Minutes of FHWA Recycled Asphalt Pavement Expert Task Group
Meeting date: July 24, 2012

Call to Order:
A regular meeting of the Recycled Asphalt Pavement (RAP) Expert Task Group (ETG) was held at the Radisson Hotel in Arlington, VA on July 24, 2012. The meeting convened at 8:00 AM, Chairperson Gerald Huber presiding, and Lee Gallivan, secretary.

A total of 40 individuals attended the meeting (17 members, 21 visitors, and 2 contract personnel). Attachment A is the meeting Agenda and Attachment B includes a listing of the ETG members.

Roll Call; Members in Attendance:
Members of the FHWA Recycled Asphalt Pavement ETG that were in attendance at the July 2012 meeting included:

Gerald Huber,	Heritage Foundation (Chairperson)
Lee Gallivan,	FHWA (Co-Chairperson)
Audrey Copeland,	NAPA
John D'Angelo,	D'Angelo Consulting
Jo Daniel	University of New Hampshire
Jon Epps,	Texas A&M University
Mike Harnsberger,	WRI
Ed Johnson	Minnesota DOT
David Lippert,	Illinois DOT
Becky McDaniel,	Purdue University
Andy Mergenmeier	FHWA
Jim Musselman,	Florida DOT
Jim Pappas,	Delaware DOT
Ron Sines,	Old Castle Materials
Randy West,	National Center for Asphalt Technology
Dale Williams	Missouri Asphalt Pavement Association
Richard Willis	National Center for Asphalt Technology

Members Not in Attendance:

Hussain Bahia,	University of Wisconsin-Madison
Phil Blakenship	Asphalt Institute
Don Brock,	Astec Industries, Inc.
Bob Forfylow,	LaFarge Canada, Inc.
Hamid Moussavi,	Caltrans
Kurt Williams,	Washington State DOT

Contract Personnel:
Meeting Coordinator: Lori Dalton (SME, Inc.)
Meeting Notes: Harold L. Von Quintus, (ARA, Inc.)

"Friends" of the ETG in Attendance:

Haleh Azari, AASHTO
Gaylon Baumgardner, Paragon Tech. Serv.
Jason Bausano, MWV Asphalt Innovations
Ryan Clark, Municipal Group of Companies
Matthew Corrigan, FHWA
Everett Crews, MWV Asphalt Innovations
Danny Gierhart, Asphalt Institute
Nelson Gibson, FHWA
Elie Hajj, University of Nevada at Reno
Greg Harder, Asphalt Institute
Tom Harman, FHWA
Edward Harrigan, NCHRP
Ala Mohseni, Pavement Systems
David Newcomb, Texas A&M University
Gerald Reinke, Mathy Construction
Chuck Paugh, ESC Inc./FHWA
Gerald Reinke, Mathy Construction
Roger Sandberg, Maxam Equipment, Inc.
Richard Schreck, Virginia Asphalt Pavt. Assoc.
Annette Smith, PQ Corporation
Chris Williams, Iowa State University

Review of Action Items from 2011 Meeting: Gerald Huber (Heritage Foundation)
The following are the action items from the meeting.

Coordination Effort for Selecting Virgin Binder/Blending Issues

1. Listing of research projects and findings being accumulated by Lee Gallivan will be submitted to the ETG members prior to the next ETG meeting. STATUS: Huber noted this will be on-going to increase the amount of information available relative to the amount of virgin asphalt to be added. One of the task of this group was to provide information to states that do not use or use low percentages of RAP. He also noted that Becky McDaniels is working with TRB to produce a circular on this topic to increase the use of RAP.

Target Low RAP Usage States Standing Committee:

2. Copeland will send the Tech Briefs on successes, studies, and fact sheets on using high RAP mixes to West for use in visiting agencies restricting the use of higher RAP content mixes. STATUS:
3. McDaniel will explore another venue for publishing the TRB circular. STATUS:

RAP Use Survey Standing Committee:

4. Pappas will ask to be on the agenda for the next SOM meeting related to the use of higher RAP contents. STATUS: On going survey.

Research Needs Standing Committee:

5. Epps and Corrigan will prepare a research needs statement on the use of recycling agents for determining mix properties for improved performance. STATUS: One of the items that comes from this group are things unknown, so RNS is a major product from this group.

6. Brock and Forfylow will prepare a research needs statement on the use of anti-stripping additives and quantifying the effects of high RAP mixtures to improve performance. STATUS:

High RAP Performance Task Group:

7. McDaniel will attend the next LTPP meeting and make a case for the forensic investigations. If the support for this effort does not materialize, a research needs statement will be prepared to sponsor the forensic investigations. STATUS: What is the effect of performance on using high RAP mixtures. They are looking at conducting forensic investigation studies for the LTPP sections that are going out of service.
8. West and McDaniel will prepare a listing of the SPS-5 projects and test sections of those still in service and those already taken out of service. STATUS:
9. Information Sharing: Daniel will forward their case study to Copeland; West will send the Florida information to Copeland; Copeland will summary this information and forward it along to other agencies on the ETG. STATUS:

Huber noted the website for advertising information from this group. He noted the importance of the information getting out to people.

RAP ETG Website Standing Committee:

10. D'Angelo will forward the specifications from selected agencies (FL, TX, IL, OH, UT, and VA) to Willis in the near future for including them on the website. STATUS:

RAP Variability Task Group:

11. Reinke and Chaignon will share their data on variability with West. STATUS:
12. The webinar on "Best Management Practices" will be redone in the future. West and Huber will plan the Webinar. STATUS:

Framework for Building/Monitoring High RAP Content Mixes Task Group:

13. Copeland will distribute the document with comments on the framework to the ETG. STATUS: Noted that Audrey has been involved in building a report for using high RAP content.

Case Studies Task Group:

14. Audrey Copeland will send the final list of items shown on the screen to the ETG for further comment and review. STATUS: D'Angelo been looking at this.

Mixing and Compatibility of RAP/Virgin Binders:

15. Gaylon Baumgardner will send Kalberer some of his samples for expanding the database. Kalberer requested virgin and RAP binder samples (2 grams each) be sent to him for inclusion in the study. This request includes projects where softening occurred when adding RAP to the mix. He also requested the individuals send the physical properties of the binders. Two grams of each asphalt is needed unless the individuals request other tests to be performed. STATUS: Been looking into this.

Recycled Binder Percentages for AASHTO M 323 Task Group:

16. Peter Sebaaly will send his study reports and results to Frank Fee (Mixture ETG) for review and comment. STATUS: Noted that Lee Gallivan has been leading and Audrey Copeland has been heavily involved. There will be activity on today's agenda on this topics.
17. Audrey Copeland will forward the revised M 323 to AASHTO (Rick Harvey) after making some minor changes. STATUS:

This gives a picture of where we are at and what has been doing since the May 2011 meeting. Huber asked for questions from the group relative to the minutes. None were

Approval of Minutes: Lee Gallivan (FHWA)
Lee Gallivan made a motion to accept the meeting minutes. The motion was seconded by Randy West and Don Brock. Huber called for a vote on the motion. The minutes passed and were accepted unanimously – **Motion Accepted**.

Huber asked does anyone object to the meeting minutes. None noted. They are considered approved.

Gallivan noted minutes revised were sent out to all. Also agenda was sent out to all members. Gallivan noted that sign up sheets were passed around the room. Gallivan noted this will be the last meeting of the RAP ETG and that they RAP ETG will be combined with the mix ETG meetings. He also noted that the WMA will be incorporated into the mix ETG. The action items will continue.

Gallivan noted the names that have been submitted from the RAP ETG to be members of the mix ETG. He noted that the members nominated will be contacted to get their approval. Harmon asked to identify the next mix ETG meeting. Gallivan noted Sept. 24 in Minneapolis Park Place will be the next meeting of the mix ETG. He noted the electronic notification of the meeting has been sent out and Dalton is the person to the inivitation.

Chairperson's Report:

Standing Committees and Task Groups Reports

RNS: Advancing Studies, NCHRP 9-55, etc. – Jim Pappas (Delaware DOT)

Summary of Report:

Action Items:

RNS: Experimental Design for Field Validation of Tests to Predict Cracking in Asphalt Mixtures – Updated – Randy West (NCAT)

Summary of Report:

Action Items:

RAP Use Survey for 2013 and Beyond – Jim Pappas (Delaware DOT)

Summary Report:

Action Item:

NAPA/FHWA Survey Update – Audrey Copeland (NAPA)

Summary Report:

Action Item:

Shingles – Best Practices Guide: NAPA Update – Richard Willis (NCAT)

Summary of Report:

Action Items:

Performance of Recycled Asphalt Shingles in Hot Mix Asphalt – TPF Project, Conclusions and Recommendations – Chris Williams (Iowa State University)

Summary Report:

Action Items:

Break

NCHRP 9-46 High RAP Mix Design – Conclusions and Recommendations – Randy West (NCAT)

Summary Report:

Action Item:

High RAP Mixtures: Properties of Plant Mixes Containing High Asphalt Binder Replacement – Conclusions and Recommendations – Gerald Huber (Heritage Foundation)

Summary Report:

Action Items:

Lunch

Northeast High RAP Pooled Fund Study – Conclusions and Recommendations – Jo Daniel (University of New Hampshire)

Summary Report:

Action Item:

Recycled Binder Percentages for AASHTO M 323 – Resolution of AASHTO Comments – Lee Gallivan (FHWA)

Summary Report:

Action Item:

Identify Top Priorities to Transition to Mix ETG (Action Items) – Gerald Huber (Heritage Foundation)

Summary of Report:

Action Item:

Accomplishments of RAP ETG and Acknowledgements – Gerald Huber (Heritage Foundation)

Summary Report:

Next Meeting

Adjournment
Chairperson Huber asked if there were any other items to be brought before the ETG. Hearing none, Huber adjourned the meeting at PM.

