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 65 individuals attended the meeting (22 members, 43 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 that were in attendance included:
Frank Fee, NuStar Asphalt (Chairman)
Ray Bonaquist, Advanced Asphalt Technologies (Co-chairman)
John Bukowski, FHWA (Secretary)
Howard Anderson, Utah DOT
Haleh Azari (Liaison), AASHTO-ARML
Shane Buchanan, Old Castle Materials
Mark Buncher (Liaison), Asphalt Institute
Jo Daniel, University of New Hampshire
Ervin L. Dukatz, Jr., Mathy Construction Company
Heather Dyall, NAPA; attending for Audrey Copeland
Georgene Geary, Georgia DOT
John Haddock, Purdue University
Kevin Hall, University of Arkansas
Gerry Huber, Hertiage Research Group
Louay Mohammad, LTRC/Lousiana State Univeristy
James Musselman, Florida DOT
David Newcomb, Texas A&M Transportation Institute
Charlie Pan, Nevada DOT; attending for Reid Kaiser
Timothy Ramirez, Pennsylvania DOT
Randy West, NCAT; attending for Nam Tran

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

Members of the ETG that were 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
Reid Kaiser, Nevada DOT
Julie Kliewer, Arizona DOT
Richard Kim, North Carolina State University

Todd Lynn, Thunderhead Testing, LLC
Allen Myers, Kentucky Transportation Cabinet
Nam Tran (Liaison), National Center for Asphalt Technology

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

Todd Arnold, University of Nevada at Reno	Daryl MacLeod, Husky Energy
John Barry, Crowley Chemical	Pamela Marks, Ministry of Transp. Ontario
Gaylon Baumgardner, Paragon Tech. Ser. Inc.	Kieran McGrane, IPC Global
Phil Blankenship, Asphalt Institute	Ala Mohseni, Consultant
Alexander Brown, Asphalt Institute	Peter Moore, Pike Industries, Inc.
Eliana Carlson, Connecticut DOT	Steven Muncy, BASF
John Casola, Malvern	Roger Pyle, Pine Instruments
Barry Catterton, Maryland SHA	Ali Regimand, InstroTek, Inc.
Andrew Cooper, James Cox & Sons	Gerald Reinke, Mathy Construction
Matt Courser, New Hampshire DOT	Walaa Mogawer, Univ. of Mass. - Dartmouth
William Criqui, Road Science	Geoff Rowe, Abatech
Robert Fitzgerald, Massachusetts DOT	Mansour Solaimanian, Pennsylvania State Univ.
Jean Paul Fort, Colas	Laci Tiarks-Martin, PRI Asphalt Tech.
Lee Gallivan, FHWA	Kevin VanFrank, CME
Matt Groh, Bituminous Technologies	Scott Veglahn, Mathy Construction
Elie Hajj, University of Nevada at Reno	Bob Voelkec, Maryland SHA
Andrew Hanz, WHRP	Eric Weaver, FHWA
Greg Harder, Asphalt Institute	Randy West, NCAT
Brian Johnson, AASHTO	Jeff Withee, FHWA
Ryan Kirkendall, Troxler	Tim Yasika, Sonneborn
Robert Kluttz, Kraton Polymers	Jack Youtcheff, FHWA
Jason Lema, Massachusetts DOT	Doug Zuberer, Cox and Sons

DAY 1: Wednesday, September 18, 2013

1. Call to Order—Chairman Fee (Frank Fee, LLC) called the meeting to order at 1:00 PM.

John Bukowski asked Lori Dalton for any announcements.

Welcome and Introductions – Chairman Fee welcomed the group to the meeting. Dalton distributed two "sign–in" sheets, one for the members of the ETG and the other for Friends of the ETG. Copies of the agenda were distributed. Fee thanked Mogawer for sponsoring the meeting.

Frank Fee and John Bukowski 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)

Bukowski reported the technical report from the last meeting was sent out via e-mail prior to the meeting. Any revisions or corrections to the technical report should be sent to him. No corrections or revisions were identified during the meeting. Extra copies of the agenda were available at the meeting. Bukowski announced Friends of the ETG can receive the Mix ETG technical report on request.

Bukowski reviewed the Action Items from the April 30 – May 1, 2013 Mix ETG meeting. The following is a listing and status of the Action Items from the last meeting.

1. Recommend to SoM 2d: for PP60. While minimum height for specimen preparation is 160 mm for compression testing, the minimum height for specimens subjected to tensile testing should be 180 mm.
   UPDATE: Action item is on the agenda; Geary will report on this action item during the AASHTO Standards update.

2. RAP/RAS Task Force will incorporate the comments from the ETG along with the proposed revisions to PP53/MP15. Revised documents to be provided to Bukowski for SoM 2d consideration. A one year time extension as provisional standards will also be requested, if possible, to allow time for further evaluation of the proposed changes.
   UPDATE: Action item is on the agenda; Geary will report on this action item during the AASHTO Standards update.

3. RAP/RAS Task Force will be provided the report from NCHRP project 9-46 and draft of suggested changes to R35 and M323. RAP/RAS Task Force will review and comment at the next ETG meeting.
   UPDATE: Action item is on the agenda.

4. The procedure developed by Andrew Hanz for estimating RAP/RAS binder properties without extraction will be sent to the Binder ETG for comment. This item will be included on agenda for discussion at the next set of ETG meetings for any potential comments to the SoM after the fall meeting.
   UPDATE: Bukowski reported this item was presented previously at the Binder ETG meeting. He also mentioned the ETG comments are very valuable and helps the SoM decisions.

5. Richard Kim will report at the next ETG meeting on the status of the IDT ruggedness study.
   UPDATE: Action item was included on the agenda but will be delayed until the next meeting because Kim is not in attendance. Bukowski reported Kim is in the process of evaluating the roughness testing.

6. ETG members are requested to forward comments to Ellie Hajj on his draft procedure for low temperature tensile mixture testing, and a summary of comments and potential action will be discussed at the next ETG meeting.
   UPDATE: Action item is on the agenda.

7. Richard Kim's revised draft procedure for cyclic fatigue tensile testing with S-VECD will be forwarded to the SoM 2d for further consideration.
   UPDATE: Has been submitted to the SoM. In addition, information/comments from the Mix ETG were provided to the SoM.

8. The Flow Number Task Force's proposed draft procedure/criteria (Incremental Repeated Load Permanent Deformation - iRLPD) on a new method to characterize the rutting potential of asphalt mixtures will be distributed to ETG members for evaluation by additional laboratories. ETG members are requested to conduct evaluation before any final recommendation in 2014 regarding possible replacement of the existing TP 79 criteria.
   UPDATE: Action item is on the agenda.

9. Proposed final revised version of T 321 (Beam Flexural Fatigue) and commentary will be sent to the SoM 2d for consideration.
   UPDATE: Action item is on the agenda. Bukowski reported changes were forwarded to the ASSHTO SoM and ASTM as well is reviewing a revised procedure.

10. ETG members are requested to provide Raj Dongre comments on his workability procedure and presentation at the next ETG meeting.
    UPDATE: Action item is on the agenda.

Bukowski reported there is another item on the agenda which was not an action item. A report will be provided by Jack Youtcheff on the ALF project and its construction.

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

Presentation Title: *AASHTO Standards Update*—Georgene Geary (Georgia DOT); Liaison for the AASHTO Subcommittee on Materials (SoM)

Summary of Presentation:
Georgene Geary provided an update on the AASHTO Standards under ballot/evaluation.

Geary provided a summary of the Tech Section 2d meeting. All items on the 2013 spring SoM Tech Section 2d ballot passed. Geary presented an overview on the full SoM ballot. The 2013 SoM spring meeting was held on August 5-8 in Stateline, Nevada. The following summarizes the five ballot items from the Tech Section 2d ballot.

1. T 321 on Fatigue Life subjected to repeated flexural bending: All changes/revisions proposed by the ETG were accepted, as well as other editorial items. There were questions on sections 8.6 and 8.7 which were resolved. The item passed the Tech Section ballot and will be moved forward to the SoM ballot.

2. PP60 Preparation of Cylindrical Performance Samples Using SGC: The change included adding a minimum height of 180 mm for tensile testing. There were comments from the

ballot that not all gyratory compactors can compact to a height of 180 mm. Editorial changes were made and sent to SoM for full ballot.

3. Direct Tension Cyclic Fatigue Test (DT-VECD) is a new provisional test method. The same comment was received regarding the 180 mm height issue. Editorial comments were resolved and moved onto the full SoM ballot.

4. MP 15, Specification for Use of Reclaimed Asphalt Shingles in New Asphalt Mixtures, and PP 53, Design Considerations When Using Reclaimed Asphalt Shingles in New Asphalt Mixtures. Geary reported there were no negatives, but extensive changes were made to both standards regarding issues related to the binder availability factor and blending chart. The Tech Section maintains that with this many changes more time is needed before moving to a full standard. Both provisions will sunset. However, to preserve the standards content/use, they will now be balloted, with changes, as two new provisional standards in 2013.

5. T 312, Preparing and Determining the Density of Asphalt. A change will be made to allow the Coordinate Measurement Machine used by manufacturers to be recognized as being equivalent to the 3 point bore gauge. A note was added and Geary presented the note to the ETG. It read, "It is good practice and recommended for the recipient to check new molds that have CMM certification by the manufacturer with a 3-point bore gauge to verify before putting molds into service." The note was considered editorial. With this addition, the item moved to a full SoM ballot.

Other items included:

1. T 245, Resistance to Plastic Flow of Asphalt Mixtures Using Marshall Apparatus. Geary reported on the changes made to this item. Fee asked if any State still uses the Marshall Hammer. It was noted that Tennessee still uses the Marshall Hammer. Fee's concern was related to AASHTO, and if States are not using it, then it should be dropped. Jim Musselman noted that other local agencies still use Marshall, so his suggestion is that it needs to stay as a standard.

2. T 283, Resistance to Compacted Asphalt Mixtures to Moisture-Induced Damage. Geary reported no major issues but "cores" added to section 9.1 and a note was added to section 10.3.1 to provide guidance on vacuum level used.

3. T 312, Preparing and Determining the Density of Asphalt Mixtures by Means of the Superpave Gyratory Compactor. Clarification to what constitutes failure in 3 point bore measurement in section A.3.4.5.

Geary next summarized changes proposed for the 2014 AASHTO Standards. She identified a listing of the standards plus 5 new provisional standards, which will be concurrent ballot items. The standards included: T 245, T 283, T 312 (2 ballot items), T 321, PP 60, R 30, and R 35. The five new provisional standards included: specification for RAS, RAS design, DT-DECVD, PFC Mix Design, and Abrasion Loss of Asphalt Mixtures.

The fall 2013 Tech Sect ballot included six new proposed provisional standards which initially included a recommendation that the Tech Section only post to a website, but this was not approved. These provisional standards will not be in the 2014 Provisional Standards book.

Chris Abadie approached the AASHTO SoM about adding a category of experimental or research test methods. This category could include test methods that have limited exposure but be available to increase the body of knowledge on their use. However, Geary reported the Tech Section and the SoM do not agree with this approach. Some of the Tech Section maintained this was the purpose of provisional standards. Geary noted the initial reason for the provisional test standards was to allow agencies to try new test methods prior to becoming a standard. The history of provisional standards was from SHRP. Under that program items that became provisional standards had considerable evaluation. Now we have recommendations for provisional standards, many of which have only been evaluated in a single laboratory. Geary noted AASHTO is still open to other ideas on how to handle this issue.

For the 2014 AASHTO Publication cycle, Geary reported the SoM ballot items are due by September 23. SoM ballot is to be issued in October 2013 with 30 days to return the ballot. The ballot items for Tech Section 2d will be reviewed during the February 2014 webinar; and any revisions will be published in July 2014.

Geary overviewed the changes made to the SoM Operations Guide. Those changes to the SoM operations guide will be included on the fall 2013 ballot. These included jointly owned and solely owned standards. She reported the standards that are jointly owned go through additional processes of ASTM and AASHTO. Other items include:

- SoM will be adding non-agency members which will be non-voting members. This will be Tech Section dependent.
- A research task force was created this year which will be included in the operations guide. This is basically for research liaisons for research needs statements. Every Tech Section has named a research coordinator. Geary will discuss this with Amir Hanna of TRB. This will be more of a structured basis than what has been done in the past.

4. Update on Related NCHRP Projects—Edward Harrigan (NCHRP)

Bukowski will give the report in Harrigan's absence.

Summary Presentation: *NCHRP Update – April 2013*

Warm Mix Asphalt Projects: Matt Corrigan will provide more detail on the WMA items later.
9-47A: Properties and Performance of WMA Technologies. NCAT is the prime contractor to determine WMA properties that influence short-term pavement performance. A draft final report is being prepared. Bukowski mentioned the deliverables from this project in his report. Randy West is the PI for the project.

