

Program Progress Performance Report

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University Transportation Center for Highway Pavement Preservation



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PROGRESS REPORT

1. Accomplishments

Program Major Goals and Objectives

Table 1 lists the major goals and objectives outlined in the Center for Highway Pavement Preservation (CHPP) proposal and highlighted during the US DOT RITA site visit on November 20, 2013.

Goal Accomplishments

Currently, all CHPP activities are either in progress or in the planning stages as indicated in the “% Complete” and “Status” columns of Table 1.

Training and Professional Development Opportunities

As indicated in Table 1 below, multiple opportunities for training and professional development have been implemented and/or are scheduled for future growth and sustainability. During the period April 1, 2014 - September 30, 2014, CHPP provided the following opportunities:

- CHPP Short Course Development and Implementation for High School and College Students,
- Publication of TeachEngineering.org Lesson Plan and Hands-on Activities,
- Middle and High School Design and Engineering Day,
- High School Engineering Institute,
- Metro Detroit Youth Day,
- Women in Engineering Girls’ Adventures in Mathematics, Engineering, and Science (GAMES) Camp,
- Science and Engineering Enrichment Program for Deaf Students,
- CHPP Summer Research Program for Undergraduate and Under-represented Students,
- CHPP "Aggie Shark Tank" Program, and
- Other CHPP professional development activities.

A brief summary of these activities is provided below.

K-12 Outreach

1. MSU Middle and High School Design Day at Michigan State University (Spring and Fall)

Program Description

Middle and high school Innovative and Creative Dart Foundation Design Day focus was to involve approximately 175 students and 25 teachers in hands-on and experiential engineering education. It introduces participants to innovative, challenging and inspiring engineering designs and projects. The students and teachers worked on projects such as:

- Building a sample of asphalt pavement cross-section using crumb rubber,
- Using smart materials (piezo-electric sensors) to generate voltage as a measure of deflection.

More details about the activities are provided on: <http://www.chpp.egr.msu.edu/?p=187>



Table 1 CHPP Major Goals and Objectives

Overall		Status	% Complete
	Kick-off meeting with USDOT, Steering Committee and Advisory Board	Complete	100
	Sub-award contracts in place	Complete	100
	Request for problem statements	Complete	100
	Evaluation and ranking of problem statements	Complete	100
	Request for Proposals	Complete	100
	Proposals and Budgets under External Review	Complete	100
	Research Projects under Contract	On Schedule	83
	Library Resources Posted/Linked on Website	On Schedule	10
Leadership Activities			
	Partner with NCPP to work with regional partnerships	Complete	100
Educational and Outreach Activities			
K-12	Middle and High School Design Day (Spring, 2014)	Complete	100
	Middle and High School Design Day (Fall, 2014)	On Schedule	100
	Participate in the activities of Middle and high schools STEM clubs	On Schedule	100
	High School Engineering Institute	Complete	100
	Metro Detroit Youth Day	Complete	100
	Developing Highway Pavement Preservation short courses for HS students	Complete	100 (Y1) 10 (Y2)
	TeachEngineering.org lesson plan and hands-on activities publication	On Schedule	80
	Preview Day of Highway Pavement Preservation related research	Complete	100
	Research Experiences for Teachers (spring 2015)	On Schedule	20
	Training camps for high school students and minorities (summer 2014)	Complete	100 (Y1) 20 (Y2)
	Science and Engineering Enrichment Program for Deaf Students (spring 2015)	Forthcoming	0
	CHPP "Aggie Shark Tank" Program	On Schedule	20
Grad/Undergrad	CHPP Course Development & Implementation	On Schedule	50
	Summer Research for undergraduates (Summer 2014)	Complete	100
	CHPP/CUTC student of the Year Program - Annually @ TRB	On Schedule	15
	Transportation student Chapter (ITE/ASCE/etc.) related activities	On Schedule	10
	Summer Research for Underrepresented Students (Summer 2014)	Complete	100
Technology Transfer Activities			
	Website for disseminating UTC related activities	Complete	100
	Publish newsletters and synthesis reports	Forthcoming	0
	Disseminate technology and results to agency and industry	Forthcoming	10
	Be represented at conferences and meetings	On Schedule	100
USDOT RITA: Reporting			
	Website developed and running	Complete	100
	Posting directory of key center personnel	Complete	100
	Posting research projects description	Complete	100
	Federal financial reports (quarterly)	On Schedule	100
	UTC Program Progress Performance Reports (biennially)	On Schedule	100
	Annual Performance Indicators Report	On Schedule	100



2. Participation in School Career Days/Fairs at UH at Manoa

Program Description

In this program, students are engaged in activities and discussions related to information regarding engineering opportunities at college levels. Faculty and graduate students are invited to collaborate in these outreach efforts. More details about this activity are available on the center website www.chpp.egr.msu.edu

3. Summer Internship Program for High School Students at MSU and UH at Manoa

Program Description

The Summer Internship Program is a highly competitive six-week program that allowed high school juniors (heading into their senior year) to take a hands-on approach to working in College of Engineering research laboratories. Along the way, interns also participated in group activities and a field trip to local engineering companies. At the end, they make a presentation about what they learned during the summer. The UH Pavement Engineering Laboratory hosted two high school students to introduce them to materials research related to pavement preservation. Michigan State University also hosted one high school student who learned about using smart material in pavement monitoring. Table 2 lists the name of the students and their advisors.