Action Item Summary:

ATTACHMENT A:
Recycled Asphalt Pavement Expert Task Group Meeting Agenda
July 24, 2012
Washington, DC

8:00-8:15	Welcome and Roll Call (Introductions) Action Items from 2011	Huber
8:15-8:30	Approval of Minutes from last meeting(s)	Gallivan
8:30-9:20	**Standing Committees & Task Groups**	
	RNS: Advancing Studies, e.g., 9-55 etc.	Pappas
	RNS: Experimental Design for Field Validation of Tests to Predict Cracking in Asphalt Mixtures- Updated	West
	RAP Use Survey for 2013 and beyond	Pappas
	NAPA/FHWA Survey Update	Copeland
	Shingles - Best Practices Guide: NAPA Update	Willis
9:20-10:00	Performance of Recycled Asphalt Shingles in Hot Mix Asphalt - TPF project, Conclusion & Recommendations	Williams
10:00-10:30	BREAK	
10:30 – 11:30	NCHRP 9-46 High RAP Mix Design - Conclusions & Recommendations	West
11:30 – 12:00	High RAP Mixtures: Properties of Plant Mixes Containing High Asphalt Binder Replacement – Conclusions & Recommendations	Huber
12:00-1:15	LUNCH	
1:15-1:45	Northeast High RAP Pooled Fund Study– Conclusions & Recommendations	Daniel
1:45 – 3:00	Recycled Binder Percentages for AASHTO M 323 – Resolution of AASHTO Comments	Gallivan
3:00 - 3:30	BREAK	
3:30 – 4:30	Identify top priorities to transition to Mix ETG (action items) Need for case studies Roll of Shingles – Development of Technical Information RAS Best Practices Combination of WMA, RAS, RAS RAP in rubber modified pavements AASHTO & NAPA Surveys	Huber
4:30 – 5:00	Accomplishments of RAP ETG and Acknowledgements	Huber

All are welcome to stay for the Warm Mix Asphalt Technical Working Group Meeting starting tomorrow at 8 am!

Attachment B

FHWA Recycled Asphalt Pavement Expert Task Group Members

Chairperson:
Gerald Huber
Heritage Research Group
7901 West Morris Street
Indianapolis, Indiana 46231
Phone: 317-390-3141
gerald.huber@heritage-enviro.com

Co-Chairperson:
Lee Gallivan
Federal Highway Administration
Office of Pavement Technology
575 N. Pennsylvania St., Room 254
Indianapolis, Indiana 46204
Phone: 317-605-4704
Victor.gallivan@dot.gov

Members:

Hussain Bahai
University of Wisconsin-Madison
3350 Engineering Hall
1415 Engineering Drive
Madison, Wisconsin 53706-1691
Phone: 608-265-4481
bahia@engr.wisc.edu

Phil Blankenship
Asphalt Institute
Lexington, Kentucky
Phone:
pblankenship@asphaltinstitute.org

Don Brock
Astec Industries, Inc.
P.O. Box 72787
Chattanooga, Tennessee 37407
Phone:
dbrock@astecindustries.com

Audrey Copeland
National Asphalt Pavement Association
5100 Forbes Blvd.
Lanham, Maryland 20706
301-731-4748
Audrey@asphaltpavement.org

John D'Angelo
D'Angelo Consulting
8528 Canterbury Dr.
Annondale, Virginia 22003
Phone:
johndangelo@dangeloconsultingllc.com

Jo Daniel
University of New Hampshire
W171 Kingsbury Hall
Durham, New Hampshire 03824
Phone: 603-862-3277
Jo.daniel@unh.edu

Jon Epps
Texas A&M University – TTI
3135 TAMU
College Station, Texas 77843-3135
Phone: 979-458-5709
j-epps@tamu.edu

Bob Forfylow
LaFarge Canada, Inc.
10511 15th Street S.E.
Calgary, Alberta, Canada T2J 7H7
Phone: 403-292-1585
Bob.forfylow@lafarge-na.com

Mike Harnsberger
Western Research Institute
365 North 9th Street
Laramie, Wyoming 82072
Phone: 307-721-2334
mharns@uwyo.edu

David Lippert
Illinois DOT

Phone: 217-782-7200
David.Lippert@illinois.gov

Andy Mergenmeier
FWHA

Phone: 410-962-0091
Andymergenmeier@dot.gov

Jim Musselman
Florida DOT
5007 NE 39 Avenue
Gainesville, Florida 32609
Phone: 352-955-2905
jim.musselman@dot.myflorida.com

Jim Pappas
Delaware DOT

Phone: 302-760-2400
james.pappas@state.de.us

Randy West
National Center for Asphalt Technology
277 Technology Parkway
Auburn, Alabama 36830
Phone: 334-844-6228
westran@auburn.edu

Kurt Williams
Washington Department of Transportation
P.O. Box 47365
Olympia, Washington 98504-7365
Phone: 360-709-5410
WilliKR@wsdot.wa.gov

Ed Johnson
Minnesota Department of Transportation
1400 Gervais Avenue
Maplewood, Minnesota 55109
Phone: 651-366-5465
eddie.johnson@state.mn.us

Becky McDaniel
Purdue University
P.O. Box 2382
West Lafayette, Indiana 47906
Phone: 765-463-2317; ext. 226
rsimcdamni@purdue.edu

Hamid Moussavi
Caltrans

916-274-6176
Hamid.moussavi@dot.ca.gov

Dave Newcomb
Texas Transportation Institute
3135 TAMU
College Station, Texas 77843
Phone: 979-458-2301
d-newcomb@ttimail.tamu.edu

Ron Sines
Oldcastle Materials
14 Monument Square, Suite 302
Leominster, Massachusetts 01453
Phone: 978-840-1176
rsines@oldcastlematerials.com

Dale Williams
Missouri Asphalt Pavement Association
P.O. Box 104855
Jefferson City, Missouri 65110
Phone: 573-635-6071
dalewilliams@moasphalt.org

Richard Willis
National Center for Asphalt Technology
277 Technology Parkway
Auburn, Alabama 36830
Phone: 334-531-3150
Willi59@auburn.edu

Attachment C
Proposed Organization of FHWA's RAP ETG

Standing Committees

- **Targeting Low RAP Usage States**
  - Purpose: Identify agencies with low or no RAP, identify what is restricting contractors from using more RAP if it is allowed in a state, and assemble information to provide to state agencies with low or no RAP
  - Lead: West
  - Members: Sines, Musselman, Pappas
  - Activities:
    - TRB Webinar "Design and Production of High Reclaimed Asphalt Pavement Mixes" http://www.morerap.us/RAP%20Resources/webinar.html
    - NAPA document How to Increase RAP Usage and Ensure Pavement Performance
    - Identify target states to go to and promote RAP usage
    - Pamphlet on RAP FAQ (West)
      - Review by Gallivan, Copeland, Corrigan, Newcomb, Sines

- **Coordinating Development of Research Needs Statements**
  - Purpose: To coordinate the RNS developed by the RAP ETG and present the RNSs to the appropriate AASHTO tech section.
  - Committee Lead: Pappas
  - Members: West, Huber, Copeland
  - RAP RNS
    - Cracking – outline for broad project including ALF, labs, etc., lab prediction test, link to performance, Lead: West
    - WMA & RAP/RAS , Lead: Corrigan
  - RAS RNS
    - RAS use and processing (expanding on Chaignon's presentation at Shingle Forum), Lead: Huber

- **RAP Use Survey**
  - Lead: Pappas (Cecil Jones)
  - Members:
  - Survey was conducted in 2007, 2009, and 2011.