9-49: Performance of WMA Technologies; Stage I – Moisture Susceptibility. This project is to investigate moisture variability and answer the question - do WMA technologies adversely affect

the moisture susceptibility of asphalt pavements. This project is being conducted by Texas Transportation Institute (TTI) and will end September, 2013. The final report will be published in early 2014. Amy Epps-Martin is the PI.

9-49A: Performance of WMA Technologies; Stage II – Long-Term Field Performance. Washington State University is the prime contractor and Haifang Wen is the PI. This project does not end until July, 2016. The purpose of this project is to identify the material and engineering properties of WMA pavements that are significant determinants of their long term field performance. In May 2013, a 24-month analysis report was reviewed by the panel.

9-52: Short-Term Laboratory Conditioning of Asphalt Mixtures. TTI is the prime contractor for this project. The focus of this project is with short-term aging of mixtures. Specifically, the objective is to develop procedures and associated criteria for short-term laboratory conditioning of mixtures that simulate plant mixing and processing to the point of loading in the trucks, and the initial period of field performance. The end data for this project is November 2014.

9-53: Properties of Foamed Asphalt for Warm Mix Asphalt Applications. TTI is also the prime contractor for this project and Dave Newcomb is the PI. The focus of this project is to look at the foamed WMA technology for developing standards for laboratory simulation on what is being done in the field. This project's completion date is December, 2014.

9-54: Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction. The prime contractor for this project is North Carolina State University, which is a more recent project. Its objective is to develop and validate a laboratory procedure to simulate long-term aging of asphalt mixtures for performance testing and prediction. The end date for this project is May 2016.

9-55: Recycled Asphalt Shingles in Asphalt Mixtures with Warm Mix Asphalt Technologies. NCAT is the prime contractor and this is a more recent project. The objective of this project is to develop a design and evaluation procedure for acceptable performance of asphalt mixtures produced with WMA technologies and RAS, with and without RAP, for project specific service conditions. The end date for this project is September 2016.

<u>Materials and Mix Design Projects:</u>
9-48: Field versus Laboratory Volumetric and Mechanical Properties. The contractor for this project is Louisiana Transportation Research Center (LTRC) and Louay Mohammad is the PI. The project is scheduled for completion in December, 2013. The purpose of this project is to determine sources of variability for volumetric and mechanical properties of dense-graded asphalt mixtures between laboratory mixed and compacted, plant mixed and laboratory compacted, and plant mixed and field compacted specimens.

<u>Asphalt Mixture Properties for MEPDG:</u>
9-44A: *Validating the HMA Endurance Limit: Laboratory Experiment and Algorithm Development*. The objective of the project was to validate the endurance limit and determine the mixture and pavement layer design features related to the endurance limit for bottom-up fatigue cracking of HMA. Bukowski reported all work has been completed and the final report is expected in late 2013.

FY 2014 Projects:
Bukowski briefly discussed the upcoming "9" and "1" series projects and reported panels for these projects are being formed.

- 9-56: Asphalt and Aggregate Correction Factors in Ignition Furnaces; $500,000. The RFP has been issued. Bukowski reported the panel on this met last month.
- 9-57: Experimental Design for Field Validation of Tests to Assess Cracking Resistance of Asphalt Mixtures; $250,000. The panel has yet to meet.
- 9-58: The Effects of Recycling Agents on Asphalt Mixtures with High RAS and RAP Binder Ratios; $1,500,000. The RFP has been issued.
- 1-54 Pavement Design Guide to Prevent Damage to Asphalt Pavement from Water Intrusion ($350,000). This is a field project to identify water damage prior to rehabilitation.
- 1-55 Porous Friction Course Design and Maintenance ($300,000). This is intended to be more than mixture design, but may also include construction and maintenance issues.

5. ALF Experiment – Selected Design/Proposed Tests—Jack Youtcheff (FHWA)

Presentation 1: *Update on ALF Reconstruction High RAP/RAS Study*

Summary of Presentation:
Jack Youtcheff acknowledged the partners for this FHWA and Eastern Federal Lands study: Virginia Paving, CAT (Alban), SITECH, Trimble, MWV and Maxim Equipment.

Youtcheff presented the experimental design for the study, which included factors of drum discharge temperature, Warm Mix Asphalt (WMA) technologies, and the recycle content. He identified the cells of the sampling matrix that will be included in the experiment. The two WMA technologies included in the experiment are foamed and chemical additive technologies. Youtcheff reported they were 60% complete as of September 2013.

Youtcheff overviewed some of the material properties and uniformity of the reconditioned base material that was placed. This a comparison of the responses as measured by the light weight deflectometer (LWD) and intelligent compaction (IC) rollers. Youtcheff stated there were differences but most sections were relatively uniform. He also summarized some of the volumetric properties of the RAP and RAS stockpile materials that were used in the experiment. The contractor used two RAP bins and sampling was done behind the paver. All material properties will be included in the construction report. Youtcheff also showed an illustration of the splitting the sample technique that was used for acceptance and for a Go/No-Go decision.

The next part of Youtcheff's report was on the amount of material sampled for different agencies associated with this study. Youtcheff stated anyone wanting some of these materials for other research projects to just request them for test sections that are still to be placed.

Youtcheff discussed the construction specifications. The plant temperature for different materials was 315°F. The next item presented was the mixture specifications. Youtcheff

showed the volumetric properties target values. Youtcheff noted the thickness was 9.4 inches. Youtcheff also reported on the variability and errors in terms of the different lanes.

ETG Comments, Questions, and Discussion:
John D'Angelo was concerned that if a study that does not include aging the mixtures, then will not see any difference between those mixtures in terms of performance. His opinion is that aging of the materials should have been included.

Ramon Bonaquist asked if cells are being repeated or replicated. Youtcheff replied that the plan is to do the testing at different points in time relative to durability. Bonaquist noted that the most dramatic effects you will see will be relative to cracking because each lane number has a different thickness. Bonaquist asked if replication and variability were considered between the different mixtures. Youtcheff replied the replicates will be tested first. John D'Angelo commented that with one test, you do not have replication in terms of the test. Youtcheff replied two samples will be tested in the short term and two will be aged. Youtcheff also noted both long-term sections will include accelerated aging.

ACTION ITEM #1: Jack Youtcheff will provide the ETG a copy of the ALF sampling and testing plan for comment.

6. Aggregate and Mixture Anisotropy—Dave Newcomb (Texas Transportation Institute)

Presentation Title: *Anisotropy in Asphalt Mixtures*

Summary of Presentation:
Dave Newcomb discussed the topic of anisotropy – need to start looking at anisotropy in more detail. Newcomb provided a white paper on anisotropy.

Newcomb discussed the use of elastic layer theory for pavement and mixture design. The assumption that properties are equal in all directions is of concern and probably not correct. He referenced that the Australians have used for some time; a program called CIRCLY, which includes anisotropy.

Newcomb identified the different types of anisotropy, which include: (1) inherent properties like aggregates that orient in the horizontal direction during field compaction and result in different horizontal and vertical properties; and (2) crack-induced properties or diagonal cracks that propagate in different directions and result in different damage densities and rates. In terms of aggregate orientation, he illustrated a test that is a scanner and results in images that show the aggregate orientation in a core.

Newcomb's asked how to reconcile differences between the field and laboratory compacted mixtures. There needs to be a link of isotropic material properties to anisotropic behavior. The calibration is imprecise and a factor is needed to correct for these differences. The anisotropy magnitude of vertical to horizontal deformation or modulus ratios can be from 1.2 to 2.0. In other words, there is a difference between the vertical and horizontal properties. The anisotropy

affects the strain calculations in the vertical and horizontal directions because of the modulus differences. He showed an example demonstrating these differences in the complex modulus or master curve.

Newcomb mentioned NCHRP project 9-49 and included some differences in test results of resilient and complex modulus for a mixture from Iowa. This illustration showed a difference between the resilient and complex modulus. These were differences between plant mixed-field compacted and plant mixed-laboratory compacted samples. He also included the same type of comparison for a mixture from Texas. An illustration was included in his presentation that demonstrated the impact of aggregate orientation on the results between laboratory and field compacted specimens. He summarized that anisotropy has an impact on material behavior and performance. The assumption of one size fits all correction factors leads to potentially large errors in performance estimates, and performance related tests will have more meaning if anisotropy is corrected accounted for.

Newcomb presented some ideas for research related to anisotropy: (1) identify the relationship of particle size and shape to anisotropy; (2) further characterize field versus laboratory aggregate orientation; (3) development of anisotropic based correction factors; and (4) development or adoption of anisotropic structural analysis.

ETG Comments, Questions, and Discussion

Frank Fee asked if there is a standard for measuring aggregate orientation. Newcomb replied, yes, but it can be improved. Fee asked if changes in the air void differences between samples (should be no aging issues) between field and lab was considered. Newcomb replied yes.

Geoff Rowe commented this is an interesting topic. His opinion is that most of the anisotropy has been treated or considered in the unbound aggregate layers and not in the HMA layer. He also mentioned the FAA is treating the HMA layer as anisotropic, and thought the University of Illinois was doing a study for the FAA on this topic. Rowe also noted he has a program that is based on anisotropic properties and does back-calculation of those anisotropic properties. The anisotropy is fixed and based on a rule or a correction factor related to the aggregate materials that are stress sensitive. He mentioned he has been using this program for 10+ years, but noted there are limitations.

Fee asked what are the plans for going forward on this topic. Newcomb answered that Bob Lytton is doing work for the ARC for characterizing damage using anisotropic behavior.

D'Angelo commented that the vertical and horizontal strains are not measured in the laboratory. Newcomb agreed this is difficult and a careful laboratory study is needed.

Matt Corrigan asked if the aggregate orientation test was something any laboratory technician could perform. Since only scanning the surface or face of the specimen, Newcomb believes it can be performed in many labs. Corrigan asked if TTI has examined internal aggregate orientation, and if that would cause differences and explain the difference between vertical and horizontal measurements. Newcomb replied the correlation has yet to be done.

Gerry Huber commented on the difference between the higher angle-gyratory compactors relative to the effect on modulus. He asked which set of samples had the lower modulus values – field or laboratory compacted because there appeared to be a difference between the Texas and Iowa cores. The differences caused in the mix response between the lower and higher gyratory angles and the results cause by different aggregate orientation were explained in the AAMAS project conducted in the 1980's.

Erv Dukatz asked about the elongated ratio for these mixtures. Newcomb did not know, but thought the amount of elongated particles would make a difference in terms of shape and size.

7. BBR Mix Creep and Moisture Testing—Mihai Marasteanu (University of Minnesota)

Mihai Marasteanu was not in attendance, so this presentation will be postponed until the next ETG meeting.

8. BBR Mix Creep and Moisture Testing—Jo Daniel (University of New Hampshire)

Presentation Title: *TPF-5(230) Evaluation of Plant-Produced High-Percentage RAP Mixtures in the Northeast*

Summary of Presentation:
Jo Daniel gave an overview of an ongoing study being conducted for the Northeast agencies under a pool fund study. Daniel acknowledged Frank Fee assistance and also the members of the team doing the work, including: University of New Hampshire, University of Massachusetts-Dartmouth, Rutgers University, and North Carolina State University. Daniel also acknowledged the current participants of the pool fund study, including: New Hampshire DOT as the lead agency, Maryland DOT, New Jersey DOT, New York DOT, Pennsylvania DOT, Rhode Island DOT, Virginia DOT, and FHWA.

Daniel reported there are three objectives: (1) evaluate the performance of plant-produced RAP mixes (in the lab and field) in terms of low temperature cracking, fatigue cracking, and moisture sensitivity; (2) provide a further understanding of the blending that occurs between RAP and virgin binder in plant-procedure mixes, and (3) refine fatigue failure criteria for RAP mixes that can be used in the Simplified Viscoelastic Continuum Damage (S-VECD) model. She also overviewed the test program that was being completed, and summarized the current status of the project. The project is divided into three phases:

- Phase I: all testing has been completed and the team is doing a detailed analysis on all sets of mixes for an interim report.
- Phase II is related to silo storage and includes mixes from New Hampshire and Virginia. The testing and data analysis are ongoing to determine S-VECD failure criteria.
- Phase III is a lab study to evaluate the effect of bumping binder grade and increasing virgin asphalt content. Daniel mentioned there is a paper that will be presented at AAPT this year which summarizes some of the findings and recommendations.

Daniel reported there will probably be future phases but those will be dependent on the results from Phase III. She also mentioned additional activities are being planned under this pool fund study. The next parts of her report were to overview and present some of the results from the study and each of the phases.

Phase I Mixtures: 2010 Production
Phase I mixes were produced in 2010. Daniel showed a tabulation of the mixes used in this phase, and included a comparison of test results for the Vermont and New Hampshire mixes. This is basically a tabulation of the production information of these mixes. She did not show results for all of the Virginia mixes because they have been included in other documentation. Daniel started with the Vermont data and showed a comparison of test results for the different mixtures. The properties presented included dynamic modulus master curves, s-VECD fatigue (relationship between the damage S value and pseudo secant modulus C value, and flexural fatigue.

