RUTGERS
Center for Advanced Infrastructure and Transportation

QUARTERLY PROGRESS REPORT

Project Title:	HMA Pay Adjustment (2012-01)
RFP NUMBER: 2012-001	NJDOT RESEARCH PROJECT MANAGER: Daniel LiSanti
TASK ORDER NUMBER: TO 282 / RU Acct 4-34770	PRINCIPAL INVESTIGATOR: Hao Wang, Ph.D.
Project Starting Date: 07/01/2012 Original Project Ending Date: 07/01/2014 Modified Completion Date: 12/31/2014	Period Covered: 1st Quarter 2014

Task #	Task	% of Total	Fixed Budget	% of Task this quarter	Cost this quarter	% of Task to date	Total cost to date
1	Literature Search	2.21%	$ 5,223	0.00%	$ -	100.00%	$ 5,223
2	Evaluation of Current NJDOT QA Specification	8.47%	$ 20,010	0.00%	$ -	80.00%	$ 16,008
3	Evaluation of Existing Performance-Related Specifications	9.84%	$ 23,252	0.00%	$ -	100.00%	$ 23,252
4	Development of Pay Adjustment Methodology	31.43%	$ 74,271	10.00%	$ 7,427	90.00%	$ 66,844
5	Acceptance Limits for In-Place Pavement Quality Characteristics	17.84%	$ 42,154	0.00%	$ -	80.00%	$ 33,723
6	Development of Draft Specification	13.65%	$ 32,245	30.00%	$ 9,674	60.00%	$ 19,347
7	Evaluation of Draft Specification	15.16%	$ 35,822	10.00%	$ 3,582	30.00%	$ 10,747
8	Quarterly /Final Reports and Recommendations	1.40%	$ 3,333	20.00%	$ 667	60.00%	$ 2,001
	TOTAL	100.00%	$ 236,310		$ 21,350		$ 177,145

Blue text is entered once at the beginning of the project

Green text is updated ever quarter

Black text is automatically updated or static

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Project Objectives:
The objective of NJDOT 2012-01, *HMA Pay Adjustment*, is to search and critically evaluate the literature to determine how the HMA quality characteristics can best be incorporated into the existing NJDOT HMA pavement specification to produce a comprehensive and effective multi-characteristic acceptance specification that can be easily understood and implemented. Particular attention will be paid to methods to develop a simple but scientifically-based performance-related pay adjustment methodology to produce a new specification that is practical and effective, fair to both the highway agency and the construction industry, and legally defensible. It is expected that successful completion of this project will significantly advance the asphalt technology development in NJ and extend the service life of flexible pavements.

Project Abstract:
The research plan is broken down into eight major tasks including literature search and reporting and recommendation. An extensive literature review will be first conducted to review previous research studies related to the project topic and the QA specifications and pay adjustment used by other states. The research team will then perform an assessment of New Jersey's current pay adjustment methodology by looking at actual QA data and their performances. After analysis and NJ specific considerations, the research team will develop a pay adjustment methodology that relate HMA quality factors and pavement performance and the acceptance limits for in-place pavement quality characteristics (such as longitudinal joint density and bond strength). Finally, the research team will submit a draft specification for discussion with NJDOT, which will then be evaluated through a pilot project system.

1. Progress this quarter by task:

Task 1 - Literature Review
This task has been completed. A draft literature review report – *Quality Assurance and Performance-Related Pay Adjustment* has been submitted to the NJDOT for review.

Task 2 - Evaluation of Current NJDOT QA Specification
The research team has analyzed the current pay adjustment using the QA data obtained from selected projects. The research team is waiting for the summary report from the subcontractor (Richard Weed from AID) that describes the risk analysis of current QA specification using SpecRisk.

Task 3 - Evaluation of Existing Performance-Related Specifications
This task has been completed. The research team evaluated the applicability of using the Quality-Related Specification Software (QRSS) that is developed by NCHRP 9-22

project for HMA pay adjustment. The concerns and disadvantages of directly using the QRSS for pay adjustment were identified.

Task 4 - Development of Pay Adjustment Methodology

The research team has developed the pay factors using field air void data and pavement performance data with the following steps:

Step 1: Collect and summarize field air void data.
The research team worked with Bureau of Material to acquire the air void data for all the projects constructed between 1995 and 2005 (except the projects with missing or incorrect milepost). The data from these projects were summarized into different groups based on the functional class, traffic volume, and pavement structure.

Step 2: Predict pavement life from field performance data.
The research team worked with Pavement Management Unit to acquire pavement performance data. Totally 60 projects were used in the analysis after data check and quality control. A sigmoidal (S-shape) model was used to fit pavement performance curves and predict pavement life before the SDI reached 2.4.