- **High RAP performance from previous projects and field studies**
  - Lead: West
  - Members: Epps, Daniel, Musselman
  - Activities:
    - Request reports on performance of RAP mixes from state engineers
    - Contact states with 25% or more RAP for performance data
    - Analysis of LTPP SPS-5 RAP sections

- **RAP ETG website**

  - Lead: Willis
  - Members: Sines, Mergenmeier, and Copeland
  - www.moreRAP.us

Task Groups

- RAP variability document
  - Lead: West
  - Report title: Summary of NCAT Survey on RAP Management Practices and RAP Variability http://www.morerap.us/RAP%20Resources/reports.html
- RAP State-of-Practice
  - Lead: Copeland
  - Assist: D'Angelo, Musselman, Weigel, Newcomb
  - Develop a best practices manual based on current best practices of RAP
  - Final draft ready for publication
- Performance tests for RAP mixes
  - Lead: McDaniel
- Document with 6-10 case studies
  - Lead: McDaniel
  - Assist: Daniel
- Develop Framework for Building/Monitoring High RAP Projects (similar to WMA framework)
  - Lead: Copeland
  - Members: Musselman, Pappas, Harnsberger, Epps
- RAP as percentage of binder
  - Leads: Gallivan/Copeland
  - Members: McDaniel, Sines, D'Angelo, Musselman, Corrigan, Mergenmeier, Williams
  - Framework recommendation to AASHTO for binder replacement/contribution

Other responsibilities for review and comment:

- NCHRP 9-46 recommendations (West)
- Asphalt Research Consortium
  - Binder evaluation (Bahia)
  - Aggregate properties (NCAT rep, Haaj)
- NE States pooled fund study for RAP (Daniel)
- Missouri pooled fund study for RAS performance (Williams)

ATTACHMENT D: Narrative Minutes of FHWA Recycled Asphalt Pavement Expert Task Group Meeting in July 2012

Recycled Asphalt Pavement Expert Task Group Purpose:

The primary objective of the FHWA Expert Task Group is to coordinate, develop, and improve national guidance and recommendations for the asphalt pavement recycling program. This group will provide feedback as well as encourage correct utilization of recycling technologies and address construction problems with current state-of-the-practice solutions.

Tuesday, July 24, 2012

1. Call to Order—Chairperson Gerald Huber (Heritage Research) called the meeting to order at 8:00 AM.

Welcome and Introduction – Chairperson Gerald Huber (Heritage) welcomed the group to the meeting. He noted that the last meeting was May 2011, so he wanted everyone to introduce themselves. He also noted a long list of action items that came from the last meeting.

Action Items Reviewed.
Huber announced copies of the agenda are being passed around the room, and asked everyone to introduce themselves. After the introductions, Huber passed the list of members around the room and Lori Dalton passed a sign-up sheet around the room. Huber noted anyone wanting to be a friend of the committee should check the box on the sign-up sheet.

Purpose/Mission of the ETG
Huber reminded the group on the purpose and mission statement of the RAP ETG. He read the purpose statement of the ETG, and noted the agenda for these meetings is structured around specific topics related to that mission statement.

Huber asked for any questions or comments relative to the agenda; none where noted.

2. Approval of Minutes from Last Meeting – Lee Gallivan (FHWA)
Huber turned the meeting over to Lee Gallivan.

3. Standing Committees and Task Groups Reports

3.1 RNS: Advancing Studies, e.g., 9-55, etc. – Jim Pappas (Delaware DOT)

Summary Report:

ETG Comments, Questions, and Discussion:

Action Items:

3.2 RNS: Experimental Design for Field Validation of Tests to Predict Cracking in Asphalt Mixtures - Updated – Randy West (NCAT

Presentation Title: ***Verbal Report***

Summary Report:
Randy noted this RNS was drafted some time ago and emphaisezed that we need better tests to predict cracking. So it seems to him in selecting the test to be used that we need to develop an experimental plan with that focus – both mix effects and pavement effects. We need real test sections to be used that are well documented in terms of structural and other data elements. So the best way to do the experimental plan is to use accelerated testing facilities for this plan. So the RNS objective is to develop a plan between the APT facilities to develop one or more tests for predicting plan. The plan went out to one of the tech groups of AASHTO and discussed in Vermont meeting about two years ago. He reported it did not move forward from this meeting. He reported some minor corrections were to be made and asked if more information was available.

Audrey noted that the AASHTO tech group said the way the RNS was written was more like a proposal, so it needs to be rewritten in terms of a RNS. She reported that they liked the idea but were not big on its format. Audrey reported that it was submitted to Georgine rather than Eileen in AASHTO. D'Angelo noted that accelerated laoding and its relationship to aging that must be included. He is unsure whether that was a part of the proposal that he thought AASHTO objective to. Randy noted that it was already critized about being too detailed.

Jon Epps noted that he and Matt were assigned another RNS that is not on the agenda. Huber noted this is the time to review its status. Jon Epps noted the discussion was suppose to be brought here – Use of softer asphalt or recycling agents in mixes with recycling agents. Matt gave the title and what its intent was. He referred to the sites to be used and to ensure that there is a strong literature review so there is not or minimal duplication from other projects. Jon noted some of the issues of age hardening and use of softer asphalts. Huber asked what is the plan for the RNS. Jon noted if we do not get it to AASHTO right now, we might as well drop it. Becky noted that Ship Paul has taken over and has been more active in getting some of these moved forward. She also noted any state agency personnel can push this one forward and Skip should be aware of this one. Gallivan should be contact Skip to make sure. Becky said that she would contact Skip Paul about this. TRB committee not planning to move forward with this one. D'Angelo noted that AASHTO is looking for this group for recommending RNS to be moved or recommended to be moved forward. Jon noted he sees no need for a detailed literature review for this topic. Jon asked if Becky was taking this to Skip to find a champion for this one. Becky

agreed. Huber asked individuals from ETG about the importance of this RNS topic. Jon noted Texas and South Dakota are interested in this topic and have RNS out on this topic. Lady back of room noted not sure are the definitive need for this topic. Huber asked where do we go with this. D'Angelo suggested that Huber send this to one of the tech groups as being the chairman of the RAP ETG. Huber agreed that he will take the RNS and contact Tom Baker and ask that he consider it at the AASHTO Subcommittee of materials. Jon noted what it missing is the detailed literature review. Becky noted that there have been a lot of recent studies that included literature reviews --- does not see that as being an issue to hold it up.

Huber asked if anyone knew what the Netherlands is doing because most of their mixtures contain above 50% RAP in their mixtures. Imad El Kadi is visiting over there and reported to him about these high values being typically used. Huber noted it was unclear on how this was being done from a volumetric standpoint. Newcomb referred to the WMA trip to Europe. GAylon noted that most contractors know their materials a lot better and treat their RAP differently than we do by heating and treating the RAP than we do. A lot more processing of the materials. Huber noted the item he was asking was about the recycling agents as a softner. He noted it looks like they are at the leading edge of this technology. It was noted the reason they are using so much RAP is that they do not have good aggregates. Richard Shrek noted they have worked with a Japanese group and the standard policy is to use 80% RAP in base mixtures and 60% in surface mixtures. He reported that said they would be out of business if they only used 40% RAP in mixtures. Jon noted this is probably more important than we think it is. Huber agreed and asked Matt to make tweeks to the RNS and he will follow up with Tom Baker. Huber also asked Randy West about the test RNS. Huber asked that Randy send him the RNS on testing predicting and he will forward it to Tom Baker. D'Angelo suggested the RNS be submitted with a letter so that they will have something to act on. Huber noted that is why he asked Randy and Jon to send him the RNS statements.

ETG Comments, Questions, and Discussion:

Action Item:

3.3 RAP Use Survey for 2013 and Beyond – Jim Pappas (Delaware DOT)

Summary Report: PowerPoint presentation

Jim Pappas started with a summary report on the questions to be asked so he wanted to ask the group what type of questions do we want to ask. This survey dovetails with Audrey has been doing. He asked What questions do we ask relative to RAP and RAS. Jim noted he is no longer the representative from Delaware, but Jennifer F. is the person and she said that she will push this out the door. Audrey noted one of the items previously discussed was added rubber to the list of questions or materials. James M. agreed with that statement because they get bombarded with different surveys so combining them is good. Jon asked is there anything in performance in the questionnaire. Jim replied yes. Jim noted that they do not plan to send it out until after about 1 to 2 months. So anyone wanting to add something that is possible.

Jim then overviewed the questions that they were planning to ask. Starting with the basic ones first. He showed the questions to be included on the 2010 RAP survey, including WMA, and reviewed each one on the list. Question #10 he considered an important question. After reviewing the questions for RAP he then moved to the questions for RAS. After RAS he discussed the RCA, recycled concrete asphalt questions. Shane Buckanan asked can you break this down by layer. Jim noted yes and the states when they replied broke it out by layer. Ron Sines asked about returing the RAP to the agency and how it is being used --- maintenance material. He also asked about including the gradation information. The last comment was it would be nice to see if the answers are the same between the agency and contractors as opposed to what the agency thinks the contractors are doing. Jim noted a 70% response, and after bugging them, all but one or two states responded. Basically all states responded to the questionnaire. Audrey noted about asking … Richard Schrek suggested that the same survey be sent to the state pavement association to see how different the answers or replys are between the two. He commented that many times the answers are incorrect. Then you can focus on the differences. Audrey agreed with that suggestion and suggested they send the survey out to the pavement associations. Jim agreed. He also suggested that the questions go out with the minutes and then send him any suggestions or comments and he will send those out to the individuals.