In explaining the New Hampshire data, Daniel mentioned this stimulated the storage silo study because of observed differences between the laboratory and plant compacted specimens. She reported these differences were found to be related to the time in silo storage, so the study was initiated. Daniel included the same comparisons of test results that were presented for the Vermont mixtures.

The Vermont data did not have much of an impact of the RAP on performance for the PG 64-28 mix probably because of the softer RAP and higher total amount of asphalt. For the New Hampshire data, Daniel reported there was an effect at higher RAP contents probably because of the harder RAP and lower total amount of asphalt. The uncontrolled plant production variables make it difficult to isolate the causes of different performances.

Phase II Mixtures: 2011 Production
Phase II mixes were all produced in 2011. Some of these mixtures were used to answer the silo storage question from Phase I. These were plant mixed, plant compacted samples. The silo storage study included the New York mixtures, while the New Hampshire and Virginia mixtures include varying RAP percentages. Daniel acknowledged the assistance of Gerry Reinke in performing the binder recovery, which also included complex binder modulus testing. Daniel summarized the results from the binder testing. The RAP mixtures/binders are stiffening with storage time, while virgin mixtures are “softening” with time. These results were unexpected. To address this unexpected finding, additional testing of the 0% RAP, 0 hours and 0% RAP, 7.5 hours. binders was initiated. While the G* values do “close the gap” with regard to the 0% RAP, 0 hours mixture, the 7.5 hours. mixture was “softer”. This observation resulted in concerns regarding production practices of the discharge temperatures, silo state, and actual storage times which are being addressed.

The mix testing included dynamic modulus, fatigue testing, and TSRST. Daniel provided comparisons which included lab versus plant compacted dynamic modulus RAP comparison. Daniel reported the lab compacted specimens are stiffer because they were reheated (which was the only difference), but the difference was found to decrease the longer the mix was held in the silo.

Daniel presented a summary of the TSRST results related to the 25% RAP silo storage. In summary, the binder stiffened with increasing storage time. After reheating, the mixtures were stiffer than the plant compacted mixtures but the difference decreases with storage time. Daniel reported the results are directly opposite of what they expected related to the storage times. The explanation is the asphalt at the bottom of the tank was a softer asphalt, and that could explain the results.

Phase III Testing Plan:
Daniel overviewed the phase III testing plan in terms of a tabulation of the physical properties of the mixes to be tested as related to the RAP content, asphalt content, and different asphalt graded binders. She mentioned the results would be available next spring and reported they plan to redo the storage silo study. The additional phases of the testing plan include: studies on other mixtures that are based on the results from Phase III, studies on plant produced mixes based on results from Phase III, and a combination of WMA technologies and high RAP contents.

ETG Comments, Questions, and Discussion:
John D'Angelo asked about fracture testing. Daniel replied they will be doing beam fracture testing, flexural fatigue, and others.

Kevin Hall noted the term performance is being used here as related to laboratory test results which is not actual field performance. He asked if field performance data will be available for comparisons. Daniel replied for the New Hampshire mixes they do have data but not for the Vermont mixes. The New York mixes are all base mixtures.

Randy West asked about the software being used in the study. Daniel noted the s-VCED test software is being used and redefining the failure criteria.

Jim Musselman asked about the absorption of the aggregates used in the study. Daniel replied they do have some volumetric data, but not for all mixes. They will have that data in the future.

Frank Fee adjourned the meeting for the day at 4:00 PM.

DAY 2: Thursday, September 19, 2013

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

9. AMPT Test Development Task Force

Presentation #1: *AMPT Flow Number Task Force; Development and Implementation*—Jeff Withee (FHWA)

Summary of Presentation:
Jeff Withee stated his report with an overview of NCHRP project 9-29 regarding equipment development, including: AMPT development, the ruggedness study, equipment standards, test

standards, and the inter-lab study. The objective of pooled fund TPF-5(178) is to enhance implementation of the AMPT by: (1) nationally procuring the AMPT equipment, (2) providing training for technicians and engineers, and (3) supporting the national implementation effort. Withee summarized the status of obtaining equipment to agencies. A total of 26 AMPT devices have been procured and delivered. As of 2013, a final 2 AMPTs are on order.

Withee acknowledged the training effort through NHI course 131118. This course provides classroom instruction, as well as hands-on experience. Withee reported one of the courses has been video tapped. That video is divided by modules to ease in its use.

Withee identified the implementation goals of the pool fund study: (1) advance state of the practice with the AMPT, (2) share implementation plans and experiences, (3) identify and address implementation hurtles, (4) conduct coordinated studies on pooled results, and (5) build on user testing proficiency. He also noted the user base for the AMPT is diversified. Withee identified support groups supporting this implementation activity, including; the Asphalt Mixture ETG, NCAT-FHWA Cooperative Agreement, Asphalt Institute-FHWA Cooperative Agreement, SEAUPG AMPT User Group, and NEAUPG AMPT User Group.

The next part of Withee's report was related to the AASHTO Standards, focusing on some of the changes that have been made. The two standards reviewed were TP 79-13, Modulus and Flow Number Testing, and PP 61-13 relative to the AMPT. The items changed for TP 79-13 included the precision statements, the operating temperatures, and the Appendix X2 on the flow number criteria. The items changed for PP 61-13 relative to the master curve development has to do with the number of specimens based on the precision included in TP 79.

Withee summarized the AMPT workshops that have been completed and those that have been planned. Some of workshop topics include; the background, equipment basics, user needs and roundtable discussions. He then presented some of the feedback received from the participants of the more recent workshops. Feedback from the workshop included some of the benefits and concerns with the AMPT testing. Many of the concerns have been resolved. As part of this discussion, Withee referred to the NCAT report on implementing the AMPT for use with the MEPDG—NCAT Report #13-04. He also noted the FHWA Tech Brief, FHWA-HIF-13-060. Both of these documents summarize the data requirements and identify successful practices.

The Inter-laboratory Study (ILS) was overviewed. The ILS purpose is to compare and build testing proficiency, 22 labs are participating in the ITLS. The results from the ILS will be compared to the NCHRP 9-29 ILS precision results. Withee mentioned the specimen preparation study, and noted Ramon Bonaquist will report on this topic later in the meeting. Withee reported the silicone friction reducer is required for flow number testing but not dynamic modulus testing. There is a study underway on the silicone friction reducers to look at two methods related to variability of the flow number. The study parameters include the flow number testing procedure, silicone grease types, and application rates.

In terms of standardized flow number testing, Withee summarized previous reports and referred to the Task Force under this ETG to compare the different methods. He also referred to the review panel that looked at four protocols. The presentation at the last meeting provided a

recommendation on the one to move forward. This was the iRLPD based on a draft provisional practice. Geary reported the iRLPD is one six draft teat methods being balloted by the Tech Section. Withee reviewed the details of the iRLPD method. Withee summarized some of the ETG comments and concerns. These included: only one lab has to date performed this test, there was no field validation, the test temperature and how to define LTPPBind or degree days, the repeatability or precision statement is not included in the standard, and there were questions on where the criteria for the MSR evaluation of 500 cycles came from. He mentioned most of these could be included as ruggedness factors for the test method.

Withee identified some of the current concerns related to data output of the Francken model fit parameters and how equipment manufacturers will provide these. Haleh Azari mentioned how the MSR value will be provided. She reported they have been working with Interlaken to determine the fitting model parameters through regression and stated the Francken model does not work very well. The MSR will be determined by a fitting regression model. Withee asked if that was included in the version provided to Geary for ballot. Azari noted this is part of the software which the users do not have to purchase, so it is not included in the ballot. Withee noted we need to be clear about the version going forward. Fee noted a version going forward needs to be one that can be used. Bukowski replied there is a version the ETG is working on and but cannot prevent everyone from doing something different. Withee reported the ETG still has not agreed on a final version. The version that was submitted to the ETG by Azari included 3 levels of evaluation using a single temperature and load, but there is a level 2 that uses multiple temperatures and loads to evaluate the mix at any combination at pressure and temperature, and level 3 which looks at the mix from an aging standpoint—both prior to and after aging. The ETG Task Force suggested only level 1 is evaluated. Strain rate and Francken model were recommended for use by the Task Force.

Bukowski asked Withee if there would be a recommendation on how to move forward. He asked Withee to discuss how we go forward because if the Tech Section does ballot this item, there will be comments and the ETG will need to respond to those comments.

Bonaquist mentioned how the minimum strain rate was used and gave the reason why the Francken model was selected for used in previous test standards. There is no specification or guidance provided on how the MSR is determined. He mentioned to Azari that if you change the way the value is determined that changes everything done previously, which is part of the current specification value. So we need to be careful on which version becomes an AASHTO standard. More importantly, the pooled fund equipment is based on the early version and if you change test parameters the question becomes what are the effects to the equipment.

Currently there is an AASHTO standard and criteria for flow number. If duplicative test protocols are developed that do the same thing, we are not helping State agencies/users. Azari stated there is a flow number test, but believes everyone is doing that test differently. She explained the different levels in terms of comparing the results of the master curve for a mixture, which was related to levels 2, 3 and 1 in terms of comparing the results between the different levels. She reported for the iRLPD the software is ready to use.

Withee noted a final report is being prepared on comparing the various methods. Randy West at NCAT will perform additional testing under the NCAT cooperative agreement on the iRLPD method. Matt Corrigan noted recommendations on flow number criteria were provided years ago based on different performance parameters, which were moved forward to AASHTO.

Geary asked about a report that compares the flow number and the iRLPD. Bukowski noted the Task Force worked on a report, but Withee clarified there was not anything yet on the more recent concerns with the iRLPD. Bonaquist discussed the procedure that was used to select the procedure and make decisions through the ETG. The Task Force recommended level 1 in the iRLPD.

Bukowski summarized they are now going to the next step and expand the database for possibly replacing the current flow number standard with the iRLPD. D'Angelo commented to Azari that you have some mixes that seem to work okay but you do not have actual performance observations. To do the final evaluation, you need actual rut depth measurements and results from other lab tests/studies. These could include the NCAT test track, Hamburg and other torture tests to determine and compare different rates of rutting. His opinion is that adoption of this test is premature and work needs to be done before adopting the iRLPD.

Withee continued with his report as related to the fatigue testing study which he overviewed in terms of the tests and factors being considered in the study. The next part of the report was air void uniformity. This item related to PP 60—Note 6 and Appendix X2. Withee identified the webinar held and reported there was a lot of discussion on the air void uniformity. He referred to the Appendix X2 and Note 6 in the PP 60 and mentioned there is no guidance on the frequency to be used. He recommended every lab should do Appendix X2 prior to ILS participation. Withee asked for any comment from the ETG on this issue.

Nam reported the variability in the AMPT ILS was similar to what Bonaquist reported under NCHRP 9-29. Bonaquist noted in the original ILS, labs used a specific height of 129 mm.

The last part of Withee's report was on future work. This includes additional regional user groups.

ACTION ITEM #2: Ramon Bonaquist and Jeff Withee, as part of the flow number task force, will report on the progress of the iRLPD procedure.

ACTION ITEM #3: Jeff Withee and Tran Nam will report on the results from the AMPT ILS at the next ETG meeting.

Presentation #2: *AMPT Specimen Fabrication and Ruggedness*—Ramon Bonaquist (Advanced Asphalt Technology) and Phil Blankenship (Asphalt Institute)

Summary of Presentation:
Ramon Bonaquist stated the report will focus on two items: the outcome from further analyses of the NCHRP 9-29 ILS and an overview of the recommended study. Under the first part he will

discuss topics related to the results of the ILS NCHRP 9-29 study and provide background information on how to eliminate selected parameters.

Further Analyses of NCHRP 9-20 ILS
Bonaquist started with the first ILS under NCHRP 9-29 and referred to the parameters included in that ILS: three materials and 8 laboratories, cores were fabricated in a single lab, and specimens prepared from loose mix. Bonaquist reported they did the ILS twice: (1) all cores were fabricated in AAT's lab, and (2) loose mix was sent to each lab for compacting the test specimens. The goal was to evaluate whether the AMPT or specimen fabrication procedure could be improved.

Bonaquist summarized the dynamic modulus data for within lab variability/repeatability. The data were presented in a graph comparing the average dynamic modulus with the coefficient of variability within labs. In summary the softer the material, the less repeatable the results, which is typical and an expected result.

Bonaquist summarized the dynamic modulus data between lab variability/reproducibility. He reported the test results measured on test specimens made from individual labs compacting loose mix had significantly higher variability as compared to one lab making the mix, as expected. Bonaquist compared the repeatability and reproducibility values and identified two labs that exhibited drift in the LVDTs measurements. Bonaquist noted the results indicate that specimen fabrication is the issue and not the AMPT equipment.