Table 2 High School Students Involved in CHPP-related Research

Student Name	Level	Hosting Institutions	Advisor
Nandan Kodur	High School, Okemos High School	Michigan State University	Nizar Lajnef
Neecha Dinman	High School, Kalaheo High School	University of Hawaii at Manoa	Adrian Ricardo Archilla & Jose Corrales
Tris Tanaka	High School, Kalaheo High School	University of Hawaii at Manoa	Adrian Ricardo Archilla & Jose Corrales

4. Engineering Day at NC A&T

Program Description

During the Engineering Day, the College of Engineering hosted more than 700 students (K-12) and engaged them in using more than 20 educational stations organized and hosted by various campus programs and research groups. As part of the CHPP's outreach activities, the NC A&T hosted a station related to pavement maintenance and preservation.

5. Engineering Day at UH Manoa

Program Description

During the Engineering Day, the Pavement Engineering Laboratory at UH Manoa was opened and presented to the attendees on Saturday, September 27, 2014. The research activities related to pavement preservation as part of CHPP's outreach activities were part of the program. During this event, CHPP collaborated with different student organization such as AISES (American Indian Science and Engineering Society), ASCE (American Society of Civil Engineers), ECUH (Engineer's Council at the University of Hawaii), HKN (Eta Kappa Nu), IEEE (Institute of Electrical and Electronics Engineers) and SWE (The Society of Women Engineers). More details about this activity are provided on the center website www.chpp.egr.msu.edu



6. Blueprints: Engineering Your Manoa Success (August each year) at UH

Program Description

This is a welcoming and orientation event for first time incoming freshmen, transfer students, and families. Students were able to design their own blueprint to success at UH Manoa while meeting the faculty, listening to industry leaders, learning about the opportunities offered, and making new friends. More details about this activity are available on the center website www.chpp.egr.msu.edu

7. MSU High School Engineering Institute I– June 25, 2014

Program Description:

Forty (40) high school students spent a week exploring engineering through lecture, lab and design sessions offered by faculty and student assistants from our various programs. This activity was intended for rising high school sophomores, juniors and seniors seriously considering engineering as their career choice. The residential program was designed to give in-depth experiences in engineering majors. Our focus in CHPP is to convince these students to pursue a college degree in a transportation-related area. Students spent a half day with an engineering faculty member, a graduate student, undergraduate students, and participated in short lectures, demonstrations, hands-on experiments, team-based problem solving, and tours. Participating students and teachers worked on projects such as:

- Building a sample of asphalt pavement cross section using crumb rubber (Road in a Box),
- Using smart materials (piezoelectric sensors) to generate voltage as a measure of deflection, and,
- Building a wireless monitor to measure the temperature of the pavement during deflection testing.

The event was featured in the news at:

- <http://www.chpp.egr.msu.edu/?p=413>;
- <http://www.egr.msu.edu/future-engineer/news/high-school-engineering-institute-session-1-recap>

8. Metro Detroit Youth Day with a Transportation and Pavement Theme – July 9, 2014.

Program Description

The Metro Detroit Youth Day, the largest youth event in Michigan, was formulated to bring together Metro Detroit area youth from all walks of life for a day of sports, fun, and constructive activities. The event demonstrates to youngsters how business people, the community, and the food industry cared and respected them. The CHPP had rented a tent for the event to showcase transportation and pavement-related research through short lectures and hands-on experiments. The activities introduced approximately 10,000 children to innovative and inspiring engineering designs and projects. The CHPP invited Formula SAE, Baja Racing team, Steel Bridge, and Solar car student organizations, FIRST LEGO, VEX IQ, and VEX robotics to present displays with transportation themes. The event was featured in the news at:

- <http://www.chpp.egr.msu.edu/?p=386>;
- <http://www.wxyz.com/news/30000-youth-gather-for-metro-detroit-youth-day-at-belle-isle-park>



9. Development of a Highway Pavement Preservation Short Course.

Program Description:

A short course in three different transportation-related areas is being designed for use by Middle and High school teachers in their classrooms to attract students to the transportation field. The course focuses on the use of smart materials and image analysis techniques for pavement monitoring and the use of crumb rubber in asphalt as a student introduction to sustainable materials. The PowerPoint presentation and hands-on activity worksheet are available on the CHPP website.

CHPP is currently planning to develop a second short course for High school student about sustainability in transportation systems. Meetings with the concerned faculty members have been held. The objectives and outline for the short course lecture and hands-on activities have been established.

10. TeachEngineering.org Lesson Plan and Hands-on Activities Publication

Program Description:

The short course developed previously was prepared in the TeachEngineering.org format. The course is designed for students interested in exploring the exciting field of transportation engineering. The course focuses on short lectures, hands-on experiments, team work, and lab tours. The materials were submitted for publications and it is currently under review.

11. High School Education and Outreach at NC A&T– June 30, 2014

Program Description:

Through CHPP, we organized a Sustainable Pavements workshop for High School Students (June 30, 2014) at NC A&T, June 30, 2014. The entire session was designed for high school students to learn about sustainable materials for highway pavements and their applications. Through the workshop we engaged twenty one (21) high school students with both lecture and hands-on lab activities related to pavement materials followed by a competition among teams of high school students. Each team of four students was mentored by one graduate student who advised the team on sample preparation, mixing and testing of an asphalt mixture while learning about properties of various recycled materials including rubber, recycled pavement, bio-mass, recycled shingles, etc.