ETG Comments, Questions, and Discussion:

Action Items:

3.4 NAPA/FHWA Survey Update – Audrey Copeland (NAPA)

Summary Report:
Verbal report.
She reported the survey was done last year between Newcomb and Kent Hanson. Audrey will briefly cover the results and this information is available on the NAPA website. She passed out a summary of the survey. Need to get copies. She also reported that this survey is being repeated right now and encouraged all contractors involved to respond. Audrey summarized the results from the survey. Ron asked about the total tonnage went down but the average percentage increased with RAP in HMA. Audrey agreed. After RAP she then moved on to RAS included in the survey. Summary was included in her report. After RAS, she summarized the use of WMA as an overview. She noted that the percentage of WMA will be around 25% in 2011. She also reported foaming was the more common technology used. Newcomb agreed that the percentage decreased between 2009 and 2010 on the use of WMA regarding plant foaming.

ETG Comments, Questions, and Discussion:
Huber noted about Shreck suggestion to send the same survey to state asphalt pavement association. Audrey noted the different surveys that are going out. The survey she is referring to is the one that goes to the actual companies, so no it will not go to the directors of the asphatl pavement associations.

Action Items:

3.5 Shingles – Best Practices Guide: NAPA Update – Richard Willis (NCAT)

Summary Report:
Verbal report.
Richard Willis summarized the work that has been done related to shingles. To this point, the Construction Recycling Associations has put out this best practices guide wasa more for shingles processing and not related to including it in mixtures. It only briefly talked about the end use. Only a paragraph or two on mixture design. So what they decided to do is to provide more guidance on characgterization and what are the best way to determine the shingle gradation related to use in HMA. They are developing a document that is going through a peer review that will go out that solely looks at characgtetrizatiohn of the material. She also noted that Crhis Williams is looking into what impacts the HMA characterization related to including shingle in the mix. How to determine the properties themselves and not how to put them into the mixture design process itself. They are trying to minimize the overlap between each one.

Huber asked about the three documents being prepared: processing the shingles, determining properties, and effect of shingle on performance. His goal is to get the determining properties document to the committee by the end of next week. Gallivan asked about sending the version that goes to the steering committee it will be distributed. Huber noted then then ETG can take that document and go forward. Gallivan said that answered his questions.

No further questions for Richard.

ETG Comments, Questions, and Discussion:

Action Items:

4. Performance of Recycled Asphalt Shingles in Hot Mix Asphalt – TPF Project, Conclusions and Recommendations – Chris Williams (Iowa State University)

Presentation/Report Title: Performance of Recycled Shingels in HMA Update of Pooled Fund Study TPS-5(213)

Summary Report:
Chris noted this is a 3 year study and it should be completed December by this year. He acknowledged Andrew Cascione and others that are involved in the study.

This report covers the results from this study. He noted that Missouri is the more aggressive state related to this topic an is the lead agency on this pooled fund study. He mentioned Audrey was the point person before joining NAPA and now Gallivan is the point person. He overviewed the different tasks.

Agency interests in RAS: he reviewed the research interest of each agency included in the study in a tabular form. These included Iowa (percentage of RAS), Minnesota (Post-manufacturered versus post consumer RaS), Missouri, Indiana, Colorado (replacement of RAP with RAS), Illinois (RAS in SMA), Wisconsin (RAS with RAP and 3G as a late compaction aide). From that Chris showed the laboratory testing plan summary and the different tests that were completed by the different agencies. Williams then overeview the RAS properties in terms of gradation and how they varied by agency. He also presented the binder content and high PG value.

Williams then showed some photos from each of the demonstration projects, starting with the Iowa Demonstration project. He also summarized the experimental plan for the Iowa demonstration. He reported that shingles do have an impact on gradation but it is very minor. He then summarized some of the performance testing that was completed. The mixtures start to deviate on the high temperature side and are close on the cold temperature side. The flow number significantly increases with higher RAS. The four point bending beam test shows a decrease with increasing RAS. He then overviewed the SCB for low temperature testing and there is an optimum but that lead into many more questions in terms of why the values or mix reacted as it did. Is it a process of the test, mixtures, etc. He then showed some photos of the mixture after time. Reflective crack from he JPCP. He then summarized the Iowa Pavement Evaluation for transverse cracking. He emphasized what they are seeing in the field after a couple of years is reflecting what was measured in the laboratory with the SCB.

Moving on to the Minnesota demonstration project. First the mix properties were illustrated or summarized in the same manner. He noted not a lot of difference between the high and low temperature sides across the board. Illustrated the gradations and then overviewed the test results. Similar results to the Iowa study but more divergence with some of the mixtures. Shingle performing better than for the RAP in terms of fatigue. SCB – no difference between the shingles and 30% RAP. Pavement evaluation there are differences between the different mixtures related to transverse cracking. There are differences but it might not be that great.

Missouri demonstration project. Missouri went with the fine grind mixtures based on visual observations after placement and compaction --- it was very evident. He showed a photo of the surface texture of both the fine and coarse grind. Next was the mixture properties comparison. He noted there is a significant difference between the fine and coarse grind in terms of low and high temperature properties. Test results in terms of E* results are similar to what others found. Chris noted no flow number failure between all different mixtures so they compared the percent strain vlue at 10,000 cycles. No statistical difference between the SCB results of all samples. Pavement evaluation: the control had a lot less cracking within a year. The coarse grind section had much more cracking.

Indiana demonstration. Becky asked about the difference between RAS. Chris noted that was an error, they are both post consumer. It did not change between the HMA and WMA. Chris noted they followed the LTPP distress identification manual on all pavement surveys. For this project the WMA section exhibited a lot more cracking.

D'Angelo did you do any long term aging. Chris replied no long term aging only looked at up front conditions.

Lookiing at the last slide, is this more of a post consumer effect difference or a difference between WMA and HMA. He asked for Chris opinion. Chris noted there are interaction effects and the focus was on shingles and what was the impact of WMA. It is hard to say and there is some interaction effect so it is hard to say what is the pure contribution effect on cracking between WMA and HMA.

Colorado demonstration project. Chris showed pavement condition prior to overlay – extensive cracking. He then summarized the mix properties but noted they did not have the test results for this report to show how the high and low temperature properties of the binder changes.

Illinois demonstration project. Not all test results completed.

Wisconsin demonstration project. Not all test results completed.

Chris then showed a summary of all properties or project mix properties between the demonstration project for the SCB fracture energy results.

Chris then provided a summary of the remaining work to be completed. This included: continue to evaluate pavement performance, continue laboratory testing and analysis of results, Illinois and Wisconsin demonstration projects, …

He then spend some time on the RAS education part of this project, he mentioned there are a lot of people out there that do not have a lot of knowledge about this technology. You need to know where those shingles came from and what qualifies for them to be used in your state. He referred to the different plant configurations and mentioned that one size does not fit all. He mentioned contractors introducing the shingles closer to the hot zone which is a good idea. And preventing the shingles from clumping up. Related to volumetrics – utilizing about 80 percent of the binder in the shingles, not utilizing all of the available binder – typically this value is about 70 percent and you have to look at what are the effects on the VMA and other volumetric properties. Intergration with other technologies Best off doing the mix tests to capture the effect of the fibers. He noted in Iowa they are using the Hamburg device for comparing the different mixtures. He encourages others to consider the use of shingles in SMA, his opinion is that this is the best mix for utilizing the RAS.

<u>ETG Comments, Questions, and Discussion:</u>
D'angelo is IOWA doing any long term aging of these mixtures. You are assuming that the long term aging is the same. Chris replied items or mixtures will not age the same which is a far

statement and had a discussion on including long term aging but that would have expanded the experiement a lot. The agencies made the decision not to consider or use long term aging. He also mentioned as of 2009, the right protocol to use for long term aging had not been agreed to. He agreed with the point about long term aging from D'Angelo.

Rienke made a comment that shingles ages very quickly and if you look at the recovered binder relaxation modulus or mix relaxation modulus you will see a big difference in the slopes between RAS and no RAS. Reinke mentioned that initially the properties look great before aging at day 1, but after aging the RAS mixes look significantly worse. He suggested that we need to look at aging before making a final decision. We must not loose sight of this last step. Chris mentioned that the decision was made by a lot of discussion and based on what was known in 2009. Reinke asked about the temperatures for the WMA that exhibited more cracking. Was the temperature below the softening point of the shingles – maybe you did not soften the shingles asphalt. Chris explained that all temperatures were the same.

Randy West asked or mentioned that the SCB test and field performance related to transverse cracking, based on what you have did the SCB do a good job to simulate field performance. Chris noted in some cases it did a good job, while in other cases it did not. He mentioned that you do see differences in SCB results between labs for testing the same mix. He also mentioned the range of age between when the projects were completed. Second point was related to the mix design, related to shingle binder and others. Chris recognized that more work needs to be completed in this area. Randy noted he disagrees with the factor included in the current AASHTO mixture design procedure. He does not believe that you can combine all of the factors and make a decision about the mixture. He would rather do the mix testing. Chris agrees especially with the low temperature cracking properties.

Frank Fee do you have all of the information about the plants and how the material was handled during construction. Chris replied yes and it will be put into the reports.