Bonaquist included an evaluation of the average dynamic modulus difference measured on loose mix. With the exception of two labs the difference is always high for all mixes or always low for all mixes. Kevin Hall asked if this was prepared loose mix or cores. Bonaquist replied it is loose mix.

Bonaquist reported Don Christiansen was concerned about the effect of storage time, so they went evaluated the impact storage time on the test results. The results suggest there is an increase in stiffness with storage time, but the increase in really small being about 10% increase over 0 to 100 days. Another question was whether storage time caused the difference between the labs. In the evaluation the average difference was age adjusted, but it was concluded that different ages did not cause the difference between labs.

The second item evaluated was the type of gyratory compactor. In some cases, different labs had the same compactor. However, could not determine from this data that compactor type was causing the difference between labs. Air voids was another parameter evaluated. Bonaquist does not believe that air void differences are causing the difference in modulus values between labs. Another question was whether the ovens were causing the difference. The next part of the presentation overviewed the planned oven uniformity and ruggedness studies.

Two Part Study: Conditioning Oven Uniformity Study and Ruggedness Study
Bonaquist briefly mentioned the items that were being evaluated under the conditioning oven uniformity study, and provided details on the ruggedness study. He reviewed the assumptions used in planning the ruggedness study. Bonaquist has prepared a document for the Asphalt

Institute entitled "Ruggedness Study for the Asphalt Mixture Performance Tester" which had been distributed to the ETG. He explained the different parameters included in the roughness matrix.

Bonaquist explained the rationale behind using the entire core in going forward for performance testing because the variability of the test becomes very important. Bonaquist also reported, modulus has the lowest variability so that is why they have been concentrating on dynamic modulus.

John D'Angelo noted that he was involved in some of the original discussion on using slab prepared specimens. He was initially not in favor of using slab specimens, but significant improvements have been made on that process. We have to core gyratory specimens anyway, so why not core out of a slab versus a gyratory specimen. This would reduce variability. Bonaquist agreed. Gerald Reinke believes the number of gyrations to achieve a certain air void level tells you something about the mix. Mathy Construction has done a lot in terms of getting the correct height with varying gyrations and that is a good predictor of mixture behavior.

Fee noted in the ruggedness study, specimens are prepared at 7% voids and at a fixed height. His asked how you compact those specimens and does PP60 cover this procedure. How specimens are compacted is very important, and need to add the number of gyrations as a data element to be collected. Bonaquist agreed with that suggestion and is part of the plan. Bonaquist noted compacting specimens to different height will need significantly different gyrations.

It was noted that rodding and non-rodding will make a difference and asked if this was considered. Bonaquist agreed with that point and for the 190 mm it will be hard not to rod the specimens.

Randy West asked about the time between testing for aging versus storage. Bonaquist stated that factor is not considered in the ruggedness test plan. Bonaquist pointed out storage time has been looked at in previous studies. What he is evaluating was the average of all mixes, so he believes it is an insignificant parameter and just plans to require testing at a specific some point in time.

Ali Mohseni asked how dry the specimens are during testing after coring. Bonaquist was uncertain and asked if this is something that needs to be in the specimen measurements criteria as part of the ruggedness test plan.

Matt Corrigan requested some of the limits be analyzed to make recommendations on not storing the specimens longer than a certain time period. Bonaquist will consider the two recommendations – storage time and moisture.

In summary, this part of the ruggedness study has yet to start and will consider all the ETG input. Storage time needs some limits, moisture is included but is unsure how to handle that, as well as how do we handle layering the mix for tall specimens.

The next presentation was to report on the effect of some specimen fabrication variables on dynamic modulus.

Presentation #3: *Effect of Specimen Preparation Variables on AMPT Dynamic Modulus*
Ramon Bonaquist (Advanced Asphalt Technology) and Phil Blankenship (Asphalt Institute)

Blankenship acknowledged his graduate student, Alireza Zeinali, efforts in this of this work. He also acknowledged this is a joint effort between the Asphalt Institute and Advanced Asphalt Technologies.

Summary of Presentation:
Blankenship noted the items related to cutting and bagging samples and agreed all of the variables make a difference. This report focuses on the effect of the ovens.

Phase I focused on sample conditioning by examining the ovens. He provided background information on this topic related to the performance testing and how all of these variables are important. Blankenship overviewed two types of ovens, Grieve, Blue-M, and Quincy included in the study. They evaluated the ovens in terms of uniformity of temperatures prior to this study. The Phase I evaluation was designed to answer the following questions:

- How different is the temperature distribution in various forced-draft ovens?
- Does the over quality make any difference in conditioning of the samples?
- Does frequent opening and closing of the oven door affect the conditioning of the loose mixture?

Blankenship included an illustration of the temperature probe location in the oven that was used and the temperature readings at different points in the oven. He identified the different evaluations that were completed to answer specific questions.

- Evaluation 1: Empty oven temperature, started with the larger oven - Grieve. With the Blue-M oven a small hole in the oven was discovered that caused an outlier in one of their data points. Blankenship explained how some of the forced draft ovens operate. He noted the Quincy is typically used to heat aggregate and as an extra or backup oven. Data shows the top and bottom of this oven have different temperatures. The issue is if this makes a difference in the mixture's conditioning and final response?
- Evaluation 2: Temperature of pans used for loose mix in terms of comparing air and mix temperatures. Blankenship noted there is a variation of plus or minus 10°C. Again does this have an effect.
- Evaluation 3: Opening and closing doors of the oven. Blankenship showed the results or temperature profiles from opening and closing the doors by the data collected. They have changed their procedures regarding opening and closing the doors because it was making a significant.

In conclusion, Blankenship showed a summary of mix to air temperature. He summarized the findings from this study:

- Oven type had a significant effect on the conditioning temperatures of the mix.

- When the oven door was kept closed, the mix temperature varied by 10.8°C at different points of the Quincy oven. Opening and closing the oven door every 30 minutes significantly reduced the average conditioning temperature of the mixes. Stirring the mix every hour lowered the mix conditioning temperature in the Quincy oven by up to 4.5°C.

Blankenship overviewed the Phase II testing plan. The three questions to be answered by data collected within the experiment were: (1) what specimen preparation variables have a significant effect on AMPT test results; (2) what is the acceptable range for the significant factors; and (3) what are the recommendations to minimize the AMPT test variability? Thirteen variables had been identified to answer these three questions. The focus here is the AMPT dynamic modulus value. The goal of Phase II is to determine the allowable tolerances of factors based on allowable dynamic modulus error.

ETG Comments, Questions, and Discussion:
Frank Fee mentioned a TRB paper submitted this year under committee AFK50 that is related to this activity. Blankenship was aware of the TRB paper and gave an overview of the study documented in the TRB paper—bagging the samples and leaving them for an extended number of days related to absorption. Reinke asked if bagging samples was significant. Blankenship replied no. Gerry Huber asked for an explanation of sample bagging. Blankenship replied, it is putting the sample in a Ziploc bag for an extended period of time prior to testing. Cut versus uncut specimens being stored made a difference, but bag or un-bagged specimens did not make a difference.

ACTION ITEM #4: Ramon Bonaquist, as part of the TP 60 sample preparation Task Force, will report at the next meeting on the sample variability study.

10. Task Force Review Update on T 321 (Beam Fatigue)—Geoff Rowe (Abatech)

Presentation Title: *Update Review—The Bending Beam Fatigue Test; Improvements to Test Procedure Definition and Analysis Methods*

Summary of Presentation:
Geoff Rowe reported that the ASTM and AASHTO test procedures will not be in alignment when AASHTO T 321 is published in 2014. That standard has been balloted and passed by the SoM. One focus of this effort is now on making these two consistent. Rowe acknowledged the Task Force members. The objective of the Task Force is to improve repeatability within laboratory of the fatigue test and reproducibility between laboratories. Rowe noted there are three critical elements regarding critical aspects of the test. These include test specimens preparation, testing procedures, and the analysis of the test data. Current efforts have addressed the analysis issues, and were provided to the SoM.

The next phase of this process includes evaluating the loading or wave form applied during the test (ASTM needs to be consistent with AASHTO) and the equipment definition improvements including input from the manufacturers.

- ASTM will change to a sine loading to make it consistent with AASHTO and generally acceptable practice by users.
- Current equipment is different to that which was used previously when the standard was initially written. Rowe explained some of the differences in equipment. These evolving differences need to be addressed.
- Issues related to loading include how is the load controlled and maintained by different manufacturers, and the reference points. Another issue is whether drift is allowed, and if so, how much.
- Other changes are more related to the wording used in the standards, such as: HMA and WMA. Geary noted some of the wording changes are part of AASHTO's review process and being revised, at least relative to HMA and WMA. Other revisions include tightening tolerances and removing outdated references.

In closing, Rowe wants the Task Force to meet and deal with some of these editorial items prior to the end of this year. Another part of the work plan is to review the differences for test control and develop a future plan of action. Rowe plans to report progress to the ETG at the next meeting. He also asked for others to become involved in this Task Force.

ETG Comments, Questions, and Discussion:
Geary also noted she needs clarifications for some of these issues and will meet with Rowe to clarify these items and ensure this is ready for the SoM ballot.

ACTION ITEM #5: Geoff Rowe will report on additional input for the T 321 changes for discussion and referral to SoM Tech Section 2d.

11. NCHRP Project 9-43 Follow-Up Information on Absorptive Aggregates—Ray Bonaquist (AAT)

Presentation Title: *Update on FHWA Expansion of NCHRP 9-43 Mix Design Study to Higher Absorptive Mixtures.*

Summary of Presentation:
Bonaquist reported the primary product from the NCHRP project 9-43 was the appendix for R35 for designing WMA mixes. He also noted it was based on the mix design study as related to differences in volumetric and engineering properties between HMA and WMA that were designed in accordance with the existing standard's appendix. The NCHRP project also included a field study that identified differences in engineering and volumetric properties between HMA and WMA mixes.

Bonaquist showed the original mix design study experiment and sampling matrix. The factorial was originally designed to include both high and low absorption aggregates, but was not completed. Only some of the mixes contained RAP and generally included low absorptive aggregates. Bonaquist reported that a paired t-test was used to analyze the test results regarding differences between WMA and HMA mixes. The aggregates finally included in the initial study had asphalt binder absorption from 0.5 to 1.0 percent. The NCHRP team originally thought that

this was acceptable, but Matt Corrigan subsequently asked that higher absorption aggregates be added to the experiment. Florida was the only agency to provide these higher absorption aggregates. The aggregate from Florida had absorption of 2.0 %.

Bonaquist showed the expanded mix design study. He reported FHWA loaned their laboratory foaming device for use on this study. Bonaquist showed the PA, VA, and FL aggregates used to vary the absorption in the tested mixes. He also mentioned the cells highlighted were to identify the mixtures prepared using the accufoamer. He reported the volumetric properties for the foamed mixes look about the same as for the other mixes.

Bonaquist reported the design binder content increased significantly for the higher absorption mixes. The binder absorption also increased so this is also a consideration. He noted they will revise the report to include these higher absorption mixes.

ETG Comments, Questions, and Discussion

Shane Buchanan asked what were the differences in absorption between HMA and WMA. Bonaquist replied there is about 0.25% less absorption in the WMA mixes as compared to HMA. Also, the WMA appears to be a more compact or a tighter mix than for the HMA for the higher absorptive mixes.

Gerald Reinke asked if reducing the temperature would the change the results. Bonaquist replied yes, and explained the reason behind selecting the temperatures for the foaming process. He stated that initially they reported there was no difference in design binder content, but this appears not always true for these higher absorption aggregates. Also, it appears the particles for the WMA are packing together better than for the HMA.

Fee asked if aging was the same between the two types of aggregates and mixtures. Bonaquist replied yes.

Erv Dukatz noted normally see a typical drop in asphalt content of about 0.2% and that drop is inversely proportional to aggregate absorption. With a harder aggregate that drop is more. Bonaquist asked Dukatz if they have used the foam process. Dukatz replied that the only foaming technology they use is for the cold in place process.

Bonaquist noted that most users appear comfortable designing WMA to meet HMA volumetric criteria. If the same materials are designed as HMA and then with WMA it appears may be able to meet the minimum criteria with lower binder content. There is some type of lubrication that allows the aggregates to compact closer for WMA.

Newcomb noted that with time the absorption between WMA and HMA mixes may even out over time. Randy West agreed, the absorption at time of construction was in the range of 0.1% more absorption for HMA than for WMA, but over time that difference goes away. A remaining issue remains, if designing WMA in accordance with HMA and you obtain a lower binder content is that something that is acceptable. Fee commented that is an issue, we are working with volumetric designs but we should be basing our decision on performance tests.

Jim Musselman replied that they have evaluated a lot of data and they use the drop-in approach. They have not had to revise the approach or change the binder content. At this point he does not see a reason not to use the drop-in approach. Using the drop-in approach, the design asphalt content is determined from HMA design approach but produced as a WMA.

