Jo Daniel will provide an update on NCHRP 9-58 later during the meeting.
- NCHRP 9-59, Binder Fatigue, Fracture, and Healing and Its Contribution to Hot Mix Asphalt Fatigue Performance. The request for proposal (RFP) has been issued.
- NCHRP 1-55, Porous Friction Course Design and Maintenance. Not yet awarded.
- Synthesis 20-05/Topic 46-03, Performance-Based Specifications for Asphalt Mixtures
- Synthesis 20-05/Topic 46-05, Use of Recycled Asphalt Shingles in Pavements.

The panels for both of these syntheses meet last week. Bukowski noted FHWA has an ongoing project related to the Performance Related Projects (PRS) and Richard Duval is the FHWA contact person for this project, and Applied Research Associates (ARA) is the prime contractor. .

5. Recycled Engine Oil Binders (REOB) Task Group Reports

5.1 REOB Background and Issues - Mike Anderson and Mark Buncher (Asphalt Institute (AI))
Presentation: *Asphalt Institute's Re-Refined Engine Oil Bottoms (REOB) Residue Task Force*

Summary of Presentation:
Mark Buncher provided an introduction to the topic and to give AI's position. AI supports the responsible modification of asphalt materials for improved performance and better life cycle costs, but does not endorse any specific or proprietary form of modification. AI currently has no official written guidance on the use of REOB. In the past, AI has developed information and guidance documents and reported on studies regarding some modification types, such as PPA, sulphur extended asphalt, PMA, etc.

Buncher reviewed some of the literature on this topic, and noted there is confusion on this topic. He stated the literature/reports in his presentation are just some examples and there are a lot of existing documents on ROEB. Buncher reviewed the different names and terminology for REOB that can be found in the literature. He commented that the different names used generally reflect the users position on the topic. He noted this adds to the confusion.

Buncher explained, REOB has been used as a modifier for over 30 years and its use can improve the low temperature properties. As an example when higher percentages are used along with RAP/RAS in a mix, there have been concerns regarding premature cracking and overall low durability. These have been expressed by Ontario and Northeast states, and some agencies have banned REOB use.

At AI's spring meeting, the technical advisory committee (TAC) was asked to develop information and guidance for industry use of REOB residue as an additive for asphalt. The TAC formed a REOB task force. Members of the task force include; John Brownie (chair), Mike Anderson, Sandy Brown, Mark Buncher, Greg Harder, Gaylon Baumgardner, Everett Crews, Kevin Harden, Edgard Hitti, Mark Homer, Gerald Reinke, Bob Hockman, and Laurand Lewandowski.

Buncher explained the objectives of the TAC is to learn more about REOB materials in the areas of processing, effect and benefits on use and best practices. Another objective is to recommend a course of action for AI that could include sponsoring a symposium, conducting research, developing information on REOB residue modification that could be similar to AI's SI-220 for PPA modification, to synthesize the literature, explain benefits, concerns, and best practices to help agencies make informed decisions.

Buncher reported the task force was formed in April and has since met twice. The AI website includes a collection of REOB literature (papers, research reports, presentations, etc.). Anyone wanting to add literature to the website should contact him. AI would welcome adding reports and information, as well as remove any publication that an author requests to be removed.

Buncher overviewed some of the questions focusing on the use of REOB. For example, can REOB be defined in a standard, are the different manufacturing processes equal, are other materials present, are there guidelines in terms of maximum limits, and are there any interactions with these materials. Buncher reported AI has no formal position at this time.

ETG Comments, Questions, and Discussion:
Bukowski asked if Buncher envisioned guidelines and standards to address these issues. Bukowski also stated the ETG would like to work with AI on this topic. Buncher replied they plan to produce a set of guidelines and standards, and definitely appreciate any comments. Lee Gallivan asked about the time frame. Buncher replied he would rather not put a time frame at this time, because there is a lot of work to do. Six months is probably too soon.

Shane Buchanan asked if there are other uses of this product. John D'Angelo noted most of the reused material goes into recycled motor oil, while some of it is going in roofing material. Reinke noted there is a formal definition and classification of the material just as for engine oils and other products.

ACTION ITEM #1: The Asphalt Institute will update the ETG on its on-going activities related to the REOB topic.

5.2 REOB FHWA Research on Mixture Effects—Nelson Gibson (FHWA)

Summary of Presentation:
Nelson Gibson commented that there have been efforts in the FHWA chemistry laboratory for surrogate testing to detect the presence and amount of REOB in an asphalt binder. This presentation today however, will focus on planned efforts to detect the effects on REOB on asphalt binder and mix performance. He reported discussions have been held and FHWA's testing plan has been vetted with the Illinois DOT, Crystal Clean, Safety Clean, and six New England DOTs.

Gibson showed graphs illustrating the effect of adding different percentages of REOB related to softening the ALF PG 70-22. The REOB used softened/reduced the temperature grade. He also showed some results for softening a BP (British Petroleum) 64-22 asphalt, as well as the stiffening and then softening of a 58-22 asphalt. He commented this is where they saw some interesting occurrences in terms of the temperature difference between the BBR m-controlled and s-controlled binder as affected by the amount of REOB. The results were presented in a series of bar-graphs. For the mixture tests, a PG58-28 with no REOB is the control. The other PG58-28 is moderately modified, typical with 3 to 6 percent REOB. .

Gibson overviewed the planned mixture experimental design. He reported the experimental design is split into two parts, moisture damage and structural performance. For the moisture damage, the tensile strength retained (TSR), Hamburg wheel tracking, and repeated load tests with and without hydrated lime are used. For the structural performance part, the flow number using confinement in accordance with NCHRP 9-30A procedure, TSRST, dynamic modulus, and uniaxial fatigue tests at short and long-term aged specimens are being conducted. The testing program is to be completed early in 2015.

Gibson ended his report by showing some of the laboratory test results (focusing on the Hamburg data) for the mixtures used at the ALF, which included REOB. FHWA did not specifically request REOB but saw that it was included in the binders. In summary, the Hamburg test results, although very limited, all meet there requirements and did not result in excessive rutting.

5.3 REOB and Other Additives Impact on Binder Aging and Mixture Low and Intermediate Properties—Gerald Reinke (Mathy Construction)

Gerald Reinke stated his report will be a discussion on some of the factors impacting performance of binders that have been blended with additives for reducing low temperature properties and their impact on mixture performance. Before starting his report, Reinke acknowledged contributors to this effort; Mary Ryan, Doug Herlitzka, Steve Engber, Alex Ensgstler, Scott Veglahn, Andrew Hanz, John Jorgenson, and Chad Lewis.

Summary of Presentation:
Reinke reported on some results related to complex modulus versus reduced frequency for binders with REOB using the colloid index. The colloid index is defined as the ratio between the dispersed constituents (aromatics and resins) and the flocculated constituents (saturates and

asphaltenes). A higher colloid index means that the asphaltenes are more peptized by the resins in the oil based medium. Reinke summarized that when aging these materials, you have a significant effect on the PG grade; the problem is dealing with paraffinic oil when using REOB. He discussed the impact of a second PAV cycle on the test results and binder grade classification. Reinke explained he used 4 percent REOB in PG 64-22. The problem is with 2 PAV cycles the grade changes or degrades by 2.8 degrees.

Reinke noted a comment was made at the AI TAC meeting regarding one possible use of REOB would be to reduce a PG grade to a -34 and then use PPA to boost the high temperature grade back up to a PG 58 producing a PG 58-28. Reinke explained what was done in their laboratory related to the performance grade to investigate that product. He concluded PPA appears to retard the rate at which the binder becomes m-controlled. Reinke then explained the mixture investigation conducted in Mathy's laboratory. He used 3 binders (a control with two different REOBs), loose mix aged for 12 and 24 hours and then 21 days. Reinke graphically showed the test results in terms of aging time effect on fracture energy using the DCT. It appeared the more aging than 2 PAV cycles is required.

Reinke showed results from the SCB test at 15 °C, in terms of the m-value for 12 and 24 hours of aging, the m-value for one and two PAV aging cycles, as well as the s-value under different aging conditions.

The next part of Reinke's report was on a comparative crude source study completed through WRI. Five test sections were built near Rochester, Minnesota for comparing different crude sources of a PG 58-28. The binders selected were from St. Paul, MN which included a blend of Canadian crudes, a binder form New Jersey using a Venezuelan crude, and a binder from Texas using Arab heavy/Arab medium Kirkuk blend. He noted several reports have been issued by WRI over the intervening years. Periodically WRI staff members have visited the test site and performed crack surveys and taken cores.

He presented test results in comparison to the amount of cracks at each site. Reinke stated in his opinion, REOB is not the only issue. His commented the conventional binders in this study do not seem to age well with the addition of REOB (the main factor is high levels of paraffinic compounds); the impact of non-asphalt blend components seems to have more of an effect on fatigue properties than the low temperature cracking properties; and the difference in m-value appears to related quite well to the increase in pavement cracking.

Reinke presented an evaluation of four Kentucky RAP-RAS mixtures. He showed the test results in a table listing the BBR results and different metal content from four different projects. He also presented the results from the DC(T) test in a bar-chart form for the same four projects or mixtures.

Reinke's conclusion based on the mixture tests were performance of the mixture with the PG 58-28 virgin binder was comparable to the control mixture. Mixtures with PG 52-34 have higher laboratory fatigue life but lower fracture energy. Adding a binder two grades softer than the target results in a softer mixture, but the mixture is not more resistant to crack growth.

ETG Comments, Questions, and Discussion:
Elie Hajj noted these materials age at different rates based on the data presented. As such, they should be aged at different times. In other words, you want the same aging measured in the field, so to get the same level of field aging they have to be aged at different time duration in the lab.

Hassan Tabatabaee referred to Minnesota, Wisconsin, and Illinois Low Temperature Transportation Pooled Fund report and that at the time that he had worked on the study they did not know the reason why the one section that exhibited more cracking had more physical hardening, but Reinke's presentation had provided an answer by showing that the section in question had used REOB in the binder, which had previously not been known at the time of the study.

5.4 ***Evaluation of Performance Properties of Asphalt Mixes Containing RAP Produced with Re-Refined Heavy Vacuum Distillate Bottoms Modified Binders***—John D'Angelo (D'Angelo Consulting, LLC)
Summary of Presentation:
John D'Angelo presented on the re-refined heavy vacuum distillate bottoms (RHVDB) effect on intermediate properties using the DSR.

D'Angelo started by summarizing the RHVDB effect, it reduced the intermediate DSR values, there is a linear relationship between the percent RHVDB and the reduction, the rate of aging is controlled by the base asphalt, and the RHVDB does not increase aging. This part of the report focused on whether EcoAddz can be used as a rejuvenator for RAP mixtures. D'Angelo reported, the mixture used for this study was from the University of Illinois moisture damage study N70 (using 70 gyration mix). The aggregate is an Illinois dolomitic limestone and the RAP was from a local Florida mix in Tampa. The control binder was a BP PG 64-22 which was modified with 2, 6, and 10 percent EcoAddz. The testing included high temperature Hamburg wheel tracking tests, intermediate temperature using the four-point bending beam, dynamic modulus testing, and low temperature disk shape compact tension test with short and long term aging of the mix. The long term aging was completed by PRI using the Accelerated Pavement Weather System (APWS).