Huber to follow up on Randy's question relative to mix design. Huber noted that the process Chris used is really fairly close to the AASHTO process written up. You have to add more asphalt. Chris disagreed because they get different asphalt utilization with different RAS. Randy noted and commented that is exactly what AASHTO recommends but the assumption incorrect is that fibers have no effect. There was a significant debate on the asphalt utilization impact for use of RAS and what factors are affecting the design of the mixture. Huber the shingle asphalt contribution is significant and there is a contribution but not for the entire amount of asphalt. Ray Bonaquist noted that his biggest point is that someone needs to create a mechanism that these projects need to be monitored beyond the project to evaluate whether raveling and other material distresses start to occur to answer this debate about binder utilization from the RAS and if it is being properly or improperly considered.

<u>Action Items:</u>

Break

Gallivan asked that all sign the signup sheet.

5. NCHRP 9-46; High RAP Mix Design – Conclusions and Recommendations – Randy West (NCAT)

Presentation Title: ***NCHRP 9-46 Improved Mix Design, Evaluation, and Materials Management Practices of HMA with High RAP Content***

Summary of Presentation/Report:
Randy mentioned he will go through the short version of the procedure, so there will be more time available for discussion.

Randy started with the Project Objectives which included: provide guidance on characterizing RPA, revise mix design procedure for high RAP contents, …

Best Practices for RAP Management. Randy overviewed the contents of the product. He also mentioned that Ron Sines, Huber and he have done the webinars which are available from the website. He also overviewed the contents within the document – sources of RAP, processing, inventory analysis, sampling guidelines, handling RAP in the lab, testing operations, and consistency of guidelines. He noted that these items will be included in the presentation.

Randy overviewed the experimental plan included in the project. The plan included 4 sets of mamterials from New Hampshire, Utah, Minnesota, and Florida. The RAP contents included 0, 25, and 55 percent or 0 and 40 percent RAP. Two binder grades and two binder sources were included. The test results and comparisons included volumetric properties and other tests.

West then overviewed the volumetric and other test results from the experiment. He started with the volumetric properties.
Dynamic modulus testing and they looked at how much did RAP stiffen the mix in terms of how it affected the pavement design. He mentioned that they have looked at this on their test track and if used properly, it can be a beneficial effect. He overviewed a summary of the E* statistical analyses: RAP content had a significant effect on E* at all temperatures and referred to Chris Williams presentation related to log-log plots may not show the difference that really exists; E* of high RAP content mixes were significantly higher than for virgin mixes; Virign binder grade did nto have a significant effect on E* at low temperatures – the influence o fthe virgin …

Moisture damage susceptibility – AASHTO T 283 was used and increasing the RAP contents generally increased conditioned and unconditioned tensile strengths, TSR can be misleading – ALTHROUGH both conditioned and unconditioned tensile strengths increase, TSR values can decrease. A lower TSR criterion with a minimum conditioned tensile strength can help.

Flow number was the rutting test used in the experimental plan. They started using a confined test procedure but he believes they should not have continued to use the procedure with a confining pressure. They did not get any flow. He recommends going forward without using a

confined test procedure. He believes the preliminary criteria put forth are reasonable. The results indicate: high RAP content mixes had statistically equal deformation compared to the virgin mixtures, …

Tests considered for the fatigue cracking test. He mentioned that they were planning to use the NCSU simplified viscoelstic continuum damage test but it had not been completed when this project started. They are not a fan of using the Texas Overlay Tester because of the unrealistically high strains that are recommended for use in this test. They also considered the Semi-Circular Bend test and considered the use of the IDT fracture energy test by Rey Roque.

Randy then moved to explaining the fracture energy test and how it is used for comparing between specimens. He did note that sometimes the RAP mix had lower fracture mix than the virgin mixtures. He also noted that the samllere NMAS had higher fracture energy.

Low temperature cracking used the Mihias procedure suing the Semi-Circular Bend (SCB) test. Randy noted this slide is incorrect. With higher RAP contents the fracture toughness went down and the fracture energy increased (CHECK THIS WITH RANDY). The others on this slide are correct.

General guidelines was presented by Randy in terms of their results. When we talk to RAP terminology we need to make sure we understand the terminology being used and to use the same terminology. He started with the definitions for processing, fractionation, RAP content, RAP binder ratio that Randy prefers to use, and warm mix asphalt.
Sources of RAP – can be open, just meet superpave aggregate requirements for mix design.

Quality control of RAP is very important and they have recommendations for sampling the stockpiles multiple times but not to combine the samples so that variability can be determined, reducing samples to test portions, and inspected for deleterious materials, QC results reviewed for stockpile approval. Randy felt deleterious materials content is very important and determining it is worthwhile.

West then showed what they are recommending for the sampling and testing guidelines for asphatl content, recovered aggregate gradation, recovered aggregate bulkd specific gravity, and binder recovery an dPG grading. He referred to the study done with Elie Hajj at UNR for developing these guidelines. West noted that the study with UNR and recovering the asphalt with solvent extraction, the ignition oven and then calculating the BSG and other properties there are errors in the last option that should not be used for high RAP content methods for determining BSG. Randy noted the problems with the solvent extraction, aggregate correction with the ignition oven, and must know the asphalt absorption. Randy believes this is one of the most important findings from the study – no longer calculate because of potential errors but measure the recovered aggregate bulk specific gravity by AASHTO T 84 or T 85.

High RAP Content mix design: Aggregate properties must meet superpagve criteria; Randy also is going to use the term RAP – Binder Ratio rather than Binder replacement. Virgin binder selection is based on the RAP binder ratio as the following: RBR less than 0.15 use binder grade

required for environment, traffic, and structural layer (i.e. may include polymer rmodifie dbinder); RBR 0.15 to 0.25 use the standard binder grade for the climate (no polymer modified binder) If the mix is produced 25 F lower than equiviscous mixing temperatures, the RAP binder ratio may be increased to 0.35 with the standard binder grade. This is the most controversial recommendation because adding polymer modified binder to higher RAP mixtures could make the mix stiffer and create more cracking. Randy did mentioned that some of these recommendations have been based on results from the test track and not within this project. Virgin binder selection: If the RAP binder ratio is …

Mix Designs for high RAP Contents: Designmix to meet M 323 and the following:
Always use moisture susceptibility using TSR or Hamburg device.
Permanent Deformation – mixtures within the top 50 mm – AMPT flow number or APA – West mentioned that many mixtures with high RAP, this is not needed.
Fatigue, surface and base mixtures, for information purposes only: West is not confortable recommending a fracture test or cracking test that can be used on a routine basis. West showed the fracture energy because they have been using this test, but there are other options out there. This is the reason for their RNS.
Low temperature for cold climates for climates where this is important is must do some type of low temperature test. West included some options that have been used and listed many. He had no specific recommendation for a specific test to be used.

West noted the draft final report went to the panel a couple of weeks ago.

ETG Comments, Questions, and Discussion:
Hiafang – what did you base your recommendations on, field or lab. West; we used both to come up with our recommendations, it is a collection from different sources. Hiafang – how convincing is it with the laboratory tests. West noted there is a body of work out there to show certain tests are better for estimating performance. He did not recommend one over the other to identify a good test suitable for routine use for cracking.

D'Angelo – for a high RAP mix what is the impact for high volume road with a thick strucgture it might improve performance but on a low volume road that might make it more susceptible to cracking because of increased deflections. West great point and he agrees that we need to consider properties and how they are used in pavement structure to improve performance. West referred to a slide of the perpetual pavement to reduce strains below some critical value. He noted where RAP mixtures do really well is where they are used in the middle layers – high stiffness mixtures. He cautioned against putting high RAP layers at the bottom because they are less strain resistance. D'Angelo referred to some of the examples where mixtures at the bottom layer are stiff but use a higher binder content to make them more strain tolerant. West agrees with using mixtures or SMA in the surface with RAP and RAS.

Do you have any recommendations for fractionating the RAP. West fractionating did not necessarily improve the RAP but it is useful from a mixture designers standpoint from a volumetric basis, so he is not against fractionating the stockpiles or RAP but not really needed form a production standpoint but is useful from a mixture standpoint.

Anotehr question realted to the use of film thickness. West is not a fan of film thickness because it is a calculated parameter and heavily dependent on minus 200 material.

Richard Schrek – when SMA was first brought to the U.S. you had to use one grade stiffer to ensure good performance based on climate. He believes you need to be looking at a higher binder content because you have a stiffer mix. He believes a mistake we are making is that we are trying to stay at the same binder content for higher RAP mixtures. He believes you have to look at the true binder grade for the virgin binder – must know where you are starting from with the true grade of the RAP binder. West agreed with Richard's comments. West definitely agrees with the comment about the binder content needing to be higher for higher RAP content mixes. West explained that they looked at different test properties and found that they needed a higher asphalt content to improve the properties. This was confirmed from Richard Willis. West noted there are some things that a mix designer can do for improving the cracking resistance. He believes that we need tests to indicate whether adding the additives or binder will make an improve.