12. Training Camps for High School Students and Minorities

Program Description:

The research investigators at the University of Hawaii reached out to high school students, females, and minorities in particular, mainly through summer camps and open-house activities. A large group of 500 to 700 students participated in a half-day event filled with engineering exhibits, games, and competitions.

Undergraduate / Graduate Outreach

1. Summer Research for Undergraduates and Under-represented Students

Program Description:

CHPP offered summer research opportunities for high-achieving undergraduates. The intent of this program was to encourage students from all consortium partners (MSU, UT-Austin,



UIUC, NCA&T, and UH) to consider pursuing graduate degrees and to provide them an early opportunity to become involved in research by working with faculty mentors in different Engineering departments/programs. Students were matched with faculty mentors (interest and specialty area) and had opportunities to engage in engineering research, interact with faculty and students from across the College of Engineering, and develop essential skills for success in graduate school. During the summer of 2014, students worked full-time on a substantive, faculty-guided research project and participate in professional development activities, including attending weekly seminars and completing periodic writing assignments. On July 25, 2014, the students presented posters summarizing their research. Table 3 lists the names of the undergraduate students involved in this activity. More details about this program are available at http://www.chpp.egr.msu.edu/?page_id=89

Table 3 Students Involved in CHPP-related Research

Student Name	Level	Hosting Institutions	Advisor
Nicholas McDonald	Undergraduate	Michigan State University	Syed W. Haider
Adam Chludzinski	Undergraduate	Michigan State University	M. Emin Kutay
Caroline Williams	Undergraduate	Michigan State University	Nizar Lajnef
Drake Veitenheimer	Undergraduate	Michigan State University	Syed W. Haider
Gabryelle Giddens	Undergraduate	Michigan State University	Nizar Lajnef
Tyler Frederick	Undergraduate	Michigan State University	Imen Zaabar
Catherine Nyombe	Undergraduate	Michigan State University	Syed W. Haider
Corey Turner	Undergraduate	Michigan State University	Syed W. Haider
Gilchrist Ireland	Undergraduate	Michigan State University	Imen Zaabar and Syed W. Haider
Ronell Joseph Eisma	M.S	Michigan State University	Karim Chatti & Syed Haider
Ugurcan Ozdemir	M.S.	Michigan State University	M. Emin Kutay
Shabnam Rajaei	Ph.D.	Michigan State University	Karim Chatti & Roozbeh Dargazany
Bonni Saust	Undergraduate	University of Hawaii at Manoa	Adrian Ricardo Archilla
Jose Corrales Azofeifa	Ph.D.	University of Hawaii at Manoa	Adrian Ricardo Archilla
Sina Famili	Ph.D.	University of Hawaii at Manoa	Adrian Ricardo Archilla
Mohammadreza Hashemi	Ph.D.	University of Hawaii at Manoa	Adrian Ricardo Archilla
Ryan Yeargin	Undergraduate	North Carolina A&T	Ellie Finie
Ahmed Lamarre	M.S.	North Carolina A&T	Ellie Finie
Yillian Rivera	M.S.	North Carolina A&T	Ellie Finie
Felix Smith Buabeng	M.S.	North Carolina A&T	Sassan Aflaki
Daniel Oldham	M.S.	North Carolina A&T	Ellie Finie
Shahrazad Hossein Nezhad	M.S.	North Carolina A&T	Ellie Finie
Grant Gorman	Undergraduate	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Michael Blake	Undergraduate	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Marina Fonseca	Undergraduate	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Felipe Trevisan	Undergraduate	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Pedro Serigos	Ph.D.	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Prasad Buddhavarapu	Ph.D.	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Franco Di Biase	M.S.	University of Texas at Austin	Jorge Prozzi & Andre de Fortier Smit
Heena Dhasmana	Ph.D.	University of Illinois at Urbana-Champaign	Imad L. Al-Qadi
Punit Singhwi	M.S.	University of Illinois at Urbana-Champaign	Imad L. Al-Qadi & Hasan Ozer
Daniel King	M.S.	University of Illinois at Urbana-Champaign	Jeffery Roesler
Sushobhan Sen	M.S.	University of Illinois at Urbana-Champaign	Jeffery Roesler
Katelyn Weiler	Ph.D.	University of Minnesota	Lev Khazanovich

2. Education and Training at the Undergraduate and Graduate Levels

Program Description:

The participants were introduced to the concepts of sustainability i.e., preserving natural resources, managing a network of pavements within fiscal constraints, and reducing greenhouse emissions. The research findings will be disseminated through regular seminars



during each semester in the department, publication in scientific journals, presentations, and mini-symposia at major conferences. Table 3 also lists the names of the undergraduate and graduate students and their corresponding advisor involved in the CHPP related research projects.

3. Interview and Recruitment by North Carolina DOT HR Representative

Program Description:

This event (Sep. 16, 2014) was organized as an information session and informal mock interview by NC DOT Recruitment Specialist (Mr. Dennis Franz). He provided an information session in which thirty five (35) junior and senior engineering students participated. He discussed various full time job opportunities and internships within NC DOT related to highway pavement design, construction, maintenance and rehabilitation. More details about this activity are available on the center website www.chpp.egr.msu.edu

Professional Development Activities, Conferences, and Workshops

1. Transportation and Pavement Preservation Seminars and Meeting at the National Level

Program Description:

The CHPP benefitted from the National Center for Pavement Preservation's (NCP's) efforts to provide outreach and technology transfer to the broad transportation community and practitioners. The CHPP used the NCP's links with a variety of state and local highway transportation agencies and private companies to accomplish its professional development mission. Table 4 presents the list of activities conducted by NCP.