D'Angelo compared the original and recovered binder test results, as well as some of the mixture tests. In summary:

- Addition of 20 percent RAP only had a minor effect on the recovered binder grades. EcoAddz modified binders had almost no loss of low temperature properties for the recovered binders.
- For the Hamburg load wheel tester, the addition of RAP only caused minor increases in stiffness and a minor reduction in rutting. The RHVDB mixtures did not cause significant reduction of the high temperature properties. Long term aging provided similar increased stiffness of control and 6 percent EcoAddz mixtures.
- The dynamic modulus data or the master curve data matches the binder PG grade; softer binder had the lower dynamic modulus data, as expected, and RAP only showed a minor increase in mix stiffness.
- The 4 point bending beam data showed the mixtures produced with RHVDB have better fatigue response than the control mixtures. In other words, adding softer binders will

reflect an improvement in fatigue results. EcoAddz improved the fatigue response of the RAP mixture, and accelerated aging only showed a minor loss in fatigue response.

- With the DCT fracture energy for N70 mix on the unaged samples, the addition of RAP resulted in a smaller reduction in fracture energy than the EcoAddz modified binder. For long term aged mixtures, RAP caused a significant loss in fracture energy of the base binder. EcoAddz modified binder indicated a minor loss of fracture energy. D'Angelo noted there is not see significant differences seen in mixture test results.

In summary, D'Angelo made the following conclusions; the recovered binder of RAP mixtures indicate the RAP has only minor effect on binder properties and EcoAddz provides a minor improvement; mix properties correlate well on recovered binder properties for unaged samples; long term aging suggests significant change in properties of mix with RAP and EcoAddz modified binder mitigated some of the long term aging effects.

ETG Comments, Questions, and Discussion:
Gayle King commented all the materials do not appear satisfactory; stiffness is part of the effect. The m-value is a significant and important part and you cannot measure the effect of healing or m-value with a one cycle fracture test for evaluating the binder.

Corrigan reported one of the Research Needs Statements (RNS) being reviewed by the SOM is related to REOB. This was reported during the Binder ETG meeting held earlier this week. He reported some of the RNSs related to this topic had not been previously approved for funding. This new RNS request, however, would provide funding and resources for this topic area. Corrigan also reported the topic of REOB is a big issue in the North Eastern states, and more than just two states are looking into banning this material.

Bukowski and Fee adjourned the meeting at 4:30 PM.

DAY 2: Thursday, April 18, 2014

Frank Fee called the meeting to order at 8:00 am.

6. Asphalt Mixture Performance Test (AMPT) Implementation—Jeff Withee (FHWA)
Jeff Withee summarized the reports on this topic.

6.1 Implementation of the Asphalt Mixture Performance Tester—Jeff Withee (FHWA)
Jeff Withee provided the objectives for pooled fund TPF-5(178), which are to procure the AMPT equipment, provide training for technicians and engineers, and support national implementation of the Asphalt Mixture Performance Tester (AMPT). He also identified the implementation activities.

The goal of the pooled fund project are to advance the state of practice with the AMPT, share implementation plans and experiences, identify and address implementation hurdles, conduct coordinated study on pooled results, and build user testing proficiency with the equipment. The activities to be discussed under the report will be the focus of the next three reports:

- Nam Tran will focus on friction reducers.
- Phil Blankenship will focus on the specimen fabrication issues related to the ruggedness of the equipment and test.
- Phil Blankenship will also focus on the fatigue cracking tests evaluation.

Withee mentioned the AASHTO standards related to these issues and planned future work on this topic. The focus will be on case study documentation, hosting additional training workshops, and conducting equipment evaluations. Withee concluded his introduction by providing contact information below:

- Contact person: jeff.withee@dot.gov; phone number 202-366-6429
- Pooled Fund Study: http://www.pooledfund.org/Details/Study/405
- FHWA AMPT Webpage: http://www.fhwa.dot.gov/pavement/asphalt/tester.cfm

6.2 Comparing Friction Reducers—Nam Tran (NCAT)

Summary of Presentation:

Nam Tran acknowledged Ramon Bonaquist work under NCHRP project 9-29. A study conclusion was the variability of the flow number when using unconfined tests and thus not entirely suitable for establishing rutting criteria developed in NCHRP 9-33. It was suggested this could be improved by better guidance for fabrication and use of friction reducers to reduce test variability. The friction reducer of the flow number test (AASHTO TP 79-13) is to use two layers of latex membranes or paste silicone grease at 0.25 plus or minus 0.05 grams. Tran reported the objectives of the study was to; (1) investigate the effect of friction reducers on flow number results and variability for paste silicone, Teflon, and spray on silicone, (2) select appropriate friction reducers for flow number, and (3) confirm that selected friction reducers are not affecting the dynamic modulus test results.

Tran presented the testing plan which included the friction reducer type and application rate, as well as any details of the test procedure that will be used from NCHRP 9-33. The test plan included both dynamic modulus and flow number. The dynamic modulus test plan included the same set of 3 specimens and same 7 friction reducers as in flow number testing. Testing was conducted from low to high temperature and high to low frequency. The asphalt mixtures included dense-graded mixes consisting of a 9.5 mm nominal maximum aggregate size mixture with 20 percent RAP by weight of aggregate and using PG 67-22 asphalt. Plant produced mixture was used with a design asphalt content determined at 60 gyrations.

Tran discussed the effect of the friction reducer on flow number. He first reported on the specimen air voids effect. There was no systematic error related to air voids related to friction reducer type and application rate. Tran also reported they used the Francken flow number and Teflon was the one with significant different results. The other friction reducers and their rate did not result in significant differences in flow number. Tran provided some photographs of the untested specimens, tested specimens using Teflon which exhibited bulging, and those using spray silicon which did not exhibit bulging. He recommended not using the Teflon friction reducer.

Tran then reported on the coefficient of variation (COV) of the flow number results. He concluded the latex permatex placed at 0.25 grams had the higher COV values and the greatest dispersion in the data.

The next topic of Tran's report was on the effect of friction reducers on dynamic modulus test results. Tran included a table summarizing the p-value and concluded there was no statistical difference in the test results.

Tran summarized the findings from the study for each test as follows:

- Flow number – the Teflon friction reducer yielded higher flow numbers and the Latex friction reducers did not statistically affect flow number.
- Teflon and latex friction reducers did not statistically affect the dynamic modulus test results.

Tran listed recommendations from this study:

- Only 2-layer latex friction reducers should be used for the flow number test; paste silicone, dry-type silicone spray, or wet-type silicone spray. The application rate should be 0.20 +/- 0.05 grams.
- Latex or Teflon friction reducers can be used for dynamic modulus test. For a latex friction reducer, any of the silicones can be used and the application rate is 0.20 +/- 0.05 grams.

ETG Comments, Questions, and Discussion:
Ramon Bonaquist commented the idea for using silicone was to make the test easier, but asked if the variability of test results if reusing the material was evaluated. Tran commented that they did not look at that issue. Bonaquist noted laboratories do not systematically remake a friction reducer each time and it is his opinion that is where most of the variability comes from. Withee replied the standard states it is recommended not to reuse friction reducers.

Fee asked about the thickness of the friction reducers. Tran noted for the latex, using less than 0.1 inches is too low. Tran asked Withee, if anything else needed to be done relative to TP 79. Withee asked Geary if the SOM needed any changes based on these test results. Fee asked if the recommendation be mandatory, to ensure the friction reducers are not reused between tests. Some members believed more information is needed to determine the variability.

6.3 AMPT, Effect of Specimen Preparation Variables—Phil Blankenship (Asphalt Institute)
Summary of Presentation:
Phil Blankenship reported on work completed under the FHWA cooperative study regarding task 2.9. Blankenship started his report by providing some background information relative to the NCHRP 9-29, Phase VI, Report #702. Mike Anderson is the Principal Investigator and this is a joint effort between the Asphalt Institute and Advanced Asphalt Technologies (AAT). For the NCHRP 9-29 study, mixture samples were made in a single laboratory and tested by 8 participating laboratories. Loose mixture was shipped to the participating laboratories and specimens were made and tested in 8 laboratories. Blankenship showed a summary of the test results from the NCHRP 9-29 study comparing the dynamic modulus to the reproducibility or

COV between cores and loose mixture. The dynamic moduli measured on the cores were consistently lower than from the test specimens made from loose mixture.

Phase I of this study was focused on sample preparation, first looking at the oven temperature differences and repeated opening closing the oven doors. This part of the presentation had been given at an earlier ETG meeting, so Blankenship just presented a brief overview of Phase I. Four different ovens were included in the evaluation study; Grieve 50 ft^3 oven, Grieve 25 ft^3 oven, Blue-M 8.3 ft^3 oven, and a Quincy 7.8 ft^3 oven. This part focused on sample conditioning by examining these ovens in three different evaluations; (1) how different is the temperature distribution in various forced-draft ovens, (2) does the oven quality make any difference in conditioning of the samples, and (3) does frequent opening and closing the oven doors affect the conditioning of the loose mixture. Blankenship showed the instrumentation located in the oven.

The conclusions from Phase I:

- Oven quality and power makes a large difference in stability and recovery.
- Opening the oven doors to stir the mixture may not be prudent and can lower the mixture temperature (less aged mixture) in some ovens.
- Mixture temperature varies during conditioning.

Blankenship then focused on Phase II. The objectives of this phase were; (1) identify the sample preparation variables that significantly affect he AMPT test results, (2) determine the acceptable range for thee significant factor, and (3) make recommendations to minimize the AMPT test variability. Blankenship explained the variables included in the sampling matrix which included mixing temperature, binder time at mixing temperature, mixer type, mixing time, loose mix conditioning temperature, loose mix conditioning depth, loose mix stirring, mold loading, placement in mold, additional time at compaction temperature, and test specimen air void level. The minimum and maximum values for each parameter were included in the tabular summary. After showing the physical properties of the mixture, Blankenship summarized the results from the ruggedness study. The test matrix included 3 replicates totaling 96 total specimens.

The goal of Phase II included; (1) quantitative factors to determine the allowable tolerances of factors based on allowable dynamic modulus test error, (2) qualitative factors for improving AMPT test reproducibility, and (3) interactions for refining the AASHTO PP 60 standard. Blankenship showed some example dynamic modulus test results at 1 Hz and 20°C and explained how the results were analyzed using a 95 percent confidence interval.

Blankenship summarized the conclusions from the study.

- The significant variables included loose mix conditioning temperature, loose mixture stirring, and test sample air void level which had the highest impact.
- Three other factors had p-values between 0.005 and 0.010 and could prove to be significant. These other factors included binder holding time at mixing temperature, mold loading with gyro loader, and rodding the loose mixture while placing it in the mold.
- The COV of the dynamic modulus data was between 2.0 and 18.2 percent. Eleven specimen groups had COV values greater than 10 percent.
- The COV of the flow number data was higher than for the dynamic modulus but within typical range previously reported for the flow number.