Shane Buchanan asked what was the temperature of production. Bonaquist replied 270°F. Buchanan noted there is no single temperature during construction. Bonaquist agreed with that comment and noted with different temperatures, the design binder content would change for different temperatures especially if we departed from the drop-in approach.

ACTION ITEM #6: Ramon Bonaquist will report at the next meeting on the results from the NCHRP 9-43 follow-up study with respect to absorptive aggregates.

12. Report from the Task Force on WMA—Matt Corrigan (FHWA)

Presentation Title: *Warm Mix Asphalt Update*

Summary of Presentation:
Matt Corrigan reminded the ETG members the WMA group was sunset, but they are still keeping track of on-going work under this Task Force. He noted Randy West is finalizing the 9-47A report and it will be reviewed by NCHRP. After the report has been approved by NCHRP, the Task Force will review to determine and identify recommendations relative to WMA mix design.

WMA Update and Related Items/Topics
Corrigan summarized the NCHRP projects that have been funded including those that have been completed. Corrigan reported the NCHRP 9-58 project is the most current that the WMA TWG reviewed before it was sunset. The total value of NCHRP WMA research is now $7.5M.

Corrigan focused on the NCHRP 9-58 project. The objectives of the project are to evaluate the effectiveness of recycling agents in HMA and WMA mixes with high RAS, RAP, or combined RAS/RAP binder ratios through a coordinated lab and field experiment. It is intended to also propose revisions to several relevant AASHTO specifications and test methods and develop training and workshop materials.

Corrigan then commented on NCHRP 9-43 project relative to high absorption WMA mixes, which had been previously discussed today by Bonaquist.

Corrigan identified NAPA's Information Series #138 document on the annual asphalt pavement industry survey on RAP, RAS, and WMA usage from 2009 to 2011. He reported there are plans to continue this survey. Newcomb asked about the percentage of WMA mix used throughout the U.S. The total of WMA continues to increase. Corrigan attributed the success of WMA to the partnership with industry and the interest of industry to understand the technologies.

Corrigan reported most of the WMA usage is with the foaming technology. He clarified these numbers are based on the membership within NAPA. Corrigan reported NAPA will continue to survey the market to see what WMA technologies are being used. He also reported RAP as well as RAS usage in HMA/WMA continues to increase. Corrigan noted RAS use is more regionally dependent.

Corrigan noted the University of Iowa's Laboratory for Advanced Construction Technologies hosted a conference entitled "Global WMA Workshop" which will be held at the end of October in Coralville, Iowa. The purpose of the workshop is to bring government employees, contractors, and manufacturers together to discuss the past and future of WMA technologies and to serve as a platform to share the pros and cons of the WMA technologies.

As the NCHRP reports are completed, there will be a need to review the results and recommendations and to establish a plan on how they get implemented. Corrigan also mentioned Caltrans had an open house and experimental section placed. However, they had some significant problems with some of the new WMA technologies. Their forensic team is doing an analysis and possible report later this year.

Jim Musselman has not heard of any failure or premature distress and asked if anyone has knowledge of what may have caused the problems. Corrigan noted that most premature failures or distress have been attributed to misapplication of the WMA technology. If the technology was used correctly, he has not heard of any early distress or premature failures. One misapplication was with a chemical modifier used in at an incorrect rate.

Bonaquist mentioned he is a member of the LTPP materials ETG. He announced LTPP is planning a WMA experiment under the SPS experiment which should be of interest to this ETG. He also noted there are some members of the ETG on the LTPP committee. Corrigan asked if any sections have been built. Bonaquist replied no, but reported Nichols Engineering is developing the plan and sampling matrix for the experiment. He reported they are currently in the planning stage and identifying what tests should be done, what samples should be collected and how much should be sampled, and what structural sections get built in what environment. LTPP will be mainly collecting performance data, but possibly not collecting sufficient materials for performance testing. Bonaquist reported the WMA experimental plans have yet to be delivered to LTPP. Corrigan asked if there are plans to collect samples of the component materials. Bonaquist replied yes, but again, possibly not sufficient amounts to conduct a lot of performance testing. He believes the supply of materials being stored in the MRL will be depleted in a short time period for performance testing. Bonaquist recommended the ETG develop a strategy related to this issue.

Jim Musselman noted the organic additives have been dropped from the LTPP experiment. For each LTPP WMA project site/location, there will be a HMA control section and two test sections. One will be for the foaming technology and the second for chemical additives. Corrigan asked what mix design method will be used. Bonaquist replied that level of detail has yet to be discussed. Bonaquist asked Musselman about the decision for eliminating the organic additives but leaving the chemical additives in the experimental plan. Bonaquist believes the chemical and organic uses are about the same. Musselman believed the decision was related to

the budget. Bonaquist and Musselman agreed a strategy is needed on what fundamental properties or performance tests need to be done and identify how these efforts can be coordinated in the LTPP WMA experiment.

Bonaquist noted there will be time between the report and building the sections to review the experimental plan. Eric Weaver has asked the LTPP about coordination with this ETG and others and how that coordination could be accomplished. Since Bonaquist is on the LTPP ETG and is also on the Asphalt Mix ETG, it is perceived by the LTPP group that the coordination already exists. Weaver recommended, as a minimum, information should be exchanged with the Asphalt Mix ETG. Weaver will also coordinate with LTPP and keep the Mixture ETG advised on this activity.

ACTION ITEM #7: Matthew Corrigan will provide an update on the WMA Task Force and the LTPP planned experiment for WMA mixtures. Ramon Bonaquist will assist Corrigan and provide additional information on the results from the WMA LTPP ETG and experiment.

Hamburg Wheel-Track Test Update

Corrigan reported that a group has been created in the Tech Section 2c to address concerns from the balloting in the SoM for AASHTO T 324 (Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt). Members of this group consist of agencies that have Hamburg requirements in their specifications; some of these agencies have many years of use with the Hamburg device. The members include individuals from FHWA, Colorado, Illinois, Louisiana, Montana, Oregon, Pennsylvania, Texas, Utah, and Wyoming.

Corrigan summarized some of the actions and recommendations from the 2c group relative to the standard, and expects the standard to move forward in the AASHTO 2014 publication. He distributed copies of the marked-up version of this standard to the ETG. The following issues have yet to be resolved.

- Impact of requirements in current standard that may limit other manufacturers producing the device. Corrigan reported there are specific requirements in the current standard that could result in limiting the number of manufacturers. No resolution was reached because there was objection from the long term users on what would be the impact if we tightened or loosened the requirements on the equipment. Areas of concern are; having free flowing water on the specimen faces, whether trays need to be stainless steel, etc.

- No guidance is provided on placement of test specimens that butt heads. It was agreed that improvements/guidance is needed for a standardized procedure to fabricate the "Figure eight" test specimen. Corrigan reviewed some of the different issues with the specimen preparation for this type of test setup. He reported a lot of the variability with this procedure and noted it probably has to do with this sample configuration. He acknowledged there is need for improvement to reduce variability. However, no consensus has yet been identified on how to do this.

- Another unresolved issue is related to standardized equipment output in terms of the procedure used to determine the stripping inflection point. This issue was discussed but not resolved.

Corrigan briefly mentioned two new items. The first is the need to prepare a research needs statement for submittal to either NCHRP 20-7 or NCHRP 09 series to evaluate the impact of equipment requirements/improvements on the test results. The second is the need to provide recommendations to standardize the specimen fabrication procedure. Corrigan noted he is leading activities. He acknowledged that he has already solicited individuals to review the solicitation (these include Tim Ramirez and Mark McDaniels).

ETG Comments, Questions, and Discussion:
Louay Mohammad noted that they found the speed of the tester wheels needs to be constant in the specimen area being evaluated because it is important to get repeatable results. Corrigan noted that issue has been brought up in previous discussions. Haleh Azari reported she is finishing the report on the Hamburg device regarding repeatability using existing sample preparation criteria.

Corrigan asked for volunteers to assist in this effort. Additional individuals for this activity include Walaa Mogawer, Louay Mohammad, Charlie Pan (for Reid Kaiser), Gerald Reinke, Kevin Hall, Dave Newcomb, Randy West, Jason Lema, and Tim Ramirez.

13. Report Task Group RAP/RAS—Lee Gallivan (FHWA)

Presentation Title: *Update on FHWA Task Force Report on RAP/RAS*

Summary of Presentation:
Lee Gallivan acknowledged members of the RAP Task Force, which include: Jim Musselman, Ron Sines, Gerry Huber, John D'Angelo, Audrey Copeland, Randy West, and Richard Willis. He started his report by mentioning many activities have been completed and gave an update on the RAS activities.

Two RAS standards were developed but needed additional review. The Task Force presented their activities and identified areas that needed additional work and improvements on these two standards. The RAP Task Force provided the Mix ETG their final recommendations for PP 53 and MP 15 in May and Georgene Geary sent the changes to the Tec Section 2d for SoM ballot.
It was decided these would be new, re-written provisional standards.

These technical comments for MP 15 and PP 53 were:

- Under MP 15, section 5.1, for reclaimed asphalt shingles shall be processed so that 100% passes the 12.5 mm sieve and 95% percent passes the 9.5 mm sieve. The comments from the Tech Section ballot were that they wanted 100% passing the 9.5 mm sieve. Gallivan reported some of the long time user agencies wanted the finer requirement but there are too few doing that right now, so the 95% is being balloted.

- Under PP 53, Section 7.1, Gallivan noted the shingle asphalt availability factor is assumed to be 0.85 for this practice. However, some agencies have elected to use factors ranging from 0.7 to 1.0. Additional research is required to define the interaction and amount of asphalt binder from shingles. The Tech Section change was to delete 0.85 and replace it with the range of 0.7 to 1.0. D'Angelo commented that was the same as discussed by the ETG.

- Under PP 53, section 7.3, Table 1, the comment was that there needs to be some blending chart guidance to be included as part of table 1 since blending charts may not be able to be used in the traditional sense.

- Gallivan reminded the ETG, the RAP Task Force identified research needs statements (RNS) that were needed for developing and revising RAS standards. One of these RNS was related to the availability factor and binder grade adjustment. He noted they plan to work with the Tech Section in developing a future RNS to resolve some of these and other issues.

The next part of Gallivan's report was on NCHRP 9-46. He reported NCAT has finished 9-46 and published as NCHRP Report #752. Gallivan noted there are a lot of proposed changes but listed the ones considered more important, such as elimination of percent mass for RAP, changes to M 323 and R 35. Most of the conclusions could be grouped into 6 main areas.

1. High RAP contents should be defined more clearly.
2. RAP stockpiles should be sampled for QC and include sampling and testing protocols.
3. Current design standards for high RAP mixes are satisfactory.
4. New sampling and testing table are included for QC.
5. The grade of mix virgin binder needs to be determined based on the true grade of the RAP binder using the ratio of the RAP binder divided by total binder and the high and low critical temperatures.
6. Moisture damage testing needs to be performed for all RAP mixes.

West added other items that were in the report conclusions. The first being the method of RAP bulk specific gravity determination and the determination of the virgin binder, which is a slight change in that it should be an equation rather than a chart. The other item is the NCHRP panel asked for performance testing of the mix beyond moisture damage testing. West's maintains we need a test related to fracture or cracking for a valid specification.

Gallivan reported on the status of R 35 and M 323. For the 2014 standard, there were no changes proposed by the Mix ETG regarding RAP and RAS. He commented more discussion is needed regarding keeping RAP in M 323 or maybe even a stand-alone standard similar to the approach for RAS.

Gallivan asked if anyone else wanted to join Task Force. Potential new members include Chris Abadie, Tim Ramirez from PA. West, Huber, Sines, Musselman, Copeland, D'Angelo, and Pamela Marks also volunteered, as well as Howard Anderson from Utah. Danny Gierhart and Bob Voelkec also wanted to be added to the RAP Task Force.

Gallivan noted the role of the Task Force is to review and make recommendation on the NCHRP study related to RAP.

ACTION ITEM #8: The balloted comments for PP 53 and MP 15 changes will be distributed to the ETG members, as well as the new provisional standards for discussion at the next ETG meeting.

ACTION ITEM #9: The RAP/RAS Task Force will provide their recommendations on the R 35 and M 323 redlines from the NCHRP 9-46 study. Lee Gallivan will send the redlined version and Task Force comments to the ETG members for discussion at the next ETG meeting.

14. Evaluation of High RAP-WMA Rubber Mixtures—Walaa Mogawer (University of Massachusetts at Dartmouth University)

Summary of Presentation:
Walaa Mogawer presented on his study of asphalt rubber (AR) mixtures. Mogawer noted the overall project focus was to develop a design with and without WMA. He identified some of the advantages of using high RAP-WMA-AR mixtures, which include; increased use of recycled materials, lower production placement temperatures with WMA, reduced emissions, decreased energy consumption, and improvement in cracking resistance by lowering aging and oxidation. Mogawer, however, noted some of the concerns with these mixtures; high RAP mixes may become too stiff and be more susceptible to fracture, compactibility and workability can be negatively affected, and WMA mixes may be more susceptible to moisture damage.