2. Transportation and Pavement Preservation Seminar at NCA&T

Program Description:

On October 1, 2014, a full day seminar was organized for students and transportation professionals. The seminar included three presentations about various aspects for highway pavement construction, maintenance and rehabilitation. The event was organized through CHPP in collaboration with ASCE and ITE society chapters. The event was attended by twenty (20) professionals and ten (10) students. Three (45min) talks were delivered by experts from North Carolina DOT and Piedmont-Triad Transportation partnership. In addition to three seminars, ten (10) students presented their research during a poster session. The poster session was in conjunction with a networking session in which graduating seniors from the Civil Engineering Department got the opportunity to meet with potential employers and professionals. More details about this activity are provided on the center website www.chpp.egr.msu.edu



Table 4 National Center for Pavement Preservation Technology Transfer Activities

Event	Dates	Location	Constituents
Northeast Pavement Preservation Partnership annual meeting	April 7 – 9, 2014	Burlington, VT	State DOTs, NCPP staff, pavement industry leaders
National Association of County Engineers annual meeting	April 12 – 15, 2014	Baton Rouge, LA	Jon Rice, Lisa Farley
Emulsions Task Force annual meeting	May 6 – 8, 2014	Washington, D.C.	Larry Galehouse
Nevada Maintenance Academy	May 6 – 8, 2014	Elko, NV	Jon Rice
Southeast Pavement Preservation Partnership annual meeting	May 28 – 30, 2014	Louisville, KY	State DOTs, NCPP staff, pavement industry leaders
Nevada Maintenance Academy	June 3 – 5, 2014	Las Vegas, NV	Larry Galehouse
Chip Seal training	June 11 – 12, 2014	Rosebud, NV	Tom Wood
NCPP Advisory Board annual meeting	June 18, 2014	East Lansing, MI	NCPP staff, Dr. Buch, Dr. Chatti, NCPP advisory board members
Florida Pavement Preservation Council Advisory Board meeting	June 30 – July 1, 2014	Orlando, FL	Larry Galehouse, Chuck Williams
Florida APWA conference	July 9 – 11, 2014	Ft. Lauderdale, FL	Jon Rice
Chip Seal training	July 10, 2014	Monroe, MI	Larry Galehouse
South Carolina APWA	July 27 – 30, 2014	Greenville, SC	Mary Corley
Sub-committee on Maintenance annual meeting	July 27 – 31, 2014	Huntington, WV	Larry Galehouse, Patte Hahn
International and Western States In-Place Recycling annual meeting	August 5 – 7, 2014	Denver, CO	Darlene Lane
Oklahoma LTAP	August 6 – 7, 2014	Tulsa, OK	Larry Galehouse
Micro Slurry training	August 15, 2014	Los Angeles, CA	Tom Wood
TERRA general assembly meeting	August 19 – 21, 2014	Madison, WI	Larry Galehouse
Midwestern Pavement Preservation Partnership annual meeting	September 2 – 5, 2014	Minneapolis, MN	Larry Galehouse
Road Profiler Users Group annual meeting	September 15 – 18, 2014	Roanoke, VA	Doyt Bolling
Judges Association of Arkansas annual meeting	September 24 – 25, 2014	Little Rock, AR	Larry Galehouse

Results Dissemination and Methods

All CHPP activities are primarily in the implementation or planning phase for the next performance period. Electronic distribution, social media, and professional meetings have been the primary means for dissemination. PowerPoint presentations have also been given. The CHPP member universities also supported student and faculty travel to the academic and professional meetings to promote and discuss the goals, objectives and research themes of the Center. Table 5 lists CHPP attendees of professional development opportunities pursued by staff and faculty over the reporting period.

Table 5 List of Professional and Academic Meeting Attendees

Name	Destination	Conference Name	Dates	University
Karim Chatti	Lincoln, Nebraska	CUTC Summer Conference	June 2-5, 2014	Michigan State University
Lisa Farley	Lincoln, Nebraska	CUTC Summer Conference	June 2-5, 2014	Michigan State University
Karim Chatti	East Lansing, MI	NCPP Advisory Board annual meeting	June 18, 2014	Michigan State University
Lisa Farley	East Lansing, MI	NCPP Advisory Board annual meeting	June 18, 2014	Michigan State University
Jeffery Roesler	American Concrete Pavement Association (Chicago, Illinois)	International Society of Concrete Pavement Meeting	July 8-9, 2014	University of Illinois at Urbana-Champaign



Planned Activities for Next Reporting Period

There will be no change in the agency-approved application for this effort. Implementation of the activities in Table 1 above for all research, education, workforce development, and technology transfer projects will continue on schedule. A brief summary of new activities planned for next reporting period is provided below.

K-12 Outreach

1. High School Education and Outreach at MSU – November 10, 2014

Program Description:

On November 10, we will organize an entire session at McDonald Middle School (East Lansing, MI) where students will participate in short lectures, demonstrations, hands-on experiments, team-based problem solving. Participating students and teachers will work on building a sample of asphalt pavement cross-section using crumb rubber, then use piezoelectric sensors to generate voltage as a measure of deflection. The team that designs a pavement with the least amount of deflection and cost wins.

2. Preview Day Showcase of Highway Pavement Preservation-related Research in Civil Engineering.

Program Description:

On October 10, 2014, a keynote lecture was given to all attendees (High school students and their parents) at the beginning of the event to introduce students to civil engineering. Then, the students participated in a research fair where special display and hands-on materials were presented to facilitate the communication of basic concepts related to materials, structures, and sensor technology.