Blankenship gave their recommendations from this study. Remanufacture samples for improved or reduced COV and make one additional specimen for each of the groups. He stated there is enough data to emphasize we need a new standard practice for sample preparation and not just limited to AMPT dynamic modulus samples. This should apply to IDT, DC(t) and beam fatigue specimens, as well as to APA, HWT, and other proof tests.

ETG Comments, Questions, and Discussion

Nam Tran asked about sample replication. Blankenship noted he used 3 triplicates and 4 in some locations. Tran believed that 4 samples may not improve on the results. Blankenship agreed with that comment because the error could be coming from different locations.

Fee requested this work be written up as a draft standard practice. Blankenship agreed with the request. Fee also asked about edge effects. Blankenship commented on the binder type and holding time. They will make recommendations on those items that can create additional errors.

Bob Klutz asked about specimen rodding. Blankenship stated they were unclear whether that is needed; however, it is not a common practice.

Bukowski commented there are a lot of variables that need to be looked. He noted some of those noted in the discussion might be included in a future research needs statement. Fee noted these will need to be examined as there is ever increasing emphasis on performance related tests. Blankenship commented only a few laboratories are accurately performing these tests.

Kevin Hall asked about air void distribution from top to bottom of the test specimen. His opinion, most individuals only report the average specimen air voids and this needs to be further examined. Blankenship agreed with that comment. He stated they did not saw these specimens to evaluate the air void distribution from top to bottom.

Bonaquist commented that how specimens are aged will make a significant difference. He believes there should be a tightening on the loose conditioning of the specimens. Bonaquist suggested this should be a recommendation from the group. More importantly, if you stir or do not stir will make significant difference. Many of these items could be included in a new standard.

Gerry Huber asked about the air voids tolerance. Blankenship noted +/- 0.5 percent was used. Tran replied they would recommend +/- 0.5 percent based on their initial work. The follow on work was to validate the 0.5 percent.

Based on discussion, a written report on this work will be prepared. Geary asked whether this is a new standard or is it already included in R 30. Bonaquist noted the existing standards PP 60 and R 30 can be revised so the results can be directly included in the standard. The R 30 revisions will be the most controversial because of the differences between ovens. Bonaquist referenced the Hamburg standard and referred back to TP 12 and commented this work applies here as well as to other tests. Withee showed three standards that relate to the AMPT; PP 60, TP 79, and PP 61 which were first published in 2009. He also noted that TP 79 was published in

2013. He had included a slide in the introduction that included a summary of each of the standards and the history behind each. Withee mentioned within the next 18 months, they will be focusing on these items and the SOM will be deciding on the permanent status of these standards. He encouraged other ETG members to comment on anything that might have a significant impact as this moves forward.

Bonaquist asked about a separate equipment reference standard. Withee reminded the group that the AMPT equipment description is an appendix to an NCHRP report and probably don't want to include all of this in TP 79. Issue is should this be a separate AASHTO document. Bukowski asked group for input and discussion at the next meeting.

ACTION ITEM #2: Jeff Withee, along with the Asphalt Institute and NCAT, will report on the potential recommended changes to AASHTO standards on use of friction reducers and specimen preparation for the AMPT. The ETG should get this data to determine the variability with using two friction reducers and to not reuse friction reducers.

7. **Update on Asphalt Institute Work Plan for Cracking Tests**—Phillip Blankenship (Asphalt Institute)

Presentation Title: *Evaluation of Laboratory Performance Test for Fatigue Cracking of Asphalt Pavements*

Summary of Presentation:
Blankenship started his report with background on this topic. He commented several tests have been developed by different research institutions that consider various testing geometries, analysis methods, and under different failure mechanisms including bottom up cracking, thermal cracking, top down cracking, or reflection cracking. The objective of this effort is to assist with deployment of a fatigue cracking test(s) that are predictive, sensitive to properties of the mixture components, sensitive to mixture aging, repeatable and reproducible, easy to implement, practical and low cost.

Blankenship reviewed the plan that has been developed. The plan is to examine various cracking tests, evaluate the capability of the different tests, practicality of the test and ease of use. The primary factors in this study include the asphalt grade, mixture properties, load range (test strains and stresses), asphalt aging and hardening, RAP and RAS content, and warm mix additives. The initial testing plan includes a 4 point bending beam fatigue, AMPT push-pull fatigue, indirect tensile strength, Disk shaped compact tension test (DC(T)), Texas overlay tester, dissipated creep strain energy, and the semi-circular bending (SCB) test. Blankenship reported, the only test that remains to be performed in this effort is the AMPT.

The phase I testing plan includes a laboratory standard mix with two levels of aging 4-hour loose mix aging at 135 °C and a 24-hour loose mix aging at 135 °C. Blankenship explained why 24 hour loose mix aging was used. This aging level was suggested by William Buttlar based on work done in Illinois. Blankenship reported they are not seeing much of a difference between the different aging times.

Blankenship overviewed the different tests being considered from a historical point of view. He began with the 4-point bending beam fatigue test which has been used since the 1950's. He concluded from that study, the data do line up well with roadway distress data. He explained the beam fatigue and stated they wanted to have 24 hours of aging, 4 hours of conditioning at 135 °C, and testing at 20 °C. Blankenship reported the test is repeatable based on their results. ASTM D4760 was used. Blankenship commented, the lines have a focal point at 20 °C, but at 15 °C the focal point starts to be removed. Blankenship looked at strain versus stress controlled and noted the endurance limit and stated the mix/specimen does not "move: much at low strain levels. He discussed changing the tensile strain from very low to very high tensile strains. This issue is determining the tensile strains needed to observe fracture. His opinion is that very low tensile strain should not be used. For beam fatigue, the issue is many organizations are hesitant because of beam specimen preparation issues, even though the test can provide good results.

The next test reviewed by Blankenship was the AMPT push/pull fatigue test using the S-VECD analysis. Blankenship noted he finds this test is very complex because of the coring, cutting, gluing, and instrumenting requirements.

Next discussed was the IDT test. This test is easy but the reliability is questionable. However, it is repeatable, gives a difference in results for many of the key factors, and it is relatively known how the test results can be used.

The DC(t) test is very easy test to run but specimens are very difficult to make. Blankenship showed slides of the equipment and test procedure.

The overlay tester developed by TTI was the next test discussed. The last two tests included in his report are dissipated creep strain energy and the semi-circular bending test. Blankenship presented a test summary of all tests considered thus far. He included a rating scale for sample preparation based on his perception of the test.

John Bukowski reminded Blankenship that the focus on which tests(s) are most predictive.
The final part of his report was on the Phase 2 test plan. Blankenship summarized the test plan.

<u>ETG Comments, Questions, and Discussion:</u>
Geoff Rowe was unsure about the binder testing in the plan. The binder stiffness will significantly affect the mix results. Rowe recommended the results be normalized relative to the binder results. Blankenship noted the purpose is not to tie this back to the field but only look at the test methods that exist today. Gayle King asked about healing, which of these tests allow you to crack and then heal the specimen to see how much strength is lost or recovered. Blankenship noted this was not examined. Bukowski also explained this is not to design the best test(s) but to select a reasonable test to predict and evaluate cracking potential.

Rowe emphasized, we do not want to test at the wrong condition. Randy West noted they have been working for years on this and this it is crucially important. We have a risk of accepting poor performance mixtures without some cracking indicator. John Bukowski agreed with the comment and noted this could be a series of tests. West noted the tests needs to be useful for quality assurance (QA) so it can be used in acceptance.

ACTION ITEM #3: The Asphalt Institute and NCAT will report on their activities comparing various performance tests and the ability to predict pavement fatigue performance.

8. Task Group Review Update: T 321 (Beam Fatigue)—Geoff Rowe (Abatech)
Presentation Title: *Review of Bending Beam Fatigue Test – AASHTO and ASTM Methods*

Summary of Presentation:
Geoff Rowe started his report by acknowledging members of the task group: Louay Mohammad, Richard Steger, Tom Bennert, Richard Willis, Phil Blankenship, and Michael Mamlouk.

Rowe identified the wave form issue. The AASHTO wave form is sinusoidal, while the wave form in the ASTM version is haversine. He reported there are some on-going activities or changes being proposed to the ASTM method. In addition, there are issues related to how the tensile strain is applied in the test. Rowe referred to work being completed by Arizona State University (ASU) relative to getting different results between the two methods in terms of tensile strain. He summarized some of the recommended changes to ASTM D 7460. These changes will be balloted to bring it closer to the AASHTO method.

He also addressed other issues identified by ASU. Sinusoidal waveform and differences between fixed and floating reference points for different equipment can be an issue. The older Cox equipment system uses a fixed reference point, while the IPC, new Cox system, and others use a floating point. The difference between the fixed and floating reference points is being investigated. The floating point is better, but you get less information relative to a fixed reference point. The fixed point is external to the beam, while the floating reference point is on the beam. Some prefer the fixed reference point for stiff materials. There is debate on which is the better or should be used. Rowe noted guidance of fixed versus floating reference points will be provided after the ASTM ballot.

Blankenship commented he did not think this issue will be balloted within ASTM during the next round for various reasons. He commented the difference between ASTM and AASHTO can be very large. Rowe explained why the difference exists in the actual applied tensile strain between sinusoidal and haversine loadings. Some of the differences include sinusoidal goes from compression to tension, while haversine goes from zero to full tension. There has been some debate about recovery between the two forms of loading and its impact on the test results.

Fee noted we are trying to reduce the variability. Based on that comment, there was discussion to decide one way or the other on a loading wave form. Blankenship did not have an opinion on which one to select or to recommend. Rowe noted, one method needs to be decided upon.

Rowe ended his report by summarizing some of the on-going needs (1) continue discussion with group on unification of methods and (2) decide on the fixed or floating reference points.

9. FHWA ALF Experiment Update—Nelson Gibson (FHWA)
Presentation Title: *Performance Impacts of Recycling and WMA Production and on Asphalt Fatigue Cracking.*

Summary of Presentation:
Nelson Gibson reported they are half way through the experiment, but still have a lot to do. He provided an overview on the objectives, materials, experimental matrix, and test plan as a reminder to the ETG. The objective of the experiment is to establish realistic boundaries for high-RAP mixes employing WMA technologies as well as RAS mixes based on percent binder replacement and binder grade changes when combined together. Gibson asked the ETG the status of the terminology related to RAP. Lee Gallivan answered that this is on tomorrow's agenda but RAP or RAS binder ratio is the terminology planned to be recommended. Gibson also reviewed the accelerated loading facility (ALF) experimental design matrix. He mentioned they settled on the 40 percent by weight of the RAP, based on discussions with the ETG.

Gibson reported on the testing progress. They have completed testing lanes 9 and 11. The ALF is now on lanes 1 and 5 which is about 15 percent complete. As the weather cools the testing will continue because they are using the temperature control unit. Testing should be done prior to next summer. The portable seismic pavement analyzer (PSPA) is being used to evaluate cracked sections. Gibson showed a comparison of the PSPA and percent cracking which was very good for lanes 9 and 11.