Elie Hajj how does adding dust change the process or properties or is it important. West noted for designing all mixtures they stayed within the current criteria which controlled the amount of fine RAP that could be used.

Huber what are the next steps coming out of this project. West noted the normal process is to get feedback from the panel and then the final report is published. West noted if you go back and look at the earlier presentations, things have changed since those first presentations – this is evolving.

Action Item:
No action item from this report/presentation.

6. High RAP Mixtures: Properties of Plant Mixes Containing High Asphalt Binder Replacement – Conclusions and Recommendations – Gerald Huber (Heritage Foundation)

Presentation/Report Title: ***High RAP Mixtures – Properties of Plant Mixes Containing***

Summary of Presentation/Report:
This project or effort was set up to determine how much RAP can you put through a plant and have a quality product that meets all of the mix design requirements. The considerations used were quality of the product, and others.

Is RAP available – yes it is! So how much RAP can you get through a plant. This was the scope of the project. The trials included up to 70 percent RAP. Huber likes the term used by Randy – RAP Binder Ratio. This was a field project and Huber gave the typical values that are typically used.

Phase I was summarized in terms of the plant details and other items. Huber showed slides of the plant for drum. He summarized the phase I mixes that were used. He showed the discharge

temperatures from the plant. Thee next was the aggregate temperature. Drum temperature was measured on the outside of the drum.

Huber showed photos of what the RAP mixtures looked like. Huber mentioned that the 60% RAP mixes pretty well, but the 70% RAP did not mix or have adequate coating very well. So they decided that 50% RAP was the maximum. He also listed the controls for each item – drum shell temperature, aggregate temperature…

Huber then went to Phase II experiment and summarized the equipment and showed photos of the plant. Huber then showed and summarized the details of the mix components and asphalt binder replacement values. Huber then summarized the properties and most were as expected.

Blending analysis demonstrated and Huber noted what they were most interested in was the calculated and measured high and low grade temperatures.

Cantabro Loss Test for durability – This is the LA abrasion test without the steel balls. This durability test did not show any problem or difference between the different mixtures.

Placement was the next item discussed. Huber gave some specific details of the construction conditions. This was not a density acceptance product or project.

Paving crew observations – what about hand work. Not too much hand work needed on project.

Phase I conclusions – 50% is a reasonable option or reasonable maximum for these two plants. Volumetric properties can be controlled with 50% Rap and with 67 % …

ETG Comments, Questions, and Discussion:
Frank Fee – did the binder grade make a difference. Huber referred back to the graph and said yes it did not a difference. Fee clarified what about in the field. Huber no difference in the field.

Gallivan – where would you like to go with this? Huber not a lot of elaborate testing here. There is a lot of RAP available in this area so the county engineer is interested in accepting a higher RAP content than not allowed by the current specifications. Huber noted what are some of the upper limits for the technology we are doing today and it appears 50% to be the value.

Chris Williams noted there are some cost effective rejunevators out there that can improve some things. Huber agreed.

Ron Sines what about the criteria or length of the mixing chamber when they are different between the two plants. Was there any consideration giving to looking at the different flight designs for lower volume production on the mixtures. Huber noted that the embedded burner was a Gencor but was unsure what the distance was between the mixing chamber. Huber noted the limitation of the volume of RAP through the chamber where the RAP is introducted to the mix or drum.

Shane Buchanan – What about storage time. Huber noted he did not recall what the storage times was for these two projects.

D'Angelo what about the RAP piles were they covered, dry weather, etc.? Huber noted the material was damp. The piles were not covered. Richard Scrhek – one of the items that we do not discuss in the equipment or plant limitations that limit the amount of RAP. What ever percent we are tring to run let s just heat up the virgin aggregatgee to heat the RAP, He noted that is not the current approach to be used other others in the world. The RAP is preheated to decrease the amount of heat the virgin aggregate. Heating the aggregate very high changes the mix and ages the mix. There are other ways of getting there. Huber agreed with those comments. He noted it cooked the asphalt that severely aged the binder. Geoff Rowe also noted the effect of heat transfer and if it is being obtained and what about the effect of aging on the binders. We probably need to redesign the drums for these high RAP content mixes. Huber agreed.

Action Item:

Lunch
Reconvene at 1:15PM because lunch is not being served.

7. Northeast High RAP Pooled Fund Study – Conclusions and Recommendations – Jo Daniel (University of New Hampshire)

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

Summary of Report:
Jo mentioned she will give the group a quick update and status of what is going on and will show the data that has been collected with focusing on the more recently collected data. She will leave time to review and discussion on what is suggested for the remaining 2 years.

Current participants include NHDOT which is the lead agency, …
The high RAP pooled fund study objectives: contractors have volunteered tto produce mixes at different RAP conents, mixes samples and taken to lab for testing, SGC specimens compacted at the time …
Testing that have been completed. Jo acknowledged that Gerry Reinke has been involved in this study with some of the testing.
An outline of the presentation includes a summary of what has been completed under Phase I testing in terms of stiffness, fatigue, an dlow tempereature cracking. The phase II silot storage study by extracting the binder and stiffness measurements.
Jo overviewed the Phase I mixtures in terms of 2010 production. She noted that they do have a batch plant included in the plan and two drum mix plants.
Published results summary: Jo identified the different papers and reports from the study. These included the AAPT 2012 paper by Mogawer, et al, and increased RAP generally increased

stiffness and decreased cracking resistance, softer binder grade effective in some cases for mitigating increase in stiffness and cracking, apparent effect of plant production (silo storage temperature) on stiffness, and reheated materials stiffer effect of RAP and /or silo storage time – this lead into the storage study to explain some of the differences in results. More details in the AAPT paper.

Phase I – the current results summary to be reviewed; Jo noted she is just going to present the New York mixes rather than for all mixes, but all testing have been completed for all mixes.
Fatigue life prediction NY PG 64-22: As you increase the RAP content they are seeing better performance in terms of fatigue. The 40% RAP mix the rankings change at the higher strain level. At the lower strain level the rankings are different and consistent with increasing fatigue life with increasing RAP level up to 40 percent.

Endurance limit for NY mixes with PG64-22: The endurance limit is increasing with RAP content. Jo also demonstrated the effect of temperature and RAP content on the endurance limit. This is probably a stiffness effect.

SVECD fatigue summary: higher RAP contents generally higher cycles rankings…

Low Temperature extracted binder results: Four different methods were used for looking at low temperature effects with increasing RAP content. The critical cracking temperature is the BBR.
Low temperature mixture testing results: Two tests were used here, the IDT and the TSRST. They are still looking into what caused the warmer temperatures for using the IDT. Jo mentioned they have yet to complete the SVECD but will have it shortly.

Testing and Analysis parameters: The different methods and analysis methods being looked at are becoming very important in terms of initial temperatures and cooling rates can be significant. This slide compared the different initial temperatures and cooling rates used. They used the TCMODEL to evaluate the impact of cooling rate using the NY40% PG64-22 material. D'Angelo mentioned that SHRP looked into the cooling rate effects and found differences. He also mentioned that the cooling rates at the surface and at the center of the specimen were different and stresses built up differently. Jo noted that when presenting data from different tests, these values are usually not reported or considered and they can be important because you need to know where you are on the relaxation curve. Elie Hajj mentioned that they are calculating the relaxation modulus and use different cooling rates. Geoff Rowe noted that poisson's ratio effect in terms of loading conditions can make a significant difference in the results.

Low temperature summary: generally warmer cracking temperatures with increase in RAP content, softer …

The next topic was the silo storage study. Callanan 12.5 mm mix with PG64-22 – two mixes or conditions included; a virgin and 25% RAP mix. With 0. 2.5, 5.0, and 7.5 hours of storage.
The mix testing included plant compacted specimens and loose mix collected and compacted in the lab with using E*, fatigue and TSRST tests; the binder extraction and recovery was done by Gerald Reinke…

Jo showed a graphical comparison of the test results on the storage time – longer storage time, the stiffer the binder.
Switching over to the mix: Plant compacted dynamic modulus with 25% RAP mix; 0 and 10 hours storage time had the statistical differences, the others were considered indifferent.
Lab compacted dynamic modulus
Randy West suggested using the terminology of hot compacted and reheated in terms of identifying what types of specimens were used.
Summary of the silo storage time study.
Next, Jo presented the TSRST results in terms of silo storage times.

High temperature grade virgin recovered results. Results showed longer storage times created softer materials. Do not understand why this was happening so they reran some tests. Asked why. Ron Sines asked about the fuel for the plant? Jo did not know. Randy West noted about where the material was relative to the cone in terms of temperature? Frank Fee asked if anti-strip was used. Jo did not think so. Plant operator told them that a different asphalt was used to empty the tank at the end of the year. A harder asphalt was used at the beginning in comparison to what was used at the end. Thus, all of the time zero specimens and mixtures are being redone.

Jo reviewed the work that is continuing. Phase II mixtures includes the NH mixes and field sections, VA mixes and 2012 mixes. New virgin silo storage study mixes, NCSU work refining fatigue criterion for RAP mixes in SVECD approach, and low temperature …

Discussion, Questions, Comments:
Nelson Gibson looking at the pavement structure can you comment what type of strain level these mixes will see. Jo replied that is one item that they have not done yet, but plan to do.