3. NGSS Compliant Introduction to Engineering Teacher Workshop

Program Description:

The objective of the workshop is to enhance the integration of design day activities into the school curriculum. Students and teachers will be engaged in hands-on experiential engineering education. The outreach and research experience for teachers (RET) coordinators will present ways in which these activities can be used in Next Generation Science Standard (NGSS) aligned engineering curriculum. Participating students and teachers will learn about engineering by members of the MSU CEE department. The day will also include transportation engineering lab tours and hands on activities. A tentative date for the workshop is May 1, 2015.

Professional Development Activities, Conferences, and Workshops

1. Pavement Sustainability though Pavement Preservation Workshop at the ASCE T&I Conference

Program Description:

The objective of the workshop is to disseminate the research results by training students and professionals. This workshop will be conducted at the upcoming ASCE T&I conference (June 7-10, Miami, 2015) and will provide an overview of recent research and implementation



examples on the application of pavement preservation techniques to enhance the pavement sustainability. This workshop will cover the following:

- Introduction to pavement preservation and its methods
- Assessment of existing pavement and selection of treatments for preservation
- Construction and QC/QA, for preservation
- Performance of treatments and their impact on safety, noise, durability etc.
- Effect of pavement preservation on LCCA and LCA

The workshop will combine well established best practices as well as some recent research findings. The instructors are:

- Imad Al-Qadi, University of Illinois at Urbana-Champaign
- Jorge Prozzi, University of Texas at Austin
- Karim Chatti, Michigan State University
- Jeffery Roesler, University of Illinois at Urbana-Champaign
- Hasan Ozer, University of Illinois at Urbana-Champaign
- John Harvey, University of California, Davis

Results Dissemination and Methods

The CHPP member universities will support student and faculty travel to the annual meeting of the Transportation Research Board, which attracts transportation professionals from across the country to promote and discuss the goals, objectives and research themes of the Center. Table 6 lists CHPP attendees of the TRB conference, as well as other professional development opportunities planned by staff and faculty over the reporting period.

2. Products

Publications, Conference Papers, and Presentations

During this reporting period, CHPP researchers prepared and produced several conference and journal papers based on the research being conducted as part of the center. In addition, to disseminate the research findings, presentations were also made at various appropriate venues and meetings. The following is the list of publications and presentations related to different CHPP research projects.

1. Impact of Pre-existing Conditions on the Effectiveness of Pavement Preservation Treatments, Ronell J. Eisma, Syed W. Haider, and Karim Chatti, paper accepted for presentation at the 94th Annual Transportation Research Board Meeting, 2015.
2. Impact of Site Factors on the Effectiveness of Flexible Pavement Preservation Treatments, Syed W. Haider, Ronell J. Eisma, Karim Chatti, Gilchrist Ireland, and Nicholas McDonald, paper submitted for presentation and publication at the Airfield & Highway Pavement Conference, June 7-10, Miami, 2015.
3. Impact of Diamond Grinding on Rigid Pavement Performance, Syed W. Haider, Karim Chatti, Ronell J. Eisma, Imen Zaabar, and Tyler Frederick, paper submitted for presentation and publication at the Airfield & Highway Pavement Conference, June 7-10, Miami, 2015.
4. Investigation of the Relationship between Dynamic Axle Load, Roughness and Fuel Consumption, Imen Zaabar, and Karim Chatti, paper submitted for presentation and publication



at the International Symposium on Pavement LCA, University of California at Davis, October 2014.

5. Impact of Thermal Inertia in Pavements and the Urban Heat Island, Sushobhan Sen and Jeff Roesler, paper accepted for presentation at the 94th Annual Meeting of Transportation Research Board, 2015.
6. Thin concrete overlay performance, Daniel King and Jeff Roesler, paper submitted for presentation and publication for the 94th Annual Meeting of Transportation Research Board, 2015.
7. Assessment of Concrete Pavement Structure on Urban Heat Island, Sushobhan Sen and Jeff Roesler, paper published and presented at the International Symposium on Pavement LCA 2014 at UC-Davis from October 14-16, 2014.
8. Structural and Environmental Benefits of Concrete Inlays for Pavement Preservation, Sushobhan Sen, Daniel King, and Jeff Roesler, paper submitted for presentation and publication at the Airfield & Highway Pavement Conference, June 7-10, Miami, 2015.
9. Micromechanical finite element modeling of moisture damage in bituminous composite materials, Ghauch, Z., H. Ozer, and I. L. Al-Qadi, Construction and Building Materials (2014) (in revisions).
10. Field Aging Investigation of Hot-Poured Crack Sealants, Ozer, H., S.S. Yousefi and I. L. Al-Qadi, Transportation Research Record: Journal of the Transportation Research Board, Washington, DC (submitted for journal publication in 2015).
11. Life-Cycle Impact of Producing Bituminous Mixes with Varying Degrees of Recycled Materials, Yang, R. H. Ozer, S. Kang, and I. L. Al-Qadi, International Symposium on Pavement LCA, October 2014.
12. Performance Characterization of In-Place Recycled Mixtures, Hafeez, I. H. Ozer, and I. L. Al-Qadi, Journal of Transportation Engineering, 2014.
13. Invited presentation: Performance Characterization of Hot In-Place Recycled Mixtures, Imad Al-Qadi and Hasan Ozer, ASCE T&DI Pavement Specialty Conference in June 2015, Miami, FL.
14. Bio-Modification of Rubberized Asphalt and Its High Temperature Properties, Ellie Fini, paper submitted for presentation and publication for the 94th Annual Meeting of Transportation Research Board, 2015.
15. Investigation of Effectiveness of Liquid Rubber as a Modifier for Asphalt Binder, Ellie Fini, paper submitted for presentation and publication for the 94th Annual Meeting of Transportation Research Board, 2015.
16. Effect of Water Conditioning on Crack Sealant's Cohesive Properties, Ellie Fini and Sassan Aflaki, paper submitted for presentation and publication for the 94th Annual Meeting of Transportation Research Board, 2015.
17. Investigating Effects of Water Conditioning on the Adhesion Properties of Crack Sealant, Ellie Fini and Sassan Aflaki, paper submitted for presentation and publication for the 94th Annual Meeting of Transportation Research Board, 2015.
18. Invited Presentation: Quantitative Ultrasonic Array Evaluation of Concrete Structures, Jorge Prozzi, Technion, Israel, April 2, 2014.