Randy West asked about the depth of influence of the PSPA and whether they are measuring over a crack or in an intact area. Gibson replied you can change the spacing of the sensors to increase or decrease the depth of influence. They are looking at a depth of influence of about 6 inches. Gibson stated you have to correct for temperature differences. Kevin Hall asked if cores were taken and Gibson they do not core during loading, they only core at the end to determine where the crack initiated. So far all cracks are classical bottom up cracking.

Gibson overviewed the AMPT fatigue experiment. He identified the testing that has been completed to date. Two conditions were included in the test program unaged and long term oven aged. The post construction testing has also been completed using field cores. Gale Page asked about the long term aged samples. Gibson answered that it is loose mix in accordance with R 30. Gibson also reported on the post construction in terms of as built dynamic modulus values and fatigue test results using reduced scale specimens. He showed the status in terms of cores taken and tests completed. All of the 2013 cores and tests have been completed and all cores for 2014 have been taken. The 2014 testing is still in progress.

Gibson included in his report a comparison of the design versus as built asphalt layer thickness. They targeted 4 inches for design and about 4.4 inches was placed on the average. He also reported on the aggregate base reconditioning with light weight deflectometer (LWD), falling weight deflectometer (FWD), PSPA, and caterpillar intelligent compactor (IC) retrofit. Gibson reported there is variation in the aggregate base, but considered that in place variation as typical in the aggregate base. Gibson provided a tabulation of the tensile micro-strains calculated at the bottom of the asphalt concrete layer in each layer which were used to evaluate the condition of

the aggregate base. He emphasized the importance on knowing how they were going to compare the differences between the different lanes relative to their observations.

John Haddock asked about the average base modulus. Gibson replied the aggregate base was "fully" crushed trap rock but thought the values were low with a modulus of about 12 to 15 ksi. Louay Mohammad asked about pavement thickness. Gibson replied at least 7 points in each of the 4 lanes were used. Mohammad noted the thickness variation in the loading area. Gibson confirmed the analysis reflected the area to be tested. Tran asked if there was a stress level for the areas included in the table comparison. Gibson replied they only installed strain gauges in two lanes and used a combination of gauges. He pointed out the values tabulated in his report were calculated based on layered elastic theory and are not measured strain levels. They plan to do a viscoelastic layered analysis.

Jim Musselman asked about tack coat coverage. Gibson replied most layers or lifts are hot on hot so no tack coat was used. Gibson stated they did do a bond test and the results were very good relative to the Kansas specification on bond requirements.

D'Angelo noted all of this is being done with minimal or short term aging, so how do you reconcile the difference over long term aging. Gibson replied the plan is to leave 3 of the 10 lanes in place for the virgin mix as compared to some high RAP mixes. They will look at the long term aging for these later. Gibson also mentioned we are not testing right after construction, but certainly not later than 5 years in age.

Gibson continued with his report, now focusing on structural and sample preparation effects on laboratory performance ranking. Gibson included a table in his report showing the lane, mixture type, and overall ranking and ranking from the referenced condition. The referenced condition is scenario A in a perfect control of the air void content. He divided these into three categories in a grouping of four. Gibson reported lane 11 with 40 percent RAP and PG 58-28 needs to be checked. His noted that binder grades are showing to be a strong factor in this experiment

Gibson then reported on the characteristics of the recycled asphalt materials for RAP and RAS. He reported the RAS mixtures and binder were very stiff. The recovered binders were ranked in order of high temperature binder stiffness. Lane 3 was the stiffest.

Gibson reviewed the ongoing collaboration with other institutions under this experiment to develop a catalog of cracking test results. He acknowledged the volunteer organizations that participated in this activity and outlined the testing being performed.

Gibson summarized the work completed to date:

- Pavements will be 18 to 24 months old when full scale testing is complete. Changes should be tracked based on dynamic modulus and fatigue tests using small scale specimens, and the observed cracking has been bottom-up – initiating in the less aged layer.
- Excellent volunteer and collaborative efforts have been exhibited in this study which should provide a robust varies of performance/cracking tests.
- The issue remains, do we see the same properties of the mixes in the lab as in the field.

ACTION ITEM #4: Nelson Gibson will provide an update on the status of the FHWA ALF project at the next ETG meeting.

10. NCHRP 9-58: Effects of Recycling Agents on Asphalt Mixtures with High RAS and RAP Binder Ratios – An Update—Jo Daniel (University of New Hampshire)

Summary of Presentation:

Jo Daniel reported NCHRP project 9-58 started in May 2014, and acknowledged the team members; the TTI staff includes Amy Epps Martin (PI), Fujie Zhou (Co-PI), E. Arambula, A. Chowdhury, E.S. Park, X. Luo, Charles Glover, Jon Epps, and Dave Newcomb and subcontractors include Elie Hajj (University of Nevada at Reno), Jo Daniel (University of New Hampshire), and Gayle King (consultant). Daniel also acknowledged the NCHRP panel members; Jim Musselman, John Bartoszek, John D'Angelo, Joe DeVol, Tejash Gandhi, Luke Johanneck, Edmund Naras, Pedro Romero, Matt Corrigan, Fred Hejl, and Edward Harrigan.

Daniel summarized the rationale for this project was to investigate the concern that since increased utilization of RAP and RAS and stiff recycled binders and potential construction and cracking problems, can recycling agents mitigate this effect. She listed some of the challenges under this project in terms of short and long term field performance, characterization of recycling agents, their compatibility, and mixture design including specimen fabrication.

The project will evaluate the effectiveness of recycling agents in asphalt mixtures with high recycled binder ratios. High is defined between 0.3 – 0.5. The work plan is divided into 3 phases.

- Phase 1 includes identification of gaps in knowledge on recycling agent use in high recycled binder rations. Phase 1 includes gathering information, designing a lab experiment, and documenting results.
- Phase 2 includes an investigation on the effectiveness of recycling agents in restoring binder rheology, development of blending protocol, and associated mixture performance. Under Phase 2 there will be a laboratory experiment and design of a field experiment.
- Phase 3 is the validation of recycling agent use in mixtures with high recycled binder ratios. The tasks include conducting the field experiment, propose revisions to AASHTO specification and test methods, developing training materials and a best practices document, and documenting the results.

Daniel showed the general location for some of the prospective field projects. As an example, she focused on the Texas field project which is located in Lufkin, Texas. This included the laboratory experiment design, as well as an overview of some of the preliminary test results from this project. In summary, the virgin binders are from two sources, two RAP locations, two RAS locations, and the use of 6 recycling agents. The recycling agent characterization is being done in accordance with ASTM D4552. Binder tests include the rheological properties using the DSR/BBR and the aging properties using the DSR/FTIR. Daniel demonstrated how they are evaluating this test data in terms of its properties as related to cracking and restoring the binder resistance to cracking. Frank Fee asked if the principal focus is on binder and Daniel agreed.

Daniel reported on the binder test for field oxidation modeling. Mortar tests and mixture tests are being used. The mixture tests include resilient modulus for different blends based on a short term aging protocol and a long term aging protocol. For cracking, the team is looking at the S-VECD with dynamic modulus, the EBM, and a modified version of the TSRST. For rutting and moisture susceptibility, the Hamburg wheel tracking test is being used. Daniel showed some preliminary test results from the Texas project. High temperature grade correlated with Hydrogreen. Daniel showed some example results to illustrate the ageing of the blended materials.

Daniel ended her report by summarizing the requirements for the field projects and requested input from the ETG on the field experiment design. She commented, they are looking for a virgin mixture with no RAP or RAS, a control mixture with high RBR, and a mixture with high RBR and recycling agent.

ETG Comments, Questions, and Discussion:
Jim Musselman asked if the brand of recycling agents will be identified for each project. Daniel confirmed that they would identify the recycling agent being used. Chris Abadie suggested starting with states that routinely use these recycling agents. King also noted they are trying to get some of the new materials that have yet to be used, so that is an issue and they need one or more agencies willing to take a risk with these materials.

Rowe suggested using the binder tests and the R-value and viscoelastic transition point in selecting the projects or materials.

The contacts for this project are:

- Amy Epps Martin the project PI, a-eppsmartin@tamu.edu
- Fujie Zhou, f-zhou@ttimail.tamu.edu
- Elie Hajj, elieh@unr.edu
- Jo Daniel, jo.daniel@unh.edu

11. RAP Mixture Binder Diffusion—Chris Kriz (Exxon Mobil)
Summary of Presentation:
Chris Kriz acknowledged the other individuals that made contributions to this report; Selena Lavorato, Andrew Pahalan, Steve Manolis, Alan Blahey, Mary Gale, Daniel Grant, Ralph Shirts, and Nadjib Boussad.

Kriz noted the purpose of this report is to provide an understanding relative to the RAP and virgin binder diffusion to help understand the impact of binder blending on the rheological properties. Kriz reported the diffusion rate depends on molecular mobility which depends on temperature and molecular structure. He demonstrated this with an illustration of the diffusion in the mix while testing in the rheometer. First tested was the viscosity of the RAP binder. Results were corrected for the effects of oxidation and evaporation. Then the virgin binder was tested, and the blended virgin and RAP binder (50/50 blend). A special sandwich binder was created to determine how the soft virgin binder can affect the viscosity. Over time, if diffusion occurs, the viscosity of the sandwich layers will approach the 50/50 ideal blend.

A diffusion coefficient was calculated from the viscosity measurements. Kriz explained the mathematics behind diffusion and how it was used. He explained diffusion is faster at higher temperature. In other words, faster Brownian motion at higher temperature increases diffusion rate and reduces time to equilibrium. He illustrated this concept as diffusion at varying temperatures to determine the time to equilibrium. Temperature is a huge factor in the diffusion challenge, as well as film thickness. However, binder blending in the mixture is more complex. His opinion is film thickness and mixing time and temperature define blending in the mixture as a function of distribution of thickness and thus proper binder contact may not be reached during mixing. It is critical that an understanding of the effective binder thickness in the mixture is essential.

Kriz reported specific mixtures were prepared to study diffusion. He explained briquettes were cut and then conditioned and purged in the PAV at a constant temperature (90, 120, and 150 °C were used with a variable time). Kriz reported a defined change in visible appearance of specimens that were cut after conditioning. The images presented by Kriz indicate the binder is liquid even at 90 °C. The testing was completed using the DSR which exhibited high variability. Variability is a challenge. Kriz recommended the torsion test be used. Based on the results, the RAP mix is softer than the control or pre-blended binders. Significant hardening of the control binder was attributed to binder absorption and evaporation. Kriz included a graph that showed a 30 percentage lower viscosity value for the asphalt diffusion sample in comparison to the control virgin binder. He explained diffusion is partially responsible for mix hardening but it is very complex.

Kriz reported the binder diffusion model fits the mix data very well. The diffusion distance is 800 microns. Kriz showed this diffusion and the model accuracy over three temperatures. Diffusion is a lengthy process at mixture/pavement temperatures. In reality, the mix production and placement scenario has incomplete blending and results in lower complex viscosity. To show this observation, Kriz included a graph showing the difference over time during production and placement compared to the in service time between HMA and WMA mixtures. The time to reach equilibrium was calculated to be 100 days. Huber asked what was the pavement surface temperature. Kriz replied the surface temperature was 20 °C and noted there was no huge difference between HMA and WMA in terms of diffusion over time.