Geoff Rowe noted one of the items is linking the binder and mix properties, what would be nice to do is to take the binder analysis and take the rheology properties and then look at those parameters and compare those to the same parameters determined from the mix. Jo agreed. Rowe agreed to work with Jo on that topic and Jo replied she would be happy to have him work with them.

Action Item:

8. Recycled Binder Percentages for AASHTO M 323 – Lee Gallivan (FHWA)

Presentation/Report Title:

Summary of Report:
Gallivan noted or reported that the M 323 revisions was forward to AASHTO last year at the thank you to Audrey Copeland. The actual revisions to the standard were submitted and the result was a ballot and the results were comments and a couple of negatives. The comments were basically in three areas: the reviewers did not like where shingles were discussed, the other set

of comments related to in consistencies between Appendix A and binder replacements, while the third area was in they could not follow what was being revised or included. Gallivan noted it has been revised. His intent was to bring it back to the group or ETG and get inputs prior to sending it forward to AASHTO this fall or within a couple of weeks.

Gallivan noted John Harvey made an executive decision to remove everything related to RAS because of comments. Gallivan noted everything related to RAS is gone.

Gallivan will skip the editorial comments.

The next was related to the inconsistencies between the Appendix A and the discussion on binder replacement.

The next part was that the reviewers could not understand what we were trying to do related to Appendix X. – Procedures for Evaluating RAP Stockpiles. Gallivan noted the purpose of this appendix and trying to make a designation of what is out there is terms of stockpiles and how to evaluate those stockpiles. This has to do with testing stockpiles in …
James Musselman asked about the value of section X.1.2.4 on separating RAP with PMA from RAP without PMA. Becky and others recommended to make this paragraph more genereal by removing the word polymer and make it more general. Richard Schrek noted that they are separating out the PG76 because it is modified and they also separate out microsurface because of the high binder content. His opinion you do need to separate out the materials with different binder content – this is stockpile management. It was agreed that the word polymer would be removed.

There was discussion regarding PAV aging of the RAP Binder. Becky noted PAV aging of the RAP binder should not be done. There was debate between Fee and D'Angelo in terms of what this is intended to do. Audrey checked and there is no PAV aging of the RAP but noted the way it is written is confusing – treat the RAP binder as if it is PAV aged.

Gallivan noted they are looking at the average low and high temperature between the stockpiles. James Mullsemnd noted he missed the last conference call. James noted that they are dropping the high temperature because only the RAP controls the low temperatures and vise versa. D'Angelo noted that it is suppose to be run the high temperature, but it will not control the amount of RAP. Discussion from D'Angeloand Mullseman of why run the high temperature grade determination.

Ron Sines asked; does there need to be a caviate about changing binders within a geographical areas if they change. Richard Schrek stated you can have binders coming from different crude sources so the actual grade will change. He suggested watching the true grade is regardless of where it came from. Schrek noted the true grade is not being captured here. Becky noted the purpose of this is getting someone familiar with how the RAP stockpiles are changing within an area or between areas. But you are still doing or evaluating the materials for a specific project. Becky agrees with Schrek and that it is important, she is just unsure whether that fits within this paragraph. "Evaluation of asphalt binder in RAP stockpiles in a typical geographica area allos on

asphalt…" All Ron Sines is suggesting is adding a statement about understanding what you virgin binder being supplied in an area is. There was debate between Mullessmand and D'angelo and others on whether the high temperature should be excluded or included. Becky agrees with Jim Mussleman. Jim thinks that both high and low temperature ends should be considered. Schrek commented that you have to look at availability of the material. D'Angelo to keep this thing from getting to a large document, it does not tell us to ignore the high temperature, but to focus on the low. Ron Sines tend to agree with D'Angelo – he understands what Jim is saying but does not believe it is necessary from a contractor's point.
Chris Williams noted you can add a rejuvenator but you are leaving yourself open if you only refer to just the low temperature. Becky noted she has worked with conditions with the mix being too stiff for some conditions – like shoulders. Her opinion is that we need to look at the high temperature side to know how stiff it is. D'Angelo suggested taking out the low term from the paragraph. Becky agreed. Lots of discussion on this topic of high versus low. Gallivan agreed he would remove the word "LOW".

Gallivan noted a note was added (Note X7) – example, PG-22 may be specified however, a RAP blend that …This note was added based on a comment from Jim Musselman.

Gallivan noted that if the stockpiles are too variable within an geographical area, you may need to do this on a project by project basis. Ron Sines noted you may just need to reduce the size of your geographical area.

Gallivan reminded everyone this does not address the two big areas about eliminating all this RAP stuff from M 323 and have an additional standard for all this other stuff. Gallivan asked if this was acceptable to the ETG. Ron Sines noted can this move forward with what he is going to mention. He has a problem with table 2 by adding a statement in the no-mans zone (above 25% RAP). He asked whether this can move forward as two separate items, which would be a caviate and consider this analysis. Gallivan noted probably not. D'Angelo referred to what Bukowski mentioned that changing table 2 would probably create too many comments or negatives. All Ron Sines was asking was to consider this in the future. James Mussleman asked the purpose of this appendix was revising table 2 from an individual state perspective and noting that this is the purpose of this appendix for creating your own table 2. Rick Harvey did not want to do this initially because it would create more problems in his opinion. Audrey Copeland referred to that many individuals were of the opinion that this would create too many problems. But many agencies are now using this for that reason so recommending that may be appropriate. Corrigan asked Ron and others if you want something brought up to the AASHTO meeting to give him this write up, he will bring it up at the meeting. Ron asked how Gallivan wants to do this. Gallivan noted to send him the note and he will find an appropriate place to stick it. Gallivan noted Corrigan will be at the meeting, as well as Audrey Copeland.

<u>Action Item:</u>

Break

9. APT Experimental Design; Next Generation – Nelson Gibson (FHWA)

Presentation/Report Title: ***Full Scale Accelerated Pavement Test; Cracking Performance of High RAP + WMA – Experimental Design and Timeline***

Summary of Report:
Nelson Gibson passed out feedback forms to get input and comments from the RAP ETG on the next APT experiment being planned which will focus on WMA mixtures with RAP. Gibson reported he is here today to get feedback and recommendations from the RAP ETG on the next APT cycle. He opened his report with a presentation on what they are looking for. Gibson first reviewed what they are requesting from the ETG through the feedback form: Does the experimental design look sound enough to write specifications up to the pre-bid stage? Gibson provided a brief review of the APT Turner-Fairbanks facility.

Gibson summarized the combined pooling results based on stakeholder input on the next ALF experiment. Gibson listed six items with the first and most important one being – Fatigue Performance of High RAP HMA and Overlays. The two initiatives being pushed to date include high RAP content and Warm Asphalt mixtures. The advantages of both were summarized by Gibson. The objective of the experiment based on the input from the stackholders and issues related to both technologies is: *establish realistic boundaries for high-RAP mixtures employing WMA technologies based on percent binder replacement and binder grade changes when using high RAP with WMA.*

Gibson addressed and summarized key features of the experiment. The key features listed included: (1) the focus will only be on fatigue cracking with a temperature controlled condition at 20C – no high temperature rutting; (2) a three year completion schedule is being proposed with two years of loading and two ALF units that allow simultaneous loading; (3) an unmodified binder PG64-22 binder will be used for all lanes and all mix designs are to be the same; (4) the WMA technology which does not change the PG grade will be used in the experiment; and (5) the purpose this time is to use a load equivalent to a legal axle load – 20 kip equivalent axle load and the same pavement structure between the test lanes – 4 inches of the asphalt layer.

Gibson showed the experimental design layout or sampling matrix. He discussed the one cell that is impractical, so they are considering adding an additional cell by increasing the binder content of one cell with the highest RAP content. Gibson explained there are 4 sections for each test pad or lane. He explained that one section will be tested and the other three sections saved for a later date to evaluate long term aging and other items like the extension of life through the application of pavement preservation strategies. He would like suggestions on this from the ETG on this plan.

Gibson illustrated the planned loading sequence for the APT experiment. Audrey Copeland asked; why the value amounts of 25 and 40 percent were selected? Gibson explained how those values were determined. Richard Schreck stated; 30 percent is the typical value, so Gibson is beginning to push the bar with using higher RAP levels. Jon Epps pointed out the 350F was

different than what was listed in the experimental plan. Gibson replied that was a typo, it should be 300F.

Gibson went on to show and summarize the laboratory characterization to address field sequencing. This included: plant produced, lab compacted and plant produced, field compacted. He also stated they are planning to conduct bending beam fatigue tests on the plant produced, field compacted samples recovered after completion of the loading of each ALF pad. John D'Angelo is very skeptical about running fatigue tests on unaged material or mix. He asked; does this really tell us what the mix is going to look like 10 to 15 years down the road? Gibson answered and explained; what needs to be done for aging the mixtures is in terms of real field conditions in terms of what has been done in the past and what is planned for the pads – the pads will not be long-term aged themselves.