Table 6 List of Planned Professional and Academic Meeting Attendees

Name	Destination	Conference Name	Dates	University
Karim Chatti	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Syed W. Haider	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Imen Zaabar	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
M. Emin Kutay	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Nizar Lajnef	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Roosbeh Dargazany	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Larry Galehouse	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Lisa Farley	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Patte Hahn	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Ronell Joseph Eisma	Washington D.C.	TRB	January 11-15, 2015	Michigan State University
Imen Zaabar	UC-Davis, California	International Symposium on Pavement LCA	October 14-16, 2014	Michigan State University
Karim Chatti	UC-Davis, California	International Symposium on Pavement LCA	October 14-16, 2014	Michigan State University
Karim Chatti	Miami, Florida	ASCE T&I	June 7-10, 2015	Michigan State University
Syed W. Haider	Miami, Florida	ASCE T&I	June 7-10, 2015	Michigan State University
Imen Zaabar	Miami, Florida	ASCE T&I	June 7-10, 2015	Michigan State University
Jorge Prozzi	Washington D.C.	TRB	January 11-15, 2015	University of Texas at Austin
Jorge Prozzi	Miami, Florida	ASCE T&I	June 7-10, 2015	University of Texas at Austin
Ellie Finie	Washington D.C.	TRB	January 11-15, 2015	North Carolina A&T
Sassan Aflaki	Washington D.C.	TRB	January 11-15, 2015	North Carolina A&T
Ahmed Lamarre	Washington D.C.	TRB	January 11-15, 2015	North Carolina A&T
Ryan Yeargin	Washington D.C.	TRB	January 11-15, 2015	North Carolina A&T
Yillian Rivera	Washington D.C.	TRB	January 11-15, 2015	North Carolina A&T
Daniel Oldham	Washington D.C.	TRB	January 11-15, 2015	North Carolina A&T
Adrian Ricardo Archilla	Washington D.C.	TRB	January 11-15, 2015	University of Hawaii at Manoa
Hasan Ozer	Washington D.C.	TRB	January 11-15, 2015	University of Illinois at Urbana-Champaign
Imad Al-Qadi	Washington D.C.	TRB	January 11-15, 2015	University of Illinois at Urbana-Champaign
Heena Dhasmana	Washington D.C.	TRB	January 11-15, 2015	University of Illinois at Urbana-Champaign
Jeffery Roesler	Washington D.C.	TRB	January 11-15, 2015	University of Illinois at Urbana-Champaign
Hasan Ozer	Miami, Florida	ASCE T&I	June 7-10, 2015	University of Illinois at Urbana-Champaign
Imad Al-Qadi	Miami, Florida	ASCE T&I	June 7-10, 2015	University of Illinois at Urbana-Champaign
Jeffery Roesler	Miami, Florida	ASCE T&I	June 7-10, 2015	University of Illinois at Urbana-Champaign
Jeffery Roesler	UC-Davis, California	International Symposium on Pavement LCA	October 14-16, 2014	University of Illinois at Urbana-Champaign
Daniel King	Washington D.C.	TRB	January 11-15, 2015	University of Illinois at Urbana-Champaign
Sushobhan Sen	UC-Davis, California	International Symposium on Pavement LCA	October 14-16, 2014	University of Illinois at Urbana-Champaign
Sushobhan Sen	Washington D.C.	TRB	January 11-15, 2015	University of Illinois at Urbana-Champaign
Lev Khazanovich	Washington D.C.	TRB	January 11-15, 2015	University of Minnesota
Katelyn Weiler	Washington D.C.	TRB	January 11-15, 2015	University of Minnesota



Website or Other Internet Site

The CHPP's website can be accessed at www.chpp.egr.msu.edu. By understanding and capitalizing upon the knowledge acquired over the past one year, we are able to make our homepage engaging, relevant, and resourceful for our viewers by posting courses, presentations and reports in the website.

Technologies or Techniques

All current research and workforce development activities are being implemented.

Inventions, Patent Applications, and / or Licenses

All current research and workforce development activities are being implemented.

Other Products

Educational Aids

A short course in three different transportation-related areas was designed and developed for use by Middle and High school teachers in their classrooms to attract students to the transportation field. The course includes short lectures, hands-on experiments, and team work. The course focuses on the use of smart materials and image analysis techniques for pavement monitoring and the use of crumb rubber in asphalt concrete to introduce pavement materials to students. The PowerPoint presentation and hands-on activity worksheet are posted on the CHPP website and will also be posted on the TeachEngineering.org website.