Kriz noted that the extent of blending is critical for RAP mix performance and virgin PG selection. Binder film thickness and time at temperature are critical parameters for diffusion in the asphalt mix. Diffusion may not be completed during mix production. The effective binder viscosity was lower than expected and questioned whether there was some lubrication effect. He also noted silo storage at higher temperatures can assist in diffusion. He concluded his report by stating the asphalt mix is a dynamic system and caution should be used during any mixture testing.

<u>ETG Comments, Questions, and Discussion:</u>
D'Angelo complimented Kriz on this work and noted this understanding is critical because a lot of testing in completed on the RAP mix, using short term aging. So it is critical to have long term aging for these mixes. We have seen in other presentations, even if you get full blending or

diffusion, the RAS is still RAS it is just more dispersed in the binder. Chemically, the asphaltenes are not uniform. Kriz agreed it is not chemically uniform. He believes the asphaltenes are dispersed and will not regroup so the material will respond differently. He believes we need to look at compatibility between virgin and RAP binder similar to what WRI has been doing. D'Angelo commented he sees promise in a 24 hour aging protocol and believes this needs further consideration.

Bob Klutz disagrees with that hypothesis. He maintains asphaltenes will regroup if you put them into a solvent, so you force conglomeration. He does not have an answer at this time when making or using these rejuvenating agents.

Buncher asked if Kriz noted a difference between RAP and RAS binders in the time it takes to get complete diffusion. Kriz noted that is a difficult question to answer, other than it will take longer for the RAS. It is not just the viscosity but the slope of the VTS relationship.

12. RAP/RAS Task Force Report—Lee Gallivan (FHWA)
Presentation Title: *M 323-12 Update on this Standard Specification for Superpave Volumetric Mix Design*

Summary of Report/Presentation:
Lee Gallivan gave a brief update on NCHRP 9-46. He reported an ETG group was formed which included Huber, D'Angelo, Abadie, Howard Anderson, Danny Gierhart, Jim Musselman, Judie Ryan, Randy West, Tim Ramirez, and a representative from one of the Canadian provinces. The group had made some recommendations to the related AASHTO standards. At their last meeting, Gallivan stated there was more discussion, and everyone was not in full agreement with the recommendations. Gallivan's intent for this report is to go through M 323 and identify suggested changes for the SOM.

Gallivan stated editorial changes were made in terminology and format but he will not focus on these changes. He commented there was a lot of discussion from the DOT members in the group. Specifically, he thanked Musselman, Ramirez, Abadie, and Anderson for their good comments. Gallivan noted that three years ago binder replacement was included in the standard, so this version shows binder replacement. Gallivan stated at their last meeting, binder ratio was suggested, so it is uncertain which term should be recommended and eventually accepted by the SOM. He also noted the percent dry weight of mixture discussion under section 5.3 was deleted. In addition, Gallivan reported the group added some new formulas and terminology to the standard. Gallivan also stated this version focuses on RAP, but RAS is still not addressed.

Gallivan reported, there is not complete agreement on how to modify Table 2. Danny Gierhart commented that AI has changed the terminology in their design manual, but still uses a three tier table.

Gallivan gave a rationale for revising AASHTO M323 Table 2 using only two tiers. Page noted even if you delete the middle tier, he thought there was a note that allowed a state agency to change it so the option is still there for using a middle tier. Gallivan agreed with that comment

and stated that is the reason note 4 was included. Gierhart also pointed out the word "recommended" was used as to not make it mandatory. West noted many agencies have already accepted the terminology of binder ratio or binder replacement ratio.

Kevin Hall asked if the group fully agreed with the recommendations. Gallivan replied not a consensus on all issues, still some concerns. Bukowski suggested sending the revised version to the entire ETG for review and comment, which should include all of the task group members. After that a "marked up" version of M323 and R35 would be referred to AASHTO. Gallivan noted some issues in particular concern converting to the term binder ratio, but in particular removing the three tier table is the most problematic. Bukowski suggested at some point this is up to the SOM to decide on which table to use, give the SOM a choice between the two versions of the table.

Gallivan continued with his report and showed the changes suggested in Appendix X1 and Appendix X2 of M323.

Gallivan will finish all edits prior to submitting to the ETG for final review and comment. The standards and comments will then be sent to the SOM. Preferably, would like to see an explanation that one table needs to be recommended for submitting it to the SOM, but if there is no consensus then we do what Bukowski suggested earlier. Gallivan suggests both tables go to the ETG. Buncher noted the use of blending charts is the most robust in the intermediate range. Bukowski noted this is the reason we need to get this under a final review by the ETG and then to the SOM, certainly they will also have a lot of concerns before moving forward. Fee asked the ETG members to review the document and send back their comments as soon as possible.

Musselman asked if anyone is keeping up with the performance of projects that have been built in previous years. His opinion states need more information if the field data supports good performance. Fee noted under some of the NCHRP projects, contractors were asked to survey agencies relative to the performance of RAS projects. He also referred to the RAS national forum in Denver in which every state discussed their position on RAS. Most states are "pulling back" on the percentage of RAS used in a mix. Corrigan referred to the Texas example where cracks had to be sealed in some areas sooner than expected.

ACTION ITEM #5: Lee Gallivan will prepare the task force recommendations/rationale for RAP changes to M 323 and distribute for comment to the ETG members/friends.

13. Pavement Temperature Prediction/Thermal Cracking Model—Elie Hajj (University of Nevada at Reno)

Presentation Title: *Thermal Cracking Analysis Model and Pavement Temperature Profile Prediction Model*

Summary of Presentation:
Elie Hajj started his report by acknowledging other members contributing to this study; Zia Alavi, Nathan Morian, Farzan Kazemi, and Peter Sebaaly. Hajj explained his report focuses on a new thermal cracking analysis model using the pavement temperature profile prediction model.

The pavement temperature profile prediction model has been presented at previous ETG meetings, so he will focus more on the thermal cracking analysis model. He explained the Thermal Cracking Analysis Package (TCAP) is a comprehensive evaluation of thermal cracking in asphalt pavements.

Hajj presented a listing of the influential factors included in TCAP. These are the different areas that have an impact on the temperature profile and occurrence of cracking, and have been grouped into specific areas such as pavement structure (layer thickness and interface condition), environmental conditions (pavement temperatures and cooling/warming rates), asphalt mixture properties (viscoelastic properties, thermal-volumetric properties, fracture and crack initiation properties), and asphalt mixture aging (property changes with oxidative aging). Hajj summarized some limitation of the existing models which were instrumental in developing the new program. As an example; aging of asphalt over time is not considered; thermal coefficient of contraction is considered constant with temperature and is usually estimated; tensile strength is considered constant with temperature, and how the EICM pavement temperature model can be improved.

The next part of Hajj's report focused on the supportive experimental plan for the proposed model which is has two components asphalt binder testing and asphalt mixture testing. Hajj identified the types of tests and materials included in the experiment. The proposed model is grouped into four steps. The first step is to determine the pavement temperature profile and history predictions. This step includes the climatic and meteorological data, layer properties, and surface radiation properties. Once you have the temperatures throughout the pavement then the carbonyl content as a function of time and depth can be predicted, which is step 2 and defined as the oxidative aging prediction. With the carbonyl growth, step 3 includes computation of the thermal stress in the pavement. The fourth and final step is determining the probability of a thermal cracking event in the mixture.

Step 1 or the pavement temperature profile and history prediction has been presented in previous ETG meetings, so Hajj focused on the final three steps of the model.

Step 2 is a prediction of field or oxidative aging. Hajj explained the age impact with depth. He included a contour plot of carbonyl with depth and over time. He also included some illustrations of laboratory versus field aging results. Hajj explained more work is needed in the fast-rate aging.

The 3rd step is the thermal stress calculation which uses a linear viscoelastic equation with oxidative aging. In this step the thermal relaxation and other properties of the mixture need to be determined. The relaxation modulus is determined from the dynamic complex modulus using a continuous relaxation spectrum directly obtained by an inverse Laplace Fourier transformation of the complex dynamic modulus. Hajj pointed out the relaxation modulus may be obtained from a fewer number of parameters using this process. He also reported consistent trends were found for the evaluated mixtures. This part is defined as the evolution of 2S2P1D coefficient with aging. Hajj illustrated the regression equations and reported they can be improved by expanding the range of parameters used. This step includes the temperature and age-dependent CTC value. Additionally, the age-dependent crack initiation stress (CIS) is computed. Hajj reported the CIS was validated using the VECD model or the elastic-viscoelastic correspondence principle. He

included some comparisons of the cracking initiation temperature versus the damage initiation temperature to support its validation. Hajj explained how the test results are used to focus on the cracking temperature, or strength versus temperature.

The 4th and final step is the prediction of a thermal cracking event in terms of probability. Evaluating the accumulative events during which thermal stress reaches a defined percentage of the asphalt mixture CIS over the analysis period. Hajj illustrated the probability of a cracking event by showing the predicted thermal stress over time using different reliability levels.

Hajj included some examples in the TCAP analysis. The location of the example was Reno, Nevada for a polymer modified binder that was designed for 20 years. He showed results from TCAP. This included the difference in the predicted thermal stresses between aging and no aging in terms of the effect on the analyses, as well as for different air void levels. For the lower air void level, there is a larger effect on the increase in thermal stress. However, the cracking likelihood increases for mixtures with the higher air voids level because of the lower mixture strengths at the higher air void level. Hajj noted this assumes that air voids remain constant throughout the design period. He also showed the effect of modification from two field projects in the Reno area. One mixture was a neat PG 64-22 and the other was a SBS polymer modified PG 64-28. Hajj reported the field results support the model regarding the length of thermal cracking.

Hajj showed the TCAP implementation flow chart for using the model and mixture properties. He emphasized the intention on the model use is not to predict the level of cracking, but to predict whether the mixture will resist or not resist thermal cracking. This is a different intent than some of the other thermal cracking prediction models.

As part of his report, Hajj included a brief discussion on the components of the pavement temperature profile prediction part of the TCAP model defined as TEMPS. The main focus of this presentation was on the finite control volume method with an implicit scheme. He referred to the heat transfer concept as well as the numerical computations using the finite control volume method. He also noted the temperature and other required data are linked to the climatic data for a specific station.

Hajj then overviewed the outputs from the TEMPS software and covered the different uses of the products from the software and how they can be used. Rowe suggested Hajj compare the highs and lows using a frequency distribution to illustrate the improvement in results. Hajj agreed with that suggestion in comparing the predicted and measured data.

The final part of Hajj's report was on additional improvements to the TEMPS program and included the following:

- Optimize the surface characteristics for the U.S. using particle swarm optimization algorithm.
- Create or include input files for LTPP SMP sites.
- Provide a summary of the average 7-day pavement temperature at various depths.
- Provide a summary of pavement cooling and warming rates.

ETG Comments, Questions, and Discussion:
Nam Tran asked how would the software be used when verifying cracking data for using newer materials, since previous cracking experience is not available. Hajj responded that if you have new products/ materials coming into use, it is more of an investigation tool, rather than a validation tool.