Mogawer discussed the objectives of this project which are to; design an asphalt rubber gap-graded mix incorporating 0, 25 and 40% RAP content with and without WMA using the SonneWarmix additive; determine the effects of using up to 40% RAP and WMA technology on the performance of asphalt rubber surface mixtures, and evaluate the effect of high RAP contents and WMA technology on the stiffness, performance and workability of the mixes. The properties and types of tests that were planned and are being used to evaluate these different mixtures in the laboratory include; mixture stiffness or dynamic modulus using the AMPT, fatigue as measured by beam fatigue, uniaxial tension-compression tests and the semi-circular bending test, the Texas overlay tester in terms of reflective cracking, the Hamburg wheel tracking device for rutting and moisture susceptibility, and using the principles of torque for mixture workability.

Mogawer identified the different materials included in this project and overviewed the mixture design procedure. The mixture design procedure follows the Arizona DOT specification section 413 where Ndesign equals 75 gyrations. The base binder is a PG58-28 and included 17% rubber for the asphalt rubber mixes. The WMA technology used is the chemical wax based additive, SonneWarmix. Mogawer showed the gradation used in the control and high RAP mixtures.

Mogawer showed some stiffness results in terms of the master curve for comparing the different mixtures and concluded the addition of RAP to the control mix resulted in an increase mix

stiffness. The increase in mixes stiffness of the RAP mix was mitigated through use of the WMA technology and reduced aging temperatures.

The mixture cracking characteristic was measured in terms of the crack initiation (bending beam fatigue and push-pull test in uniaxial fatigue) and propagation (notched and the Texas overlay tester). Results from these tests were used to compare the different mixtures to determine the effect of RAP and WMA.

Mogawer showed some of the results from the flexural beam fatigue tests, and summarized the test results from the four point bending beam test. This compared the HMA and WMA mixes relative to the amount of RAP included in the mix. From these test results, he concluded the resistance to fatigue cracking decreased with the addition of RAP. The same trend was also apparent with the addition of the WMA technology. The mixing and compaction temperatures were dropped by 17°C and 13°C, respectively.

The uniaxial fatigue as measured in the AMPT was also used in the mixture evaluation. Mogawer explained how the specimens were fabricated and the test response variable. He also showed examples from this test in comparing the different mixtures to the control mix. From the results, he concluded the VECD analysis showed the number of cycles to failure slightly increased when WMA was added to the mix. This agreed with the dynamic modulus results, but was different from the bending beam fatigue test results.

The Semi-Circular Bending (SCB) test was also used to measure fracture related properties of the different mixtures. Mogawer explained the SCB testing conditions and showed example test results.. From the test results, he concluded high Jc values are desirable for fracture resistant mixes. Threshold values of 0.55 to 0.65 kJ/m^2 are typically used as the failure criteria for this test. Using that criterion, there was a noticeable decrease in Jc values for the RAP with WMA mixtures in comparison to the control mixes which was in agreement with the beam fatigue data.

Mogawer explained the use of the Texas Reflective cracking overlay tester to measure fracture related properties of the mixes. He compared the test results between the different mixes. Shane Buchanan asked whether the aggregate gradation was revised to match the same gradation between the different mixes. Mogawer replied yes, they tried to keep as many of the variables the same as possible between all of the mixtures. From the test results, he concluded the reflective cracking resistance of the mixture decreased with the incorporation of higher amounts of RAP. This same trend was apparent when WMA was added to the control mix. Overall, the overlay tester data agreed with the results from the flexural beam fatigue and SCB tests that showed a reduced cracking resistance for mixes with the WMA additive.

The next data discussed by Mogawer was the Moisture Resistance testing using the Hamburg wheel tracking device. From the test data, he concluded all mixtures passed the moisture susceptibility testing in the Hamburg device. The magnitude of the average total rut depth observed at the end of each test was less than 1.1 mm.

Mogawer explained the workability evaluation and how it was defined using a prototype device designed and built by the University known as the asphalt workability device (AWD). He

showed examples of the measured torque used to define workability. From the workability test results, he concluded mixes without WMA showed that as the amount of RAP increased there was a corresponding decrease in mixture workability (increase in torque). Overall, the addition of WMA improved the workability of the mix with RAP to a level similar to the control mix without RAP and WMA.

In summary, Mogawer presented his recommendations based on the test results from this project, which are (1) need to further investigate and develop a procedure to determine the proper reduction in temperatures for asphalt rubber mixes with and without RAP that incorporate WMA, (2) the temperature drop may have been the leading factor contributing to the reduced cracking performance of the mix that included the WMA technology, and (3) more investigations are needed to validate these results with different types of AR binders and WMA technologies.

15. MEPDG Validation of Critical HMA Conditions—Elie Hajj (University of Nevada at Reno)

Presentation Title: *Validation of the Mechanistic-Based Approach to Evaluate Critical Conditions of HMA Mixtures*

Summary of Presentation:
Elie Hajj started the report with a statement that every mix has a critical condition of temperature, loading rate, and stress conditions beyond which the mix will become highly unstable. His report overviews their process to identify those critical conditions in judging whether a mix is resistant to rutting or distortion under selected site conditions.

Hajj noted the HMA mixes that were used during the developmental phase of the mechanistic-empirical (M-E) based approach. He identified the nine mixes that were used as a part of the flow number experiment and eventually became the validation data and used in the development stage for this approach. Hajj explained the mechanistic-based approach can be used to asses the rutting susceptibility of HMA mixtures. Hajj noted the need to estimate the dynamic modulus of the mix along with establishing the rut depth criteria. The project information is used to determine the effective pavement temperature. Hajj summarized the process into five steps (1) Collect project information and select rut depth failure criteria, (2) compute T effective either using the MEPDG analyses or the proposed predictive model, (3) determine the RLT testing conditions based on the HMA mix dynamic modulus, (4) select the flow number criteria for the project specific traffic for the no braking condition, and (5) conduct the test to compare the flow number at T effective to the critical flow number for the appropriate level of traffic. Hajj mentioned that criterion has been established for the no braking condition but not for the braking condition. The critical flow number needs to be established for this condition.

The next part of Hajj's report was on the validation projects. Hajj reported they had ten different projects. He overviewed the results from the validation testing in comparison to the measured rut depth and provided a tabulation of the comparisons. Kevin Hall asked about the comparison of data as related to the criteria. Hajj replied he is not predicting rut depth, he is only trying to determine if this process can be used as a pass or fail basis. The results to date show a reasonable estimate of what happened to the different validation mixes.

Hajj included a critical review of their proposed approach in terms of different items to consider and whether the procedure is applicable. He reported some additional work needs to be completed because the stress states they required did exceed the limits of the AMPT. Hajj also overviewed the standardized procedure in terms of a standard practice. He explained the steps needed to determine how to change the mix components when it does not pass the criteria. This was illustrated in a flow chart but a series of regression equations was performed on how to increase the critical temperature which is affected by angularity of the aggregate, Jnr of the asphalt, dynamic modulus, number of aggregate contact points, and coarse aggregate angularity. Hajj noted critical points can be defined based on selected parameters but it is not applicable to all mixtures. This is only a tool in making some judgments for improving the rut resistance of mixtures.

In conclusion to his report, Hajj identified further improvements that were needed including; further validation of the proposed procedure especially for high volume traffic, validation of the procedure for loading conditions of intersections, implementation of the proposed approach into the AMPT, and improvement and validation of the comprehensive model to determine T critical to identify and quantify the most influential HMA components.

ETG Comments, Questions, and Discussion:
D'Angelo mentioned the problem using the mean annual air temperature and disagrees with that concept. He recommends degree days that Azari is using in the iRLPD test method. D'Angelo believes degree-days will be better in terms of how the method is being used on a pass-fail basis.

16. **Mixing and Compaction Temperature Task Force**—Andrew Hanz (University of Wisconsin at Madison)

Presentation Title: *Laboratory Mixing and Compaction Temperature Task Force—Concepts for Selection of Mixing and Compaction Temperatures*

Summary of Presentation:
Andrew Hanz previously reported this work at the Binder ETG but also would be beneficial to receive comments from the Mix ETG. He acknowledged members of the project team. Members of the Task Force include; Mike Anderson, Gerry Reinke, Karissa Mooney, Edgard Hitti, and Hussain Bahia.

After presenting to the Binder ETG in 2012, Hanz noted he continued to work on mixing and compaction temperature issue regarding two different methods for calculating temperature.

Hanz gave an update of the objectives which were; review the current test procedure for mixing and compaction temperature determination, and recommend revisions to AASHTO T 312. This presentation focuses on the mixing and compaction temperature determination objective. Hanz summarized the goals for selecting the mixing and compaction temperature: (1) mix design consistency, (2) performance testing – producing test specimens; and (3) maximum mixing temperature to prevent binder degradation. Hanz noted considerations for selection of compaction temperature; setting threshold values that are related to the mix and necessary

gyration levels. Other issue is mix density versus temperature relationship. Hanz reviewed the effects of aggregate gradation, filler to binder ratio, and asphalt content as important parameters that are traditionally not considered if only the viscosity is used to determine the required compaction temperature. Using only viscosity to determine compaction temperature is ineffective.

Hanz maintains this work has practical on the current specifications such as adjustments to mix design and field acceptance. Randy West noted that minimum and maximum temperatures should not be applicable to field acceptance and were only for laboratory compaction. Geary noted there should be a minimum requirement on temperature.

Continuing, Hanz provided an illustration of the binder versus mastic viscosity at 145°C as an example. He also showed the relationship between viscosity and temperature in terms of the shear sensitivity as affected by the mastic viscosity versus temperature.

Hanz then explained the effects of filler properties and concentration on the mastic viscosity from NCHRP 9-45, which is related to the relative viscosity – the effect of filler type and binder source. The illustration used by Hanz to show this effect was a comparison of natural and manufactured sands. Hanz explained the different factors affecting the mastic viscosity. He noted from data included in NCHRP 9-45, the dust to binder ratio has a large impact on the viscosity ratio. There is a critical point of the dust to binder ratio.

Hanz noted a challenge in that it is not practical to measure mastic viscosity for suppliers and the Cup and Bob geometry is not readily available. Hanz then discussed some of the proposed solutions to these challenges in terms of further research required. For the bob and cup geometry issue there is a need to develop a procedure for measuring mastic viscosity versus shear rate in the Brookfield rheometer. Additionally, there is a need to develop adjustment factors for compaction temperature guidance and produce a range of acceptable compaction temperatures instead of a single value. Hanz also presented a framework for the proposed set of guidelines that have been developed. He summarized proposed actions that need to be taken by the pavement community:

- Relative to mix design; need to suspend use of temperature/viscosity charts as a basis for selecting compaction temperatures. The charts could remain as a part of the submittal with a disclaimer that density can be achieved at the lower temperatures.
- Relative to field acceptance; recommend that acceptance and payment be based on properties related to performance. As delivered temperatures is not a material property, if density is achieved the mix should not be rejected based solely on temperature.

Hanz identified some future work elements in the areas of mastic viscosity testing in terms of evaluating effect of shear rate and concentration for a variety of fillers and binders and develop an alternative to bob and cup; develop adjustment factors for CT using current mix design data; and performance based selection of mixing temperature.

17. Rigden Air Voids Draft Procedure—Andrew Hanz (University of Wisconsin at Madison)

Presentation Title: *Rigden Voids – Proposed AASHTO Standard – Effects of Rigden Voids on Mastic*

Summary of Presentation:
Andrew Hanz explained the Rigden Voids procedure. It is a measure of the packing of the filler by evaluating the void content after compaction. The extent of packing is determined by the filler properties and relates to the free volume available in the asphalt mastic, and thus is a stiffening effect. In other words, it relates to the effect of the volume fraction or dust-to-binder ratio on stiffening.

Hanz provided an illustration of the Rigden Voids measuring device. He discussed the test procedure and showed some illustrations for each step. In addition, Hanz presented the equation used to calculate Rigden Voids and defined each term in the equation. He included an example of the distribution of Rigden voids from NCHRP project 9-45, and noted usually there is a normal distribution.

Hanz included a listing of the factors affecting the mastic viscosity. The mastic viscosity is most influenced by the viscosity of the binder and packing of the filler or the Rigden Voids. The final part of his report was on the potential application of the methods use. Hanz stated Rigden Voids are more of a tool for mixture design but not intended to develop minimum and maximum values to exclude certain aggregate sources. Rigden Voids do have potential application for selecting mixing and compaction temperatures and can be used to adjust the dust to binder ratio.

ETG Comments, Questions, and Discussion:
West noted that while this is a recent evaluation of this method, he acknowledged it has been used in the past. ETG comments are requested, since this method will be considered by the SoM 2d Tech Section as a potential provisional standard.