Research Projects

After going through several cycles of discussions and inputs from the advisory board (members from the various state highway agencies, the Illinois tollway authority and the city-county of Honolulu and FP²), a total for thirteen (13) research ideas were selected. Subsequently, detailed proposals were submitted by the principal investigators (PIs) to describe the detailed scope of work, research plan, and funding needs (budget). Table 7 shows the preliminary progress of the research projects for the reporting period. The split between advanced and applied research projects is about 50% (advanced=7, applied=6). While the center will be focusing on some of the innovative and cutting-edge research topics to address the emerging questions regarding pavement preservation, it will also address some of the knowledge gaps in the current preservation practices. It should be noted that some of the research project proposals are under review or the contract is in process with the department of transportation.

3. Participants and Collaborating Organizations

Partner Organizations

During the current reporting period, CHPP has worked with unique organizations across the United States and around the world to develop the research, education, workforce development, and technology transfer activities that are currently underway at the Center. The organizations and their locations are listed in Table 8 along with information describing specific areas or capacities which the respective organizations have committed to support the Center.



Table 7 CHPP Research Projects and Assignments

No.	Problem Statement #	Project Title	PI/Assignment	Research Category	Progress
1	MSU-4	Feasibility of Developing a Chemical Sensor for Asphalt Aging	Chatti/Lajnef/Worden (MSU)	Advanced	0 ¹
2	MSU-5	Feasibility of Early Damage Detection Using Surface Mounted Sensors on Existing Pavements	Lajnef/Chatti (MSU)	Advanced	0 ²
3	MSU-6	Pavement Surface Characterization for Optimization of Trade-off between Grip and Rolling Resistance	Dargazany/Chatti (MSU)	Advanced	7%
4	TSP2-21	Development of an Acceptance Test for Chip Seal Projects	Kutay (MSU)	Applied	5%
5	UIUC-6	Environmental and Functional Benefits and Trade-offs of Hot In-Place Recycling Treatment Techniques	Al-Qadi (UIUC)	Applied	13%
6	UIUC-7	Mechanistic Characterization of Thin Asphalt Overlays for Pavement Preservation using Finite Element Modelling Approach	Al-Qadi (UIUC)	Advanced	13%
7	UIUC-8	Multi-Functional Concrete Pavement Inlays	Roesler (UIUC)	Advanced	13%
8	UTA-9	Determination of Expected Lives of Different Preventive Maintenance Techniques	Prozzi (UTA)	Applied	13%
9	UTA-11	Evaluation of Pavement Surface Micro- and Macro-Texture	Prozzi (UTA)	Applied	13%
10	TSP2-18	Addressing Performance Variability in Pavement Preservation	Prozzi (UTA)	Applied	0 ³
11	UMn-13	Development of Objective Methods for Determining Damage Accumulation in Pavements Prior to Visual Distress Becoming Apparent	Khazanovich (UMn)	Advanced	7%
12	NCA&T-15	Developing a Test Method to Investigate Water Susceptibility of Joint and Crack Sealants	Fini (NCA&T)	Advanced	13%
13	UH-16	Performance Monitoring of Preservation Treatments in Honolulu	Archilla (UH)	Applied	7%

Note: ¹ Project contract is under negotiation with Michigan Department of Transportation (MDOT), ² Project contract is signed and start date is October 1, 2014, ³ Project will be executed in cycle 2.

Collaboration among University Partners

CHPP offers summer research opportunities for high achieving undergraduates. The intent of this program is to encourage students from all consortium partners (MSU, UT-Austin, UIUC, NCA&T, and UH) to: (a) pursue graduate degrees; (b) provide an early opportunity to involve in research activities. The undergraduate and graduate students are encouraged to apply for summer internships at any university from the consortium.

External Collaborations

Dr. Prozzi attended the AASHTO RAC/TRB Representatives meeting in Madison (WI) to interact with state DOT practitioners and representatives of other UTC centers to explore possibilities of interaction and cooperation among universities, RAC members, and other agencies to address critical transportation problems through research. With the same objective, but seeking international partners and cooperation, he also attended the International Transport Forum in Leipzig in May and went to Tsinghua University in Beijing to promote research and technology transfer in pavement preservation.