14. NAPA Cooperative Agreement Efforts—Audrey Copeland (NAPA)
Heather Dylla gave the report for Audrey Copeland.

Presentation Title: *NAPA Advancement of Innovative Asphalt Technology*

Summary of Presentation:
Dylla stated she will discuss one of NAPA's goals related to the advancement and deployment of innovative asphalt technology. Specifically, the goal is to advance/deploy innovative asphalt technologies to enhance performance and reduce cost of asphalt pavements.

She reported NAPA has been awarded a cooperative agreement with FHWA. As part of this cooperative agreement, FHWA and NAPA will leverage NAPA's expertise in leading innovation advancement including conferences and workshops, presentation at government and industry events, host webinars, provide publications, and produce different multimedia tools. The innovation team includes NCAT, Texas A&M, AAT, industry consultants, and State Asphalt Pavement Associations.

The purpose of the cooperative agreement is not for doing new research but to deploy new and innovative technologies to design, specify, and construct asphalt pavements and present these to industry. In other words, publicize and deploy research findings and technologies in pavement and materials from NCHRP, Strategic Highway Research Program (SHRP), and other institutions. These will be deployed through several modes such as marketing, product demonstrations, and information dissemination via publications, articles, conferences, and webinars. This cooperative agreement will ultimately aid to bridge the gap between completed research and getting practice-ready technologies successfully used by industry and state DOTs. The target audience includes the entire asphalt material community.

Dylla overviewed some of the specific 2014 deliverables from the cooperative agreement, which includes, pavement economics and LCCA for asphalt pavements, high binder replacement mixtures, RAP management best practices industry publication, recycled materials/WMA usage report for 2013, porous asphalt pavements technical brief, and support for sustainability conference planned for November 2014. Deliverables planned for FY 2015 include recycled materials and a recycled materials/WMA usage report for 2014, best practices for recycled tire rubber in asphalt pavements, and sponsoring a national conference on high performance asphalt pavements for long term performance.

For more information on this cooperative agreement and products from this agreement contact Audrey Copeland: Audrey@asphaltpavement.org

15. Ground Tire Rubber Field Project Evaluation—Matthew Corrigan (FHWA)
Presentation Title: *Ground Tire Rubber (GTR) Field Projects*

Summary of Presentation:
Matt Corrigan reported on two projects, one from PA and the other from NJ. Both projects started with a PG 64-22 and used Evotherm as a compaction aide. Neither of these two projects included a control section, so the results cannot be compared to a standard type of mixture. To begin the report, Corrigan commented that these two projects will help guide agencies on the specific choices to use ground tire rubber (GTR) percentages and gradations. Existing issues include:

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- Relative to ASTM D 8, Standard Terminology Relating to Materials for Roads and Pavements: the rubber component is at least 15 percent by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles. Corrigan acknowledged there are other definitions from other standards related to GTR and have generated a lot of controversy within ASTM.
- Note 1 in ASTM D 6114 notes that it has been found that at least 15 percent rubber by weight of the total blend is usually necessary to provide acceptable properties of the asphalt rubber. This standard recommends that no rubber particle should be retained on the 2.36 mm (No. 8) sieve. This standard also states the rubber gradation should be agreed upon between the purchaser and asphalt-rubber supplier. In addition, Note 3 states it has been found that rubber gradation may affect the physical properties and performance of hot paving mixtures using asphalt rubber binder.

It was noted that there is not much guidance on the processing of the rubber particles related to construction and performance or material quality. Some guidance is provided in the current standards in terms that the rubber swells.

For the remainder of his report, Corrigan highlighted specific details for the PA and NJ projects. Some information on these materials and mix design were given at the last mixture ETG meeting.

Pennsylvania Project
This project is located in Lewisburg, PA from SR-15 to SR-11. The mixture was produced by Eastern Industries. The design asphalt content was determined for a 100 design gyrations for a design traffic level of 3 to 30M ESALs. The nominal maximum aggregate size is 12.5 mm. The binder is a PG 64-22 with 0.5 percent of Evotherm 3G by weight of the binder. The GTR was manufactured by Mahantango Enterprises. The aggregate is a combination of sandstone and limestone. The GTR was supposed to be mesh 30 material, but the Pennsylvania specifications allow oversized material. ASTM D5644 does allow 10 percent oversized material if no other requirements are given.

Three samples were recovered and it was determined that full reaction occurred in all three samples. Samples were pre-blended and reheated in the laboratory at 160 to 175 °C for testing and fabricating the specimens. DSR testing included the use of 25 mm parallel plates with 1 mm

gap setting. Corrigan showed a video on the reheating procedure of the material, and commented this is a different material than most people are used to dealing with. He also showed images of PG 64-22 with GTR. Corrigan reported there were RTFO conditioning issues and cleanup is a concern. Some of the issues included, the sample crawled out of the bottles, and then bottles were not coated completely because the oven was tilted to prevent the binder from crawling out of the bottles.

Corrigan included images of the BBR beams showing the difficulty in trimming the beams. The same difficulty in trimming the beams was true for the DTT and ABCD test specimens. You usually do not get a proper edge, and it was questionable whether the proper geometry was achieved.

Corrigan presented some of the test results from this project in terms of the performance grade (M320) to show how these graded. Corrigan reported these results are not reliable due to issues with oven conditioning, deviations from the AASHTO standard procedure, and GTR particle size. Results dictate a PG 58 test temperature. Corrigan excluded the recovery values because the recovery curve was not developed for these types of materials. Corrigan summarized some of the challenges for DSR testing which included; reheating and processing GTR modified binders, sample trimming and edge effects, GTR particle size limits, distribution of GTR particles within sample or test specimens, and high GTR percent by weight of binder. Corrigan provided some observations or recommendations from the project and tests:

- GTR percentage should be based on engineering for targeted final PG grade, and not simply just to meet the ASTM definition.
- GTR binders should be handled carefully, with special attention for blending, reheating, and mixing process. These include equipment selection, mixing time, temperature, and rotation speed.
- GTR evaluation should include gradation, distribution, and settlement or segregation.
- Test specimen preparation and trimming is not a trivial item when testing GTR samples in parallel plate geometry.
- Investigate machine compliance when testing PAV speed with GTR samples.
- The concentric cylinder test geometry configuration should be considered to overcome some of the parallel plate geometry and specimen issues.
- Practical limits on GTR percentage should be established to ensure the current grading system is applicable.
- Alternative evaluation of GTR-based mastics or fine aggregate mixes should be investigated and may be more appropriate at high GTR percentages.

Corrigan then overviewed the different samples that were prepared, 7 plant mixed laboratory compacted (PMLC) samples and 6 laboratory mixed laboratory compacted (LMLC) samples. He also illustrated the Pb verification and reported higher percentages from the production data itself. Corrigan showed photographs of the plant and other production details of the equipment. He noted the contractor on this project had to recalibrate the pump introducing binder and rubber. He reported the contractor designed/fabricated a blending system for the material. The material was being agitated and appeared to be uniform.

Corrigan then presented some of the test results from the AMPT and other devices. The specific mixtures tests included; dynamic modulus, fatigue resistance in accordance with the S-VECD, flow number, and the overlay tester.

- Corrigan reported all of the PMLC dynamic modulus values collapsed into one basic master curve.
- The test temperature selected for flow number testing was adjusted to 54 °C. The flow number test matrix included both unconfined and confined conditions. Corrigan summarized the confined test results using bar-graphs for the PMLC specimens. Some specimen meet and did not meet the minimum criteria specified in TP 79. He also summarized test results for the LMLC unconfined specimens using bar-graphs. In general, the higher GTR percentages resulted in higher flow numbers.
- Corrigan also summarized the Hamburg with similar test results. He then showed the Hamburg test results in a series of graphs. One set was for the PMLC and the other was for the LMLC specimens. D'Angelo asked what was the difference in specimens that caused the difference in results between the plant and lab mixed specimens. The different curves represent different days of production. D'Angelo also questioned the 10 percent GTR which looked like they had a lot more rubber in the mixture from the test results of the Hamburg. Corrigan reminded all that these are gap graded mixes. Corrigan commented PennDOT does not have a Hamburg requirement
- Corrigan showed results from the fatigue S-VECD. AASHTO TP 107 is now standardized, so he used the software that came with the standard software package. Three replicates were used for measuring the mixture properties. Most of the tests were performed at a temperature at 21 °C. The specimen strain levels included 350, 450 and 600 micro-strains. Corrigan reported that sample breaks are starting occur consistently in the center.
- They are also looking at where the phase angle drops off suddenly to estimate the endurance limit. Corrigan cautioned against using these values as related to performance. Endurance limits from the LMLC specimens provides the expected better grouping. Fatigue performance was similar for mixtures using 5 to 15 percent laboratory reacted GTR binders. It was noted that fatigue performance decreased for the 20 percent GTR mixtures, but could not be explained.

Corrigan summarized some of the Pennsylvania project findings. GTR increases the overall stiffness and improves the permanent deformation and moisture damage properties of the asphalt mixes. Fatigue resistance of the LMLC mixes is consistent up to a 15 percent GTR content. Binder content was shown to be affected by the performance of the PMLC mixes. More importantly, handling GTR mixes is not trivial. Corrigan acknowledged the participants providing data and coordination relative to the Pennsylvania project. These included Tim Ramirez, other PennDOT staff, and Eastern Industries.

New Jersey Project

Corrigan then reported on preliminary test results from the New Jersey project located in Ocean County, NJ along routes US 9 and 72. The mixture was produced by ECOPATH Contracting LLC and Western Technologies. The pavement surface layer design used 75 gyrations for 0.3 to 3 MESLs. The nominal maximum aggregate size was 12.5 mm. The binder was a PG 64-22 plus 0.5 percent Evotherm M1 by weight of the binder. The mixture included 20 percent GTR with 10

percent RAP. A separate mixture with 20 percent GTR but without RAP was also produced and placed. Musselman asked about the asphalt binders and GTR gradation. Corrigan replied this is a gap-graded mixture. This gradation was closer to 30 mesh GTR material than the PA project.

Corrigan noted that the mix temperature was approximately 315 °F, which is low for GTR mixtures.

Corrigan summarized PA project data. The specific mixtures tests included: dynamic modulus, fatigue resistance in accordance with the S-VECD, flow number, and overlay tester.

- Corrigan reported all of the PMLC dynamic modulus results collapsed into one basic master curve, similar to the PA project.
- The test temperature selected for the flow number test was 54.1 °C. Four replicates were used for both the unconfined and confined tests. Results from the unconfined flow number test indicate the mix failed below 3 million ESALs, so the mixture might be insufficient to resist rutting. Dukatz asked about the number of load cycles. Corrigan noted the flow number for the PA mix was about 600 cycles, while for the NJ mix the flow number was less than 50. D'Angelo commented there is probably a geometry issue with the test sample. His opinion, the flow number test results do not give you a realistic evaluation of the rut resistance of this mix. Corrigan disagreed with that statement based on the PA mixture test results but qualified that statement in that the comparison is for only two mixes
- Corrigan presented the Hamburg test results which would indicate no problem with using this mixture, but, NJ does not specify a Hamburg testing criteria.
- Corrigan showed some of the test results from the fatigue test in accordance with the S-VECD procedure, and showed some of the specimen breaks at different strain levels. He pointed out, it is more important to have the failures spread out in terms of cycles to failure.
- Corrigan illustrated the same data relative to the endurance limit for the NJ mixture as presented for the PA mixture.