Kevin Hall asked about the estimated effect of Rigden voids on mastic properties. Specifically he asked how this value can be used to establish the mixing and compaction temperatures because there appears to be considerable variability. D'Angelo added that Dave Anderson has used it for that purpose and it appears to be acceptable. D'Angelo also stated the test is repeatable, but it is not directly related to a mix property.

Fee noted that this is a tool that gives a designer guidance on selecting mix design items. Hanz added that this is not intended to develop acceptance specifications but only as a guide for selecting compaction temperatures.

ACTION ITEM #10: ETG members were requested to review the proposed draft standard for measuring Rigden Voids. The proposed draft is on the Tech Section ballot. Comments should be sent to Andrew Hanz.

Frank Fee adjourned the meeting for the day at 4:30 PM.

DAY 3: Friday, September 20, 2013

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

18. Workability and Field Compaction Temperatures—Raj Dongre (Dongre Laboratory Services)

Presentation Title #1: *Dongre Workability Test – DWT; Progress Report*

Summary of Presentation:
Raj Dongre provided a progress report on the test that he developed to measure workability. He acknowledged those organizations and individuals that have helped with the development and refinement of the test standard. .

Dongre reminded the group that at a previous ETG meeting findings from the initial ruggedness study were presented. These included; rodding was found to be extremely significant, rod type is important, use of a blunt round rod is required, tamping with a rubber mallet is unimportant when a blunt rod is used, specimen mass is significant over the tested high/low limit, stress at 0.05mm/s and start at a range of 40kPa to 80kPa is reasonable, the final stress in range of 700 to 950 is acceptable; and offset temperature range control of 10°F ±5°F is adequate. The DWT is sensitive to asphalt grade, mix gradation, mix type, and field compaction temperature.

Dongre's report continued, with a focus on the use of the DWT value for quality control during mix production. Dongre next addressed the issue related to rodding depth. Refusal depth of rodding is operator dependent, but the effect of rodding depth is insignificant even though there here is an effect on the variability of the DWT values, but not on the mean DWT value.

Dongre reported on the preliminary single operator precision estimate from the initial ruggedness testing under phase I. He believes ILS will show the true precision of the test. He discussed the preliminary between-lab precision estimate. The between lab variability is a lot higher than within-lab variability. Dongre reported the key is the rodding technique and he believes that is the reason for the low variability of a single lab in comparison to the between lab variability.

The second part of Dongre's report was on the use in terms of mix production quality control. Dongre believes the DWT test could be used as a QC volumetric specimen using the gyratory compactor. The DWT procedure would involve loading the loose mix to 700 kPa at 0.05 mm/sec. After the DWT test, the compaction can proceed normally once a 600 kPa load is reached at 0.05 mm/s and the operator determines the results are within the pre-determined limits.

Dongre acknowledged ARML's participation to determine if there was an effect on air voids. Dongre showed illustrations of the results in terms of the effect of doing the DWT test and not doing the DWT test on SGC air voids, bulk specific gravities and final height. All volumetric results for tests conducted after the DWT were within the tolerable error of the same results measured on materials without doing the DWT test.

Dongre reported he used ALF mixes to answer the QC questions. He started with the DWT value on production warm mixes. He performed the DWT first, followed by the regular compaction method. The results were presented in terms of a graph of the DWT value (y-axis) versus the air voids from the post DWT (x-axis). D'Angelo asked how you know that the mix you are referring to will pass or fail. D'Angelo maintains this needs to be tied to the air voids. Dongre disagreed with D'Angelo's comment. Kevin Hall agreed with D'Angelo and does not understand how to read the graph of test results shown.

Dongre summarized his findings from the data collected. DWT value is sensitive to asphalt binder grade, mix gradation, mix type and field compaction temperature; both within-lab and between-lab precision appear reasonable; conducting the DWT test prior to volumetric specimen compaction does not appear to affect he SGC volumetric parameters; and the DWT might be able to be implemented with minimal change to the current mix design procedure.

ETG Comments, Questions, and Discussion
Matt Corrigan noted there was some test descriptions for specimen preparation and rodding the specimen which are not shown the current draft procedure. Corrigan believes the standard needs to be clarified on when you should do rodding. Dongre will add these to the standard.

Shane Buchanan asked the time from start to finish for DWT and compaction. Roger Pyle replied that it adds less than 10 minutes to perform the test. Buchanan's doubts state agencies will allow this departure from the standard, but could add be performed on a separate sample.

Dongre will continue with this effort and the development of the ruggedness testing plan.

19. Predictive Software – Pavement Temperature Profile—Elie Hajj (University of Nevada at Reno)

Presentation Title: *Prediction of Asphalt Pavement Temperature Profile Using the Finite Control Volume Method (FCVM)*

Summary of Presentation:
Elie Hajj acknowledged the participants in this work. This presentation provides an overview of the elements included in the software that have been developed to predict pavement temperatures for use in calculating pavement responses for distress predictions. Hajj grouped the pavement temperature models into three types: statistical based models, numerical based models, and analytical based models. He focused on the numerical based models and gave examples of this type of model. One numerical based model is the Enhanced Integrated Climate model (EICM) that is included in the Mechanistic-Empirical Pavement Design Guide (MEPDG).

Hajj explained the EICM model used for solving pavement temperature profile knowing climatic data, meteorological data, pavement surface radiation properties, and pavement materials thermal diffusion properties. He identified limitations of the EICM model. These included no physical interpretation of the temperature diffusion mechanism, cannot easily handle the variability in materials thermal properties in a multiplayer pavement system, boundary conditions of pavement surface in terms of steady state conditions, and simplified surface radiation properties and

prediction of solar radiation incident. Hajj noted this information has been collected and stored in multiple databases.

Hajj overviewed the critical concept of the heat transfer model and identified the items that are needed for this model. He reviewed each item related to predicting temperature and how the different parameters can be obtained, as well as explain the mathematical relationships used to determine the parameters. Hajj reviewed the pavement surface boundary conditions and how they consider the unsteady state condition in their model. He also explained how heat diffusion or conduction is determined within the pavement structure in their model. He showed some of the mathematical relationships/equations and explained how heat diffusivity varies with depth.

Hajj then defined the critical boundary conditions and explained why this is important in predicting pavement temperature profiles. This is a finite volume control method and noted the size of the element can be varied and needs to be determined because it is important to the reliability of the procedure. Hajj included a summary of the mathematics behind this model and briefly explained how it is used to predict temperature over time and with depth in the pavement.

Hajj reported they just started doing some analyses and comparisons to define the accuracy of the system or model. He defined the significance of using the time step of 1 hour versus 30 seconds, and showed a comparison of the predictions between the two steps that were used.

Hajj showed examples on how the model was validated using one LTPP site in Arizona. He presented a summary of one year of data. Huber asked if the predictions tend to drift during time predictions in terms of one week versus one year. Hajj replied that for a year, results were good, but comparison for multiple years is not available. Hajj then showed the results from a site located in Great Falls, Montana. Kevin Hall asked if the EICM was also performed on these same sites. Hajj replied that the intention was not to compare their model to the EICM, so they have not compared their results to the EICM.

Hajj stated the University of Nevada at Reno (UNR) alpha version is available for use in predicting pavement temperature profiles because they want feedback in using the model. Hajj then summarized the program and how it is used. He identified some potential applications of the UNR Pavement Temperature Profile Prediction (UNR-RPTT), including; analysis of pavement temperature profile in different climatic and pavement structure scenarios; can be implemented in ME designs, can be used in asphalt binder kinetic evaluations, and can be used to determine hourly and daily cooling and warming rates.

Hajj summarized some of the future improvements they will be making to the UNR-RPTT, including; extending the database in the software, ability to obtain required hourly climatic data from the maximum and minimum daily values, and ability to account for variable geometries of pavement and other infrastructures.

ETG Comments, Questions, and Discussion:
Huber asked about the required input values. Hajj identified some of the different values and noted whether they are model inputs by day or season. Hajj reiterated if you only have minimum and maximum values, they assume a distribution of values from those two values.

Pamela Marks asked if the model has the capability to consider shadows from adjacent features as well as with snow cover. Hajj noted there are items that it can utilize, but those have yet to be implemented.

Matt Corrigan asked about the model validation for the two sites located in AZ and MT, it seems like the predictions are lower than the measured values during the critical time of year, while the predictions for the other times are better but there still is a little difference. Hajj replied they also observed that fact, and explained some of the input values are tied to a region and season rather than a site. They need to have more refined data but first do a sensitivity analysis to look at the parameters and see if they can refine the more sensitive parameters. The two more important ones are the absorption and diffusivity values. Corrigan asked how you envision tying to grade selection and other items related to binder and mix issues. Hajj replied the available model and data do not cover all of the sites to get to the temperature profile, so this is a tool and can create virtual sites for doing that.

Hajj noted this software is currently available on the UNR website.

20. Construction Task Force – Research Needs Statements - Lee Gallivan (FHWA

Summary of Presentation:
Gallivan first reminded the ETG what has been done in the past under this Task Force. The one research needs statement that was submitted as a synthesis did not make it to the final list either this past year or the year before. The Task Force has put together another synthesis study on pavement in-place density, which was distributed to the ETG. Gallivan presented the problem statement and objectives. Gallivan acknowledged Shane Buchanan's on this effort.

ETG Comments, Questions, and Discussion:
Fee noted that Harrigan suggested using the synthesis approach for this research needs statement. Geary noted as a synthesis under NCHRP 20-07, need to have the latest version soon and the standing committee on highways will decide these by mid-October. Right now there are three syntheses being considered under NCHRP 20-07. Geary noted that she needs the final version by the end of the month.

ACTION ITEM #11: All review comments should be sent to Lee Gallivan on the proposed synthesis on pavement in-place density by the end of month so they can be provided to Georgene Geary for the SoM meeting.

21. Low Temperature Tensile Test—Elie Hajj (University of Nevada at Reno)

Presentation Title: *Determining Thermal Cracking Properties of Asphalt Mixtures through Thermally Induced Stress and Strain*

Summary of Presentation:

Elie Hajj stated this report is focused on taking the older version of the TSRST test developed during SHRP and make refinements to make it more useful to industry. He summarized how this can be tied into the existing mixture design framework. Hajj also reported this is one of the proposed provisional standards that have been submitted to the SoM for ballot.

Hajj overviewed of the draft standard that was submitted to the SoM for ballot. He explained there are two methods in the draft standard, and discussed each method. The two methods are defined as the UTSST and ATCA devices. Hajj showed an illustration of each and noted the ATCA is from the University of Wisconsin and the UTSST is from UNR.

Hajj showed example results from the test and explained what is calculated from the measurements through an illustration. The parameters from both tests are; crack initiation, glassy hardening, viscous-glassy transition, and viscous softening. Hajj explained the different between each response stage. Rowe noted the slight difference in terminology used by Hajj of relaxation versus softening and asked if there was a specific reason for using a different terminology. Hajj replied the terminology is being refined. Fee asked if both of these methods will be balloted. Hajj replied yes, method A and B are both in the same draft standard. Fee also asked whether the volumetric properties were being monitored during the test. Hajj replied yes, but only related to the axial change of the specimen.

Hajj listed the ongoing research topics and updates to this test, which include; determining the effect of cooling rates on mix thermo-volumetric, thermo-viscoelastic, and fracture properties, and determining the evolution of thermo-viscoelastic properties with asphalt binder oxidative aging. Hajj noted he will present data as an update relative to the effect of cooling rates, which is the next part of this report.

Hajj noted the different materials and the different cooling rates that were proposed for the experimental test plan. He explained the reason for selecting the four cooling rates and showed typical test results. Hajj explained the effect of cooling rate on different parameters starting with the effect on the thermal stress. Hajj included graphs demonstrating the effect. Hajj noted all mixtures included represent long-term aged specimens. Hajj then discussed the effect of the cooling rates on thermal strain, thermo-volumetric properties, and relaxation modulus. Hajj noted the micro fracture cracking initiation is where the curves peaked for the cooling rate effect on relaxation modulus. For the effect of cooling rate on thermo-viscoelastic properties, Hajj noted the difference between the effect of cooling rate on the different components of the specimen response (crack initiation, glassy-hardening, viscous-glassy transition and viscous softening). Hajj also noted the difference between the neat and polymer modified mix, but does not have an explanation for this observation.

Hajj showed temperature differences between the glassy hardening and start of glass transition zone. Rowe asked how much is scatter in the data versus real response differences. Hajj replied he was unsure, but noted each point is the average of two replicates. There was discussion between Rowe and Hajj on the variability in the data versus real trends. Rowe also noted there are changes occurring in the binder that might explain these results.

Hajj showed a tabular summary on the effect of oxidative aging and noted discussed the differences between the samples used in this example in terms of mineralogy.

For the next part of Hajj's report, he discussed the experimental plan concerning the specimens and how they were tested for the evolution of the thermal stress and strain with aging. In summary, the experiment included long-term oven aging of compacted mixtures, thermo-viscoelastic properties measurements using the UTSST test, and carbonyl area measurements. Examples of the results included graphs showing the thermal stress versus temperature during the cooling process as well as thermal strain versus temperature.