Table 8 Organizations Involved in CHPP Activities

CHPP Program	Organization Name	City	State	Country	Financial Support	In-Kind Support	Contrib Facilities	Collaborative Research	Personal Exchange
Research	Steve Bower (Michigan DOT)		MI	USA	X	X			X
Research	Jim Moulthrop (FP2)		TX	USA		X			X
Research	Amy Schutzbach (Illinois DOT)		IL	USA		X			X
Research	Judith Corley-Lay (North Carolina DOT)		NC	USA		X			X
Research	Maureen Jensen (Minnesota DOT)		MN	USA		X			X
Research	Magdy Mikhail (Texas DOT)		TX	USA		X			X
Research	Cyndy Aylett (City and County of Honolulu)		HI	USA		X			X
Research	Alicia Pitlik (Illinois Toll way)		IL	USA		X			X
Research	Dr. Robert Worden (Chemical Engineering and Materials Science, MSU)	East Lansing	MI	USA				X	X
K-12	Leyf Pierce (TeachEngineering.org)		VA	USA				X	X
K-12	Dart Foundation		MI	USA	X				X
K-12	Okemos High School	Okemos	MI	USA		X	X		X
K-12	East Lansing High School	East Lansing	MI	USA		X	X		X
K-12	Haslett High School	Haslett	MI	USA		X	X		X
K-12	Regina High School	Warren	MI	USA		X	X		X
K-12	Union High School	Grand Rapids	MI	USA		X	X		X
K-12	Kaimuki High School	Honolulu	HI	USA		X	X		X
K-12	Wilson Elementary School	Honolulu	HI	USA		X	X		X
K-12	Stevenson Middle School	Honolulu	HI	USA		X	X		X
K-12	Chiefess Kamakahahei Middle School	Honolulu	HI	USA		X	X		X
K-12	Halau Ku Mana School	Honolulu	HI	USA		X	X		X
Tech Transfer	National Center for Pavement Preservation	Okemos	MI	USA		X	X	X	X
Summer program	Michigan State University	East Lansing	MI	USA	X	X			
Summer program	University of Hawaii at Manoa	Manoa	HI	USA	X	X			
K-12	North Carolina A&T		NC	USA	X	X			
Tech Transfer	North Carolina DOT		NC	USA		X	X		X
Tech Transfer	Piedmont-Triad Transport. partnership		NC	USA		X	X		X



Dr. Chatti was invited at the National Center for Pavement Preservation advisory board meeting on June 18, 2014 to present the research activities of the center and to seek collaboration with the regional partnerships.

Collaboration between Michigan State University and University of California at Davis is underway to investigate the effect of pavement structure and rolling resistance on fuel consumption. Rolling resistance, as one of the most significant factors in transportation industry, accounts for 5-7% of the total energy consumption of the nation. Therefore, there is a substantial economic and environmental interest to reduce it. If findings are promising, this could transform the pavement friction design and ultimately improve the sustainability of pavements which directly leads to environmental and economic benefits. The results from the collaboration can strongly assist highway engineers in (i) analyzing the trade-off between pavement grip and rolling resistance, (ii) instituting pavement design processes for different traffic conditions and (iii) ranking and rating of current road surfaces including those of pavement preservation treatments for further optimization.

4. Impact

Development of Principal Discipline(s)

Activities conducted during the current reporting period are expected to have an impact upon the transportation engineering discipline in the future. The results from a number of research projects are being incorporated into courses for the public and students that will shape future knowledge of specific transportation- related technologies.

Other disciplines

One of the MSU research projects will involve a faculty from the chemical engineering and materials science department. This research will address cutting-edge methods to evaluate field and laboratory aging of asphalt materials. If findings are promising, this will fill a big gap in the preservation treatment application timings based on the aging of asphalt materials in the field.

Development of Human Resources

The mission of CHPP seeks to provide a new platform for accelerating innovation in highway pavement preservation. The Center will assist in meeting the increasing demand for highway pavement preservation research and will further the goal of increasing the reliability and performance of the nation's highways. Also, adequate human resources will remain a clear and continuing challenge in meeting future transportation needs. Encouraging the best and brightest to pursue degrees in transportation-related engineering disciplines is a big priority for CHPP, exemplified by its emphasis on students' research and pre-professional involvement. The concept of this task is thus centered on showcasing the challenges, opportunities, and, most importantly, the rewards of pursuing a college degree in a transportation-related area. Existing efforts such as the CHPP summer research program for undergraduates/graduates students, and the education and training at the Undergraduate and Graduate Levels program, are designed to extend opportunities while enhancing interests and skills. Moreover, we anticipate that K-12 students participating in our outreach programs will benefit significantly. The interdisciplinary lessons and activities surrounding these programs enhance students' conceptual and practical skills related to math, science, and technology. Also, The Research Experience for Teachers (RET) program described above is



expected to enrich the professional development of a number of future leaders in STEM education, about half being females with a similar ratio for minorities. It will also result in innovative curricula for science and technology courses, and increase the interest of middle and high school students in scientific inquiry, specifically transportation. Through partnerships with local schools, the program will positively influence the learning and career paths of young students, especially students from under-served districts and under-represented groups in Michigan and beyond for years to come, thus contributing to a technology-savvy workforce that is much needed by the U.S.

Physical, Institutional, and Information Resources

Nothing to report.

Technology Transfer

Nothing to report.

Society Beyond Science and Technology

The national need to protect the massive national highway infrastructure investment is recognized by Congress and clearly cited in “Moving Ahead for Progress in the 21st Century Act” or the “MAP-21”. The establishment of CHPP is consistent with the U.S. Secretary of Transportation’s strategic goal of “State of Good Repair”. The mission of CHPP seeks to provide a new platform for accelerating innovation in highway pavement preservation. The Center will assist in meeting the increasing demand for highway pavement preservation research and will further the goal of increasing the reliability and performance of the nation’s highways. In addition, the research targeted by CHPP provides an ideal platform to emphasize social and environmental relevance of basic science and engineering subject matter. It is known that minorities and women have a lower representation in the science and engineering programs in universities. Several reasons suggested for this disconnect are lack of knowledge and emphasis on the social value and relevance of science, mathematics and engineering subject matters as well as the lack of multi-disciplinary project teams. The lack of a connection between subject material and life applicability has been shown to affect the retention of women in engineering. The strong societal impact and creation of multi-disciplinary teams will be crucial to attract female and under-represented minorities for the graduate and undergraduate student positions supported by this research. CHPP is reaching out to high school students, females and minorities in particular, mainly through summer camps and open house activities described above and will continue to do so in the future.

5. Changes/Problems

Nothing to Report.