Corrigan summarized some of the New Jersey project findings. Overall, the asphalt mixes included in the study exhibited similar performance results to those of the PA project. He also pointed out that the inclusion of 10 percent RAP did not significantly impact performance test results. However, he reiterated these results are preliminary. Corrigan ended his report with the statement that there is a need to establish some practical limitations on GTR criteria.

Corrigan acknowledged those that participated and provided information for the New Jersey project. The participants included New Jersey DOT, A.E. Stone Inc., ECOPATH Contracting, Western Technologies, and Keith Sterling.

<u>ETG Comments, Questions, and Discussion:</u>
Fee commented that a lot of projects have been built but we have to put limitations on the size, amount criteria of GTR materials. Musselman commented that there still remain GTR settlement issues within the binder, and present a challenge for contractors.

D'Angelo a key item is the field blenders. Terminal blending, however, is usually done at lower percentages, higher temperatures, and longer reaction times, so there can be significant differences between the field blended and terminally blended binders. Many of the reported issues go away with the terminal blends – the materials are much easier to handle. Reid Kaiser noted the terminal blends are providing good performance in Nevada. Musselman noted, in general, the states represented at the ETG meeting are using a lot of different GTR percentages. A number of individuals reiterated that a standalone specification is needed in AASHTO for rubber asphalt.

There is an issue with making specimens in the gyratory compactor. An issue remains regarding the need to hold the specimens under load and allowing them to cool prior to removing from compaction mold. All of this is needed in a specification/standard.

ACTION ITEM #6: Matthew Corrigan will provide an update on the FHWA mobile lab testing/evaluation of GTR field projects.

Fee adjourned the meeting for day 2 at 4:40 PM.

DAY 3: Friday, April 19, 2014

Frank Fee and John Bukowski called the meeting to order.

16. **Status Update of NCHRP 9-48; Mixture Field versus Laboratory Volumetric and Mechanical Properties**—Louay Mohammad (Louisiana Transportation Research Center)

Summary of Presentation:
Louay Mohammad acknowledged Mostafa Elseifi and Sam Cooper efforts in this project as well as the NCHRP project manager Edward Harrigan, the LADOTD and LTRC Research staff, participating contractors and DOTs, as well as TTI and University of Wisconsin The report focused on the project objectives, the experiment, some preliminary data analysis, and a summary of results to date.

The objective of this project was to determine the cause and magnitude of the differences/ variances in measured volumetric and mechanical properties within and between specimen prepared in different circumstances: laboratory mixed laboratory compacted (LMLC) for design, plant mixed laboratory compacted (PMLC) for production, and plant mixed field compacted (PMFC) for construction. The project is grouped into six tasks; the first three have been completed and focused on developing the experimental plan, while the final three are related to executing that plan.

Mohammad explained the experiment included five factors with two contrasting levels: baghouse fines, time delay in specimen fabrication, aggregate absorption, aggregate degradation, and aggregate stockpile in place properties. These factors are considered on how they impact the volumetric and mechanical properties of the mix. The volumetric properties include air voids, voids in mineral aggregate, maximum specific gravity, gradation, and bulk specific gravity. The

mechanical properties include the indirect tensile dynamic modulus, the axial dynamic modulus, and results from the Hamburg wheel tracking test.

Mohammad explained the experimental design which was a factorial design to evaluate the main effects. Some of the interactions between parameters may not be quantified. Mohammad reported they ended up with 11 mixtures and showed each project on a map. Mohammad explained how the samples from these projects were obtained for the laboratory. These included samples from the plant and field cores. From the plant, specimens were prepared without allowing the mix to cool down so it did not have to be reheated and confound the experiment with different degrees of aging or hardening.

Mohammad reported a lot of data is still being evaluated but will provide a snapshot of the results. He first started with air voids differences between the different events using a bar graph showing the delta air voids. In summary:

- Air voids were significantly different between laboratory and plant produced mixtures, while no difference in asphalt content was found for the Wisconsin project.
- Differences were also identified between the compacted specimens from the Hamburg wheel tracking test.
- Relative to dynamic modulus, no statistical difference was found between the axial dynamic modulus while some a significant difference was observed for the IDT dynamic modulus.

Kevin Hall asked how thick were the cores for the PF specimens. Mohammad commented, about 50 mm for the lifts placed in about a 2 inch lift for most of the projects. Mohammad noted all of these mixtures were used as a wearing surface. All of the LL and PL samples were gyratory prepared specimens, while the PF specimens were cores. Tran asked about air void differences between these samples for measuring the other mechanical properties. Mohammad replied the air voids between the samples were similar or equivalent.

Mohammad gave a summary on the magnitude of the differences between specimen types. Some differences were noted for both the volumetric and mechanical properties. John Haddock asked if the effective specific gravity of the aggregate between these specimens was tracked. Mohammad answered, yes and there was no difference. Mohammad summarized the effect of process based factors using an analysis of covariance; this was a summary on whether there was a difference in the measured results.

- Lab to production; some differences were identified.
- Production to construction; no differences were identified.

Mohammad then explained the use of a contractor survey to answer the question: why are factors not affecting the mixture properties, and did you observe VMA collapse in the HMA production at your plant after fine tuning the mixture. About 78 percent reported once the mix is fine-tuned, no difference is identified, while 61 percent of the respondents reported they do observe a reduction in VMA prior to fine-turning.

Mohammad summarized the preliminary results comparing the mechanistic properties of three specimen types LL, PL, and PF. He concluded one can develop a shift factor to explain its

impact on design. The preliminary shift factors reported by Mohammad: design to production, the factor is 1.0; design to construction the factor is 0.75; and production to construction the factor is 0.75. Mohammad also concluded the shift factors for the uniaxial dynamic modulus test need to be applied to the higher temperatures. Huber asked about the direction of the shift on stiffness. Mohammad replied the field specimens/cores have the lower dynamic modulus values.

Mohammad showed some examples using the Pavement ME software to illustrate the effect of these differences on the predicted distresses of fatigue cracking, rutting, and roughness. They expect to develop tolerance levels between the different types of specimens and compare those to the results from a survey for the tolerance recommendations or what is really being used. Mohammad thought that the existing tolerances used by agencies could be reduced. Huber pointed out; the tolerance values Mohammad is using are based on one lab, but when you have multiple laboratories, the tolerance will probably be significantly higher. Mohammad agreed with that comment.

Mohammad summarized some of the results observed to date relative to the cause and magnitude or delta in the volumetric and mechanical properties within and between the three specimen types. There are impacts of process based factors on the results, but that varies between the specimen types and properties. For example, no difference identified between PL and PF type specimens. Based on the preliminary comparison of mechanistic properties measured on the three specimen types, Mohammad is recommending use of shift factors that are based on pavement performance predictions. Use of LL or PL modulus in performance prediction will result in under designed pavement structures. Based on a comparison of volumetric properties for the three specimen types, tolerance recommendations were developed and compared to existing state practice, which can be lowered. Kevin Hall asked were there differences in dynamic modulus between the axial and IDT tests. Mohammad replied yes, there were differences.

17. Update on the WMA Task Force/LTPP Experiment—Ramon Bonaquist (AAT) and James Musselman (Florida DOT)

The presentation/report was given by Jim Musselman.

Presentation Title: *LTPP SPS-10, Warm Mix Asphalt Experiment*

Summary of Presentation:

Jim Musselman started the report by illustrating the performance of pavements in Florida and how the performance has changed over time since the Florida DOT adopted Superpave. His point; we are making a positive difference. As an example, Musselman pointed out Florida's turnpike has almost no deficiencies.

The objectives of the Long Term Pavement Performance (LTPP) SPS-10 experiment are to monitor the long term performance of WMA mixtures relative to HMA and to capture data on WMA mixtures with RAP. Musselman reviewed the experimental design to achieve those two objectives. Every WMA project will have an HMA control project. Musselman overviewed the project selection requirements for the SPS-10 experiment. The requirements include asphalt concrete overlays of flexible pavements, overlay thickness is 2 to 4 inches consisting of dense

graded mixtures, the RAP content will be within 10 to 25 percent using binder replacement, and tack coats will be placed between each lift. Three projects are to be placed at each project site: two WMA sections (foaming process and use of a chemical additive) and one HMA control section. The project can include or exclude milling of the existing asphalt concrete surface. However, agencies can and are encouraged to build additional or supplemental sections which will be monitored as part of the LTPP program. The mixture design and binder grade selection for the project will be based on the agency's standard practice.

Musselman identified the material tests to be performed on the overlay layers, as a minimum: dynamic modulus using small scale AMPT specimens, Hamburg wheel tracking tests during construction, testing of the tank binder and extracted from the mix using the DSR, BBR, and MSCR, and basic mix characterization tests for determining volumetric and physical properties. A similar materials test program is planned for the existing asphalt concrete layers: dynamic modulus using small scale AMPT specimens; binder testing using the DSR, BBR, and MSCR; Hamburg wheel tracking test, and basic mix characterization tests.

Musselman reported supplementary tests will be performed based on feedback from the ETG. At the last meeting it was suggested the agency and others include some additional tests. These tests were identified in the NCHRP research digest specifically prepared for this topic. Musselman showed the recommended supplementary tests. The other parameter suggested by the ETG was to look at variable density levels on the supplemental sections. Musselman noted the core experimental sections only include foaming and/or chemical additives, but other technologies as well as higher recycle binder ratios greater than 25 percent can be included as supplemental sections.

Musselman reported the white paper prepared by the mixture ETG was distributed to each highway agency. Currently, 17 SPS-10 projects have been nominated and 8 of those have been accepted and approved. Two projects will be constructed this fall, one in New Mexico and one in Texas. Only 2 of the 17 have been rejected. The rest of the 17 projects are under evaluation by FHWA and a meeting is planned with agencies to recruit additional projects.

All of the supporting documentation, guidelines for project selection and requirements, experimental design factors and other information relative to the SPS-10 experiment will be published in a final report by the end of November. Musselman stated anyone wanting more information on the experiment and project details can contact the following individual:

- Jason Puccinelli, LTPP WMA Contractor, jpuccineli@ncenet.com
- Jack Springer, FHWA-LTPP, jack.springer@dot.gov

ETG Comments, Questions, and Discussion:
Randy West asked what production temperatures are they considering for WMA. Musselman replied less than 275 °F and at least 40 degrees cooler than the HMA.

West asked, after the projects are built, what is the long term plan. Musselman replied the plan includes long term monitoring, and all data (monitoring performance, materials, traffic, etc.) will be entered into the LTPP database.

Bonaquist noted that the experiment design included two levels of traffic, high and low. Musselman added that the installation of WIM equipment was a requirement for each WMA site.

Bukowski asked Musselman to give a report at the next Mixture ETG meeting on the updates for this experiment. Musselman agreed, but noted that Jason Puccinelli would be a better person to do the updates.