Hajj showed test results for one of the mixtures as a function of air voids. The intent of this study is to identify the parameters that affect aging of the binder. Ala Mohseni commented that the difference in temperature in the fracture properties is not that significant. Hajj agreed with that comment, and noted the temperature is less but there is still a difference.

In concluding his report, Hajj acknowledged this work is a part of the overall effort in the Asphalt Research Consortium work and thanked FHWA for their support on this research.

22. Action Items and Next Meeting Planning—Frank Fee and John Bukowski

Action Items: Bukowski reviewed the action items from this meeting.

1. Jack Youtcheff will provide the ETG a copy of the ALF sampling and testing plan for comment.

2. Ramon Bonaquist and Jeff Withee, as part of the flow number task force, will report on the progress of the iRLPD procedure.

3. Jeff Withee and Tran Nam will report on the results from the AMPT ILS at the next ETG meeting.

4. Ramon Bonaquist, as part of the TP 60 sample preparation Task Force, will report at the next meeting on the sample variability study.

5. Geoff Rowe will report on additional input for the T 321 changes for discussion and referral to SoM Tech Section 2d.

6. Ramon Bonaquist will report at the next meeting on results from the NCHRP 9-43 follow-up study with respect to absorptive aggregates.

7. Matthew Corrigan will provide an update on the WMA Task Force and the LTPP planned experiment for WMA mixtures. Ramon Bonaquist will assist Corrigan and provide additional information on the results from the WMA LTPP ETG and experiment.

8. The balloted comments for MP 53 and TP 15 changes will be distributed to the ETG members, as well as the new provisional standards for discussion at the next meeting.

9. The RAP/RAS Task Force will provide their recommendations on the R 35 and M 323 redlines from the NCHRP 9-46 study. Prior to the next meeting, Lee Gallivan will send the redlined version and Task Force comments to the ETG members for discussion at the next ETG meeting.

10. ETG members were requested to comment on the proposed draft standard to measure Rigden Voids. Comments should be sent to Andrew Hanz. The proposed draft will become a Tech Section ballot item, but still needs comments from the ETG.

11. All review comments should be sent to Lee Gallivan on the proposed synthesis on in-place pavement density by the end of month so they can be provided to Georgene Geary for the SoM meeting.

Richard Kim was to report on the status of the IDT ruggedness study during this ETG meeting but was not in attendance. Thus, this action item was delayed until the next meeting.

Next Meeting Location and Date:
The location and date for the next ETG meeting were discussed. Bukowski reported the next meeting is tentatively scheduled for the week of March 31 to April 4, which is in agreement with Binder ETG meeting. Bukowski announced Austin, Salt Lake City, or Reno are potential locations for the next set of ETG meetings. The group needs a university or DOT to assist in hosting the meetings to try and offset some of the expenses. He also announced the Mixture ETG will occur first at the next meeting and will be followed by the Binder ETG.

23. Meeting Adjournment—Frank Fee and John Bukowski thanked all for their participation on the ETG, and adjourned the meeting at 10:30 AM.

ATTACHMENT A
Fall River, MA
September 18 – 20, 2013
Meeting Agenda – Draft

Day 1 – September 18, 2013

1:00 pm	Welcome and Introductions	**Fee/Bonaquist**
1:15 pm	Review Agenda/Minutes Approval & Action Items May, 2013 Meeting	**Bukowski**
1:30 pm	Subcommittee on Materials Updates/Comments	**Geary**
2:00 pm	Update Related NCHRP Activities	**Harrigan**
2:30 pm	ALF Experiment- Selected Design/Proposed Tests	**Youtcheff**
3:00 pm	**Break**	
3:30 pm	Aggregate and Mixture Anisotropy	**Newcomb**
4:00 pm	BBR Mix Creep Test & Moisture Testing	**Marasteanu**
4:30 pm	**Adjourn for the Day**	

Day 2 – September 19, 2013

8:00 am	AMPT Test Development • AMPT Flow Number Task Group • AMPT Pooled Fund Activities	**Withee**
9:00 am	AMPT Specimen Preparation Variables	**Bonaquist/Blakenship**
9:30 am	**Break**	
10:00 am	Task Group Review Update T-321 (Beam Fatigue)	**Rowe**
10:30 am	9-43 Follow-up Information on Absorptive Aggregates	B**onaquist**
11:00 am	Status IDT E* Ruggedness Study	**Kim**
11:30 am	Report Task Group WMA	**Corrigan**

Noon	**Lunch**	
1:00 pm	Report Task Group RAP/RAS • Update on RAS Activities • Status R35 and M323 • Recommendations NCHRP 9-46	**Gallivan**
2:30 pm	Evaluation of High RAP-WMA Rubber Mixtures	**Mogawer**
3:00 pm	**Break**	
3:30 pm	Mixing and Compaction Temperature Task Force	**Hanz**
4:00 pm	Rigden Air Voids Draft Procedure	**Hanz**
4:30 pm	**Adjourn for the Day**	

Day 3 – September 20, 2013

8:00 am	Workability and Field Compaction Temperatures	**Dongre**
8:30 **a**m	MEPDG Validation of Critical HMA Conditions	**Hajj**
9:00 am	**Break**	
9: 30 am	Predictive Software - Pavement Temperature Profile	**Hajj**
10:00 pm	Construction Task Group - RNS	**Ryan/Gallivan**
10:30 pm	Low Temperature Tensile Test	**Hajj**
11:00 pm	Action Items and Next Meeting Planning	**Fee/Bukowski**
11:30 pm	**Adjourn**	

ATTACHMENT B

FHWA Asphalt Mixture & Construction Expert Task Force Members

Chairman: **Frank Fee** Frank Fee, LLC 401 Woodward Road Media, PA 19063 Phone: 610-608-9703 Cell: 610-565-3719 Frank.Fee@verizon.net	Co-chairman: **Ray Bonaquist** Chief Operating Officer Advanced Asphalt Technologies, LLC 108 Powers Court, Suite 100 Sterling, VA 20166-9325 Phone: 703-444-4200 aatt@erols.com
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	
Members:	
Howard Anderson Utah DOT Engineer for Asphalt Materials Materials Division, Box 5950 4501 South 2700 West Salt Lake City, Utah 84114-5950 Phone: 801-965-4426 Cell: 801-633-8770 Fax: 801-965-4403 bennert@rei.rutgers.edu	**Tom Bennert** Rutgers University 623 Bowser Road Piscataway, New Jersey 08854 Phone: 732-445-5376 bennert@rei.rutgers.edu
Shane Buchanan Asphalt Performance Manager Old Castle Materials 500 Riverhills Park, Suite #590 Birmingham, AL 35242 Cell: 205-873-3316 shane.buchanan@oldcastlematerials.com	**Jo Daniel** University of New Hampshire W18313 Kingsbury Hall Durham, New Hampshire 03824 Phone: 603-826-3277 jo.daniel@unh.edu

Ervin L. Dukatz, Jr. VP – Materials and Research Mathy Construction Company 915 Commercial Court Onalaska, WI 54650-0189 Phone: 608-779-6392 ervin.dukatz@mathy.com	**Georgene Geary** (Liaison for AASHTO SOM) State Research Engineer Georgia Department of Transportation Forest Park, Georgia Phone: 404-608-4712 ggeary@dot.ga.gov
John Haddock Associate Professor Purdue University School of Civil Engineering 550 Stadium Mall Drive West Lafayette, IN 47907-1284 Phone: 765-496-3996 jhaddock@ecn.purdue.edu	**Kevin D. Hall** Professor and Head Department of Civil Engineering University of Arkansas 4190 Bell Engineering Center Fayetteville, AR 72701 Phone: 479-575-8695 Cell: 479-640-2525 kdhall@uark.edu
Adam J.T. Hand Director Quality Management Granite Construction, Inc. 1900 Glendale Avenue Sparks, NV 89431 Phone: 775-352-1953 Cell: 775-742-6540 adam.hand@gcinc.com	**Gerry Huber** Assistant Director of Research Heritage Research Group 7901 West Morris Street Indianapolis, Indiana 46231 Phone: 317-439-4680 Gerald.huber@hrglab.com
Reid Kaiser Chief Materials Engineer Nevada DOT 1263 S. Stewart Street Carson City, Nevada 89712 Phone: 775-888-7520 Cell: 775-720-4532 rkaiser@dot.state.nv.us	**Y. Richard Kim** Professor North Carolina State University Dept. of Civil Engineering Campus Box 7908 Raleigh, NC 27695-7908 Phone: 919-515-7758 kim@ncsu.edu
Julie E. Kliewer, Ph.D. District Engineer Phoenix Construction District Arizona Department of Transportation 1801 West Jefferson St., MD E700. Phoenix, AZ 85007-3289 Phone: 602-712-8965 jkliewer@azdot.gov	**Todd A. Lynn** Principal Engineer Thunderhead Testing, LLC Phone: 918-366-3818 Todd.Lynn@apac.com

Louay N. Mohammad Professor, Dept. of Civil & Envir. Engineering Director, Engr. Materials Research Facility Louisiana Transportation Research Center Louisiana State University 4101 Gourrier Ave. Baton Rouge, Louisiana 70808 Phone: 225-767-9126 Cell: 225-252-7046 louaym@lsu.edu	**James A. Musselman** State Bituminous Materials Engineer Florida Department of Transportation State Materials Office 5007 NE 39th Avenue Gainesville, FL 32609-8901 Phone: 352-955-2905 jim.musselman@dot.myflorida.us
Allen H. Myers, P.E. Director Division of Materials, Dept. of Highways Kentucky Transportation Cabinet 1227 Wilkinson Blvd. Frankfort, Kentucky 40601-1226 Phone: 502-564-3160 allen.myers@ky.gov	**Dave Newcomb** Senior Research Scientist Texas A&M Transportation Institute Texas A&M University 3135 TAMU College Station, Texas 77843-3135 Phone: 979-458-2301 d-newcomb@ttimail.tamu.edu
Timothy L. Ramirez Engineer of Tests Pennsylvania Department of Transportation Bureau of Project Delivery Laboratory Testing Branch 81 Lab Lane Harrisburg, PA 17110-2543 Phone: 717-783-6602 tramirez@pa.gov	**Judie Ryan** Engineering Specialist-HMA Wisconsin Department of Transportation Bureau of Technical Services 3502 Kinsman Blvd. Madison, WI 53704-2507 Phone: 608-246-5456 **judith.ryan@dot.state.wi.us**
Liaisons:	
R. Michael Anderson Director of Research & Lab Services Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480 Phone: 859-288-4984 Fax: 859-288-4999 manderson@asphaltinstitute.org	**Haleh Azari** AASHTO-AMRL National Institute of Standards and Technology 100 Bureau Drive Stop 8619 Building 236, Room 124 Gaithersburg, Maryland 20899-8617 Phone: 301-975-2112 Fax: 301-975-5450 hazari@amrl.net

Mark S. Buncher Director of Engineering Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480 Cell: 859-312-8312 Phone: 859-288-4972 Mbuncher@asphaltinstitute.org	**Audrey Copeland** Vice President-Research and Technology National Asphalt Pavement Association 5100 Forbes Boulevard Lanham, MD 20706-4413 Phone: 301-731-4748 Fax: 301-731-4621 Audrey@asphaltpavement.org
Edward Harrigan Transportation Research Board 500th Street, NW Washington, D.C. 20001 Phone: 202-334-3232 Fax: 202-334-2006 eharrigan@nas.edu	**Nam Tran** Assistant Research Director National Center for Asphalt Technology 277 Technology Parkway Auburn, AL 36830 Phone: 334-844-7322 Fax: 334-844-6248 NHT0002@auburn.edu

ATTACHMENT C

Task Force Members and Assignments
FHWA Asphalt Mixture & Construction ETG

Task Force Identification:		Members Assigned to Force:
1	Guidance for Flow Number Testing	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
2	Superpave Performance Test Review	Mike Anderson (Lead)
	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
3	Hamburg Wheel Tester – SOM Task Force	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.
4	HMA In Place Density Practices & Specifications	Cindy LaFleur (Lead); Erv Dukatz, Julie Kliewer, Todd Lynn, Jim Musselman, Judy Ryan, Chris Euler, Mark Buncher.
5	S-VECD Alpha/Beta Testers	Richard Kim and Shane Underwood (Leaders); Tom Bennert, Jo Daniels, Geoff Rowe, Tom Scarpas, Harold Von Quintus
6	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
7	RAP	Lee Gallivan (Lead): John D'Angelo, Audrey Copeland, Gerry Huber, Jim Musselman, Ron Sines, Randy West, and Richard Willis
8	Mixing and Compaction Temperature	Mike Anderson (Lead): Hussain Bahia, Andrew Hanz, Edgard Hitti, Karissa Mooney, and Gerry Reinke.

`