TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): __Virginia DOT______________________________

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5 (225)	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ☐Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)
Project Title: Validation of Hot-Poured Crack Sealant Performance Based Guidelines	

Name of Project Manager(s): Imad L. Al-Qadi	Phone Number: 217-265 0427	**E-Mail** alqadi@illinois.edu
Lead Agency Project ID: VCTIR 98160	**Other Project ID (i.e., contract #):**	**Project Start Date:** 09/01/2010
Original Project End Date: 09/01/2014	**Current Project End Date:** 10/31/2016	**Number of Extensions:** 2 extensions in total for 1.5 years

Project schedule status:

☐ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Percentage of Work Completed to Date**
730,000 (after revision 885,400)	$858,029	90% (with updated schedule

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	**Total Amount of Funds Expended This Quarter**	**Total Percentage of Time Used to Date**
$39,517	$39,517	94 % (with updated schedule)

Project Description:
Recently, performance-based guidelines were developed as a systematic procedure to select hot-poured bituminous crack sealants. These guidelines are the outcome of the pool-fund North American Consortium led by the University of Illinois at Urbana-Champaign and the National Research Council of Canada. The work proposed a "Sealant Grade" (SG) system to select hot-poured crack sealant based on environmental conditions. A special effort was made to use the equipment originally developed by the Strategic Highway Research Program (SHRP), which was used to measure binder rheological behavior as part of the Performance Grade (PG) system.

These developed laboratory tests allow for measuring hot-poured bituminous-based crack sealant's rheological and mechanical properties over a wide range of service temperatures. Preliminary thresholds for each test were identified to ensure desirable field performance. Then, the preliminary thresholds were utilized in the SG system based on extensive laboratory testing, limited between-laboratory testing, and limited field performance data.
However, because the preliminary thresholds were determined based on only limited field data, mainly from Canada, a comprehensive field study is urgently needed to validate and fine-tune the present threshold values.
Furthermore, the developed guidelines should be validated in several states under various climate zones.

Tasks:
I. Laboratory Validation
II. Field testing and installations
III. Test section monitoring
IV. Threshold value fine tuning
V. Cost effectiveness quantification
VI. Development of crack sealant selection procedures and installation guidelines.

Objectives:
The developed laboratory tests and the new guidelines must be verified for precision and bias between laboratories as well as within laboratories. In addition, since preliminary thresholds were established for each test based on extensive laboratory testing but with limited field and within-laboratory data, an extensive field study is urgently needed to validate and fine-tune the threshold values. Hence, this proposed study aims 1) to validate the developed laboratory tests, 2) to determine the thresholds using a more diverse array of field performance data, and 3) to implement crack sealant guidelines for field application.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Meetings:

No meetings took place in this quarter.

Task-I: Laboratory Validation (100% completed):

Progress in the laboratory testing is summarized as follow:

- New adhesion fixture was used to grade all sealants. Also, modified adhesion test was validated by correlating to the field performance.

- Hamburg wheel tracking test was used to evaluate field tracking. Four sealants were installed between two disks of asphalt mix or concrete with a proper overband. The tests were conducted in room temperature. Tracking length with number of cycle are recorded. Same as ATLAS field validation, results did not correlate well with the laboratory performance.

Task-II: Field Testing and Installation (100% completed):
- This task is completed

Task-III: Test section monitoring (100% completed).
- Second winter survey was done for Virginia test site. Only one sealant out of four had a good performance.

Task-IV: Threshold value fine-tuning (100% completed).

- Critical test methods and criteria were identified with their strength in correlation to field performance. The three performance groups were identified. The governing and key laboratory performance criteria are the stiffness and adhesion capacity. The worst performing sealants were the ones with low adhesion capacity and high stiffness for the climatic regions they are installed. The best performing sealants were with highest adhesion capacity and moderate stiffness. The remainder of the sealants were in the medium performing category with moderate adhesion capacity but with very low modulus.

- Composite score approach combining ranking and correlation was used to develop a quantitative scale to determine the level of acceptance. Based on the composite score, for most of the test sites, a strong or acceptable correlation between field performance and laboratory test parameters were obtained. CSBBR stiffness had the strongest correlation followed by adhesion energy and load for rout and seal treatment. However, average creep ratio from CSBBR test had either good or poor correlation with the performance index. Similarly, for clean and seal treatment, CSBBR stiffness had the best score followed by tensile load and extendibility. Also, a good correlation was observed between CSBBR stiffness and adhesion load as well as CSBBR stiffness and tensile load.

Finally, grade differences were calculated for each sealant installed at different test sites. It was shown that sealant performance was maximized when there is no grade difference meaning that test site temperature was equivalent to the sealant grade testing temperature (perfect match). When there was negative (too soft) or positive (too stiff) grade difference, a decline in sealant performance was observed. This shows the importance and validity of using sealant grade as performance criteria.

Task-V: Cost effectiveness quantification (100% completed).
- This task is completed

Task-VI: Development of crack sealant selection procedures and installation guidelines (90% completed).
- The installation guideline was finalized.
- Sealant selection procedure is underway and will be finalized in the next quarter.

Anticipated work next quarter:

1. Sealant selection procedures will be developed.
2. Final report of the project will be drafted.
3. A face-to-face meeting is planned in the next quarter.

Significant Results:
- New adhesion test shows an improvement in repeatability and results obtained so far is in good agreement with field performance.
- Two separate low temperature grading scheme is suggested for rout and seal and clean and fill techniques depending on the failure modes. The CSBBR and CSDTT methods is required for clean and fill treatment whereas the rout and seal treatment requires using CSBBR and CSAT methods.
- For CSBBR test method a maximum stiffness threshold is recommended to change from 25 MPa to 15 MPa defined at 240 seconds at 6℃ higher than grading temperature.
- For CSBBR test method a minimum stiffness threshold is introduced and selected as 40 MPa defined at 1 seconds at 6℃ higher than grading temperature. The minimum threshold will minimize the use of sealants with excessively low modulus

accelerating overband wear. It was also shown that adhesion capacity reduces for sealants with very low modulus.
- For CSBBR test method the average creep ratio (ACR) is kept same as before (minimum of 0.31).
- For CSDTT test method the extendibility thresholds are kept same as provisional standard. However, a secondary threshold maximum tensile load is introduced and selected as 25N to avoid the use of less ductile sealants.
- For CSAT, the minimum adhesion load is change from 50 N to 50 N at -4℃ plus 25 N for every 6℃ reduction at the test temperature.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Potential Implementation:

Based on the field validation study at various test sites, performance thresholds in Sealant Grade System will be Updated. These thresholds were initially determined based on limited field data. The finalized grade system can be used by States and other agencies for selecting sealants based on climatic region. Sealant field installation guidelines will also be available at the end of this project.