ACTION ITEM #7: Jim Musselman will provide an update and status report on the LTPP WMA project.

18. Construction Task Force Update—Erv Dukatz (Mathy Construction)
Presentation Title: *New and Reconstituted Mix ETG Construction Task Force*

Summary of Presentation:
Dukatz noted his report will be grouped into two parts relative to the goals of the task group.

- The original goal of the committee was focused on density, and how to achieve density for improving pavement performance.
- The second goal is to prepare technical briefs or a synthesis to provide when, where, and how, but more importantly why the procedures and practices must be followed.

Dukatz overviewed the original density roadmap that was prepared by Lee Gallivan, Judie Ryan and Cindy LeFluer. He also reminded the group of Ron Sines comment on this topic that contractors are put into the position of trying to achieve compaction over existing materials which may not provide the needed basis for performance. Not being able to achieve adequate compaction can lead to early failures and inferior performance. Dukatz showed some typical photos on premature pavement failures. He also mentioned how the mixture design considerations, moisture and other factors have an impact on density and performance. So taking all of this into consideration relative to the density roadmap, they added critical elements affecting the compaction of HMA pavements, 17 items were included on the list related to the density roadmap. These were ranked by level of importance from the committee members. Dukatz listed all of the factors, but the top five or five most important ones were: layer/lift thickness, acceptance requirements, mixture properties (mix design), tack coats, and design layers.

ETG Comments, Questions, and Discussion:
Gale Page noted in his opinion there are other issues that are more important than the equipment used to do the compaction. One of the issues is giving the contractor incentive to achieve better compaction. Dukatz noted incentives have been added relative to smoothness and that has significantly improved pavement smoothness (IRI) across the country.

Abadie thought there was an NCHRP project that included some of the issues identified. Musselman requested feedback from the ETG.

Bukowski appreciated this effort by the task group. He commented it is important to focus on major issues, because at the last meeting it was difficult to proceed because of all the areas of

interest. Go forward with what you believe is important, and do not try to do too many activities. Just stay focused on a couple of items whether it is a synthesis through the committee or through NCHRP. Dukatz commented an ETG synthesis, technical brief, or something under NCHRP 20-7 are possibilities. Progress by the task group is needed prior to the next ETG meeting. Bukowski noted an NCHRP activity could take several years, while if individuals are willing something through the ETG such as technical brief might be completed quicker.

ACTION ITEM #8: The Construction Task Force will provide an update at the next meeting.

19. FHWA/AI Cooperative Agreement—Mark Buncher and Mark Blow (Asphalt Institute)
Mark Buncher started the report and noted two presentations will be given. He will summarize the cooperative agreement between AI and FHWA on multiple activities but focus more on the longitudinal joint workshops that have been a big success. The second presentation will be given by Mark Blow to focus on tack coat best practices workshops.

Presentation Title: ***Promoting Quality through the FHWA/AI Cooperative Agreement***
Buncher noted AI has developed best practices documents for constructing and specifying HMA longitudinal joints, using intelligent compaction, tack coat best practices, and MSCR implementation at the state and regional levels. All of the items promote quality to agencies and were prepared under the cooperative agreement.

Buncher started with an overview of the longitudinal construction joints course developed and delivered by AI. He commented, too often longitudinal joints are the weak link in an otherwise well designed pavement. Both the agency and industry are concerned with longitudinal joints. Buncher acknowledged their 4-hour longitudinal joint workshop is free and have had a large attendance. The goal of the workshop is to create greater awareness relative to longitudinal joints, improve the agency's specifications, and improve on the contractors practices to construct the longitudinal construction joints.

Buncher summarized the number of individuals that have attended these workshops, now 7,000+ over the past two years.

Buncher showed the project website-listed http://www.asphaltinstitute.org/, and then overviewed the content of the workshop.

Buncher explained the course includes defining the different types of longitudinal joints. Buncher also overviewed the recommended joint specification that was developed and used in the course. Buncher went through some examples in different states. He commented, when the workshop was being developed and initially delivered, they thought contractors would be upset with some of the content of the course. However, contractors have been very positive over the content.

Presentation Title: ***Tack Coat Best Practices***

Mark Blow highlighted some key points. He showed photographs that included areas where slippage has occurred because of inadequate tack coat. Blow pointed out, the intent of this best practices course and accompanying document are to increase the awareness of the benefits of placing a good tack coat. This course also contains information/explains how to create bond between two pavement layers. Blow commented they have received a lot of feedback on different issues, materials, construction, testing, etc.

20. Action Items and Next Meeting—Frank Fee (Frank Fee, LLC) and John Bukowski (FHWA)

Action Items:

1. The Asphalt Institute will update the ETG on activities related to the REOB issue.

2. Jeff Withee, along with the Asphalt Institute and NCAT, will report on the potential recommended changes to AASHTO standards on use of friction reducers and specimen preparation for the AMPT.

3. The Asphalt Institute and NCAT will report on their activities comparing various performance tests and the ability to predict pavement fatigue performance.

4. Nelson Gibson will provide an update on the status of the FHWA ALF project at the next ETG meeting.

5. Lee Gallivan will prepare the task force recommendations/rationale for RAP changes to M 323 and distribute for final comment to the ETG members/friends.

6. Matthew Corrigan to provide update on FHWA mobile lab testing/evaluation of GTR field projects at next ETG meeting.

7. Jim Musselman will provide an update status on the LTPP WMA project.

8. Construction Task Force to provide an update at the next meeting.

The following action items were not discussed at this meeting but will be planned for the next ETG meeting (these were action items from the April 2014 ETG meeting):

- David Jones to provide an update on ongoing work elements related to the University of California at Davis/CalTrans GTR project and Emin Kutay to provide an update on ongoing work elements on the GTR Michigan State University GTR project.
- Richard Kim to provide the E* IDT final report and an updated draft standard incorporating recommendations from the final report to the ETG.

Next Meeting Location and Date:

The next meeting date was coordinated with the Binder ETG and will be during the week of April 7th. The meeting will be in Falls River Westport, MA. The Mixture ETG will meet on April 7th and 8th, while the Binder ETG will meet on April 9th and 10th.

21. Meeting Adjournment

Frank Fee and John Bukowski thanked all attendees for their participation on the ETG and attending this meeting. The meeting was adjourned.

ATTACHMENT A

Asphalt Mixture Expert Task Group
Baton Rouge, Louisiana
September 17-19, 2014

Meeting Agenda

Day 1 – September 17, 2014

1:00 pm	Welcome and Introductions	**Fee/Bonaquist**
1:15 pm	Review Agenda/Minutes Approval & Action Items September, 2013 Meeting	**Bukowski**
1:30 pm	Subcommittee on Materials Updates/Comments	**Geary/Abadie**
2:30 pm	Update Related NCHRP Activities	**Harrigan**
3:00 pm	Break	
3:30 pm	REOB Background/Issues	**M. Anderson**
4:00 pm	REOB FHWA Research on Mixture Effects	**Gibson**
4:30 pm	REOB and other Additives Impact on Binder Aging and Mixture Low and Intermediate Properties	**Reinke**
5:00 pm	**Adjourn for the Day**	

Day 2 – September 18, 2014

8:00 am	AMPT Test Implementation • AMPT Pooled Fund State Activities – ILS • TP79 Note on Small Scale Geometry • AMPT Specimen Preparation Variables • Friction Reducers	**Withee**
9:00 am	Update on AI Work Plan for Cracking Tests	**Blankenship**
9:30 **a**m	**Break**	
10:00 am	Task Group Review Update T-321 (Beam Fatigue)	**Rowe**

10:30 am	FHWA ALF Experiment Update	**Gibson**
11:00 am	9-58 RAP/RAS/Recycling Agents - Update	**Daniel**
11:30 am	RAP Mixture Binder Diffusion	**Kriz**

Noon - Lunch Break

1:00 pm	Report Task Force RAP/RAS • Recommendations NCHRP 9-46 • Proposed Changes R35 and M323 • RAS Task Force Recommendations	**Gallivan**
2:00 pm	Pavement Temperature Prediction/Thermal Cracking Model	**Hajj**
2:30 pm	NAPA Cooperative Agreement Efforts	**Copeland**
3:00 pm	**Break**	
3:30 pm	Ground Tire Rubber Field Project Evaluation	**Corrigan**
4:30 pm	**Adjourn for the Day**	

Day 3 – September 19, 2014

8:00 am	Status NCHRP 9-48 Mixture Field versus Lab Properties	**Mohammad**
8:30 am	Update on the WMA Task Force/LTPP Experiment	**Bonaquist/Musselman**
9:00 am	**Break**	
9:30 am	Construction Task Force Update	**Dukatz**
10:30 am	Action Items and Next Meeting Planning	**Fee/Bukowski**
11:30 am	**Adjourn**	

ATTACHMENT B

FHWA Asphalt Mixture & Construction Expert Task Force Members

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Secretary: **John Bukowski** Asphalt Team Leader FHWA Federal Highway Administration 1200 New Jersey Ave., SE; E75-332 Washington, D.C. 20590 Phone: 202 366-1287 Fax 202-493-2070 John.Bukowski@dot.gov	
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ATTACHMENT C

Task Force Members and Assignments
FHWA Asphalt Mixture & Construction ETG

Task Force Identification:		Members Assigned to Force:
1	Performance Test Review	Mike Anderson (Lead), Ray Bonaquist (Lead); Richard Kim, Ellie Hajj, Haleh Azari, Audrey Copeland, Kevin Van Frank, Phil Blankenship, Nam Tran, Raj Dongre, Nelson Gibson, Harold Von Quintus
	T 320; Simple Shear Test	Louay Mohammad, Tom Bennert, Richard Steger, Becky McDaniel
	T 321; Bending Beam Fatigue	Geoff Rowe, Tom Bennert, Phil Blankenship, Bill Criqui, John Harvey, Kieran McGrane, Mike Mamlouk, Richard Steger, Louay Mohammad, Elie Hajj, and Andrew Copper
	T 322; Indirect Tension	Jo Daniels, Becky McDaniels, Rey Roque, Richard Steger
2	WMA Mixture Design	Matt Corrigan (Lead): Louay Mohammah, Charlie Pan (for Reid Kaiser), Gerald Reinke, Kevin Hall, Dave Newcomb, Randy West, Tim Ramirez, Walaa Mogawer, and Jason Lema.
3	Construction Task Group	Erv Dukatz (Lead); Jim Musselman, Kevin Hall, Gerry Huber, Adam Hand, Ron Sines, Audrey Copeland, and Tom Harman.
4	AMPT, TP 60: Air Void Tolerance and Sample Preparation Issues	Ramon Bonaquist (Lead); Haleh Azari, Matt Corrigan, Richard Kim, Gerald Reinke, Richard Steger, and Randy West
5	RAP	Lee Gallivan (Lead): John D'Angelo, Audrey Copeland, Gerry Huber, Jim Musselman, Ron Sines, Randy West, and Richard Willis
6	LTPP WMA Group	Jim Musselman (Lead); Ramon Bonaquist, Adam Hand, Georgene Geary, Audrey Copeland

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