Gibson reported the portable seismic analyzer and FWD will be used in the field test program.

Discussion, Questions, Comments:
Dave Newcomb suggested adding one cell at 0% RAP which would be consist with reality and represent the baseline. Newcomb also commented on the small production sample of 1900 tons of mix. This amount is really small and would have concerns on variability through the plant for that small amount of mix. Gibson agreed with that comment and reported they were planning to produce more mix to be placed in other parking lots at the Turner-Fairbanks facility. Becky McDaniel suggested using 0, 20, and 40 percent RAP. Richard Schreck does not agree with using 0% RAP and suggested adding a cell with slightly higher binder content for the higher RAP cells. Jon Epps asked about how they plan to schedule the paving of the parking lots relative to the test pads. His experience is the chances of producing a mix that exactly meets the mix design or job mix formula initially through the plant is very small. Gibson replied; they have considered this issue which is the reason they have included additional areas to be paved outside the test pads. Epps also mentioned the thin versus thick issue (4 and 6 inches) for this experiment. The thickness of test pads is between those two thicknesses.

Huber wants to put one question on the floor: are there any plans to include shingles in the experimental plan or sampling matrix because of what Audrey Copeland showed this morning in her presentation – 1 million tons of HMA with shingles placed and this amount will grow over time. Gibson asked; does the ETG feel that shingles should be included in the APT experiment. His question was not answered prior to other comments being made on the experimental plan.

Huber commented; mixtures with RAP react differently between lab and field produced mixes with the shingles being added to the mix. Randy West asked about hot compacted or reheated samples being tested. Gibson replied; hot compacted samples will be produced – they will not be cooled and then reheated.

Haifang Wen asked; will the volumetric properties between all mixtures be the same. Gibson answered; they feel the volumetric properties will be under control when the test pads are placed based on the testing that has already been done in other experiments.

Break

10. Identify Top Priorities to Transition to Mix ETG (Action Items) – Gerald Huber (Heritage Foundation)

Gerry Huber commented; we need to look at where we go from here since the RAP ETG is being wrapped into the Mix ETG. The RAP ETG will probably become a task group under the Mix ETG, so he requested discussion on items to be forwarded to the Mix ETG. He first identified some items related to case studies, especially related to shingles, which he believes is a big hole. Huber's point was to identify issues for moving forward to the Mix ETG. For example, shingles as well as WMA that can be looked at under the mix ETG. His question; should these be put together or kept as separate topics, and what about rubber and other materials? Huber opened up the meeting for discussion on where we go from here.

- Randy West replied in terms of the case studies. West pointed out the WMA used in trial projects or demonstration projects for getting started and suggested something similar be established for RAS. Huber asked; is there a document or presentation that has already been put together for those items that should be included in case studies? Becky McDaniel thought that there was only a presentation on what should be included in the case studies, but it did not include any of the details. West agreed with McDaniel's memory and recommended that something be put together for summarizing the existing case studies that could be used to establish new ones for the future.

- Jon Epps asked; has anything been put together as a follow-up for evaluating materials and their performance – similar to what has been done for WMA? An answer to this question was not given before moving to the next comment.

- Dave Lippert agreed with what Randy West said earlier in the meeting and stated; we do not have a cracking test, so they have sponsored a study in Illinois for evaluating cracking and to determine basic properties for determining a mix's acceptability. This project was sponsored to identify what is needed to ensure Illinois DOT does not get into trouble.

- Tom Harman asked; what about training and are there gaps in training for taking full advantage to implement this technology? West answered; NCAT put together a package that considered RAP, RAS, and WMA individually. This was done separately for each material technology, but maybe we need something for combining these together that can be delivered at other venues. Gallivan replied; FHWA has received requests for training in each of these areas. Harman commented; with turnover in the State DOTs, how do we ensure adequate technician knowledge in these areas? D'Angelo agreed; training is a big issue – but some have been using RAP for a long time.

- Huber referred back to the issue of binder replacement value and asked; is it all active or is it all available? He stated there is a lot that we do not know and there is a lot of disagreement or debate on this issue in industry. Chris Williams commented; volumetric properties are a starting point, but the issue is – where should we spend our effort. Jo Daniels following up on

what Williams said; many have seen some of the same and different things so the answer is – it depends. You can take the materials and put them through different production plants and the results will be different. Williams suggested about getting Joe Sher's (with Missouri DOT) experience and thoughts on what they (Missouri DOT) have been doing. Jo Daniel's opinion; contractors need to know what they should do and understand what is happening for improving the performance of the mix.

- Jon Epps opinion; we are having difficulty in taking bits and pieces of information from laboratory studies for providing bits and pieces of field performance in providing guidance because of the diversity in the results of the test programs to date. It is not unusual to have bit and pieces, but we are having difficulty in making suggestions or providing guidance because of this difference.

- Frank Fee commented about the need to have a cracking test to predict performance. He believes this one should be the first one on the list.

- Epps believes that some information presented at today's meeting needs to make its way to the surface, so that it can be used.

- John D'Angelo mentioned about not using RAP in thin flexible pavements, but his question was; why does it not work and how can we design the mix so that it works. Epps opinion; there are technical solutions to all of these questions, but we have not focused on specific solutions. West replied; small mixes are still a good mix that can be used which was recommended from the 4.5 mm study – a good maintenance mix but did not work its way to the surface. Epps comment on that topic; we will be putting thin HMA overlays on poor performing roadways or roadway with a lot of distress – eventually we will be doing, so how do we do this?

- Haifang Wen suggested the performance model, as a whole, and the materials model need to be combined into one system.

- Jim Musselman following up on what needs to be done; his opinion – development of a cracking test needs to be first and foremost. The second item is related to M 323 and getting these things out to the users. His opinion; in the absence of experienced people, personnel are still going to make decisions. This group is an ETG which includes the experts, so we need to get things together for the agencies to use. Becky McDaniel suggested benchmarking items which can be really helpful, as was done during the Superpave development effort. We also heard about peer pressure, which can be real helpful. She suggests using results from the survey to reinforce and deciding what needs to be dropped and added to the list.

- Gallivan commented about a couple of agencies that started to get on board with increasing the RAP content. The idea is to hand a list of items to the mix ETG that need to be completed or need to be pursued. Newcomb asked; which agencies are we referring to? Gallivan referred to California. Huber summarized what was asked from California in terms of RAP use. He summarized the information provided to California during the visit which opened

their eyes and allowed them to come to some middle ground in using higher amounts of RAP.

- Newcomb believes the tool box is important to continue to support.

- Gallivan asked about the importance of the website. Newcomb and McDaniel replied; it is essential. Gallivan asked; what updates need to be done? Richard Willis answered; the webpage has been recently updated and most reports are posted on that webpage. West suggested someone needs to look at the organization of the webpage to make sure it is organized properly. Jo Daniel agreed with others regarding an important place to find focused information on the use of RAP. Willis replied; it will take a little time to organize the webpage. Ron Sines stated; the website or webpage is the place to disseminate information for others in terms of marketing information related to the use of RAP. Sines opinion; this activity will be important in terms of marketing the technology and use of RAP.

Gallivan reported; they will take these recommendations and put them in some organized fashion for submitting to the Mix ETG. Huber asked Sines about marketing and what is the most critical thing to put forward. Sines replied; do not underestimate the importance of the surveys and trying to overcome the bias that exists in industry.

Jim Pappas stated; one of the biggest detriments is that agency personnel are too conservative, and there is a risk because they do not understand. Some agencies are allowed more freedom to try different materials and technologies, while others are restricted from taking risks. Pappas believes marketing the facts is important and is a good thing. He noted; a few good products is a good thing, but with trying something new, there are going to be issues that must be overcome – will not have 100 percent success. Sines also noted; remember, young engineers coming up through the ranks were trained by the older engineers that are retiring, so they can have the same biases.

D'Angelo noted there are items that can be overcome by doing some research that has not been looked in the recent past – this comment was related to the rejuvenators being used with RAP mixtures.

Corrigan stated; looking at the list that had been previously presented, is it suppose to be RAS best practices. Answer was yes. He suggests putting together a comprehensive document with putting RAP and RAS together. He believes this will be valuable to the AASHTO members and without that type of document he believes we will have a difficult time selling this technology.

Huber stated; remember, a while back only 14 agencies allowed more than a minimum amount of RAP in surface mixtures. Right now only 3 agencies restrict the higher percentages of RAP in wearing surfaces. Huber thanked everyone for making this happen. Huber asked for any additional items to be moved to the mix ETG. No additional ones were provided.

11. **Accomplishments of RAP ETG and Acknowledgements** – Gerald Huber (Heritage Foundation)

Huber reminded that sometimes we forget to say thank you for items well done. Huber noted that Lee Gallivan prepared a certificate for saying thank you to the individual members for participating on the RAP ETG over the years. These were handed out at the meeting.

12. Other Business
Huber asked for any other business to be brought before the ETG. None was noted.

13. Adjournment
As there was no other business of the RAP ETG, Huber adjourned the meeting at 4:45 PM.