Step 3: Develop a quantitative relationship between percent defective (PD) of air void and pavement life.
The following relationship between the expected pavement life and the PD of air voids was developed.

$$EXPLIF=EXP\ (2.47-0.003145PD_1^{1.35}-0.000023PD_2^{2.36})$$

Where,
EXPLIF = expected life (years);
PD_1= percent defective of air void of surface course; and
PD_2= percent defective of air void of intermediate course;

Step 4: Conduct life cycle cost analysis to calculate pay adjustment.

$$PPA = (R^{DESLIF}-R^{EXPLIF}) / (1-R^{OVLIF})$$

Where,
PPA = percent pay adjustment for the initial resurfacing overlay (in this case the construction cost is the same as the cost of resurfacing overlay);
DESLIF = design life of initial resurfacing overlay (years) (pavement life at PD=AQL);
EXPLIF = expected life of initial resurfacing overlay that varies depending on construction/material quality;
OVLIF = expected life of successive overlays, typically 10 years; and
R = (1 + INF) / (1 + INT) in which INF is the long-term annual inflation rate (4 percent here) and INT is the long-term annual interest rate (8 percent here).

Task 5 - Acceptance Limits for In-Place Pavement Quality Characteristics

The research team analyzed the joint density data collected by NJDOT in 2000. A sensitivity analysis was conducted using various lower specification limits for joint density (88%, 89% and 90%) and various PD thresholds for bonus (10, 20, and 30). The acceptance limits will be finalized based on test results of field cores.

Due to the variation in interface bond strength testing and the missing of long-term performance data, the minimum requirement on interface bonding strength was not recommended. Instead, the following suggestions were recommended:

1. If the cores taken for air void acceptance tests were broken at the layer interfaces, the Department will not make positive pay adjustment (no bonus).
2. Tack coat cannot be dilated.
3. Prior to tack coat application, the distributor shall be calibrated in accordance with ASTM D-2995, Standard Practice for Estimating Application Rate of Bituminous Distributors. The RE will witness the calibration of distributor on the test strip or require the Contractor to provide documentation certifying the calibration.

The research team summarized the literature review and analysis results on interface bonding strength in a technical memorandum.

Task 6 - Development of Draft Specification

A draft longitudinal joint specification has been developed following the format of the current NJDOT construction specification.

Table 1 Pay Adjustment for Longitudinal Join Density

Range	Pay Adjustment ($) per mile
PD ≤ 10	(10 – PD)/10 x $1,500
PD = 10– 50	$0
PD ≥ 50	(PD – 50)/50 x $13,200

Task 7 - Evaluation of Draft Specification

The research team has updated the six selected projects through the communication with regional engineer. There are no longitudinal joints existing between the travel lane and shoulder for two originally selected projects. Table 3 summarized the coring and testing plan on the six projects (* indicates updated projects).

Table 2 Summary of Projects for Joint Coring

Region	Project	Direction	Milepost	No. of cores	Nuclear Gauge Points	Mix type (Mat + shoulder)
North	U.S 1 & 9	SB	42.83-45.5	18	18	SMA+SMA
	U.S 1 & 9*	NB	42.3-45.08	18	18	SMA+SMA
Central	18	NB	42.6-45.27	15	15	HMA+HMA
	206	NB	78.58-85.02	21	21	HMA+HMA
South	42	NB	6.22-7.44 11.93-13.09	18	18	SMA+ HMA
	49*	NB	27-31.4	18	18	HMA+HMA

A coring plan has been determined to take totally 108 cores from the longitudinal joints with 36 full-depth cores and 72 cores for surface course only. For every 0.5-mile of joint, three cores will be taken at different locations (6-in left, middle, and 6-in right of joint). The coring is expected to be conducted in early March after the extremely cold period.

Task 8 - Report and Recommendations
The research team has submitted quarterly reports, literature review report, and technical memorandum as the project progresses.

2. Proposed activities for next quarter by task:
Task 1- Literature Review
N/A

Task 2 - Evaluation of Current NJDOT QA Specification
The subcontractor will complete the current NJDOT QA specification using SpecRisk software.

Task 3 - Evaluation of Existing Performance-Related Specifications
N/A

Task 4 - Development of Pay Adjustment Methodology
The research team will summarize the new pay adjustment methodology in a technical memorandum and submit to the customers in the next quarterly meeting.

Task 5 - Acceptance Limits for In-Place Pavement Quality Characteristics

The research team will refine the acceptance limits for joint density based on test results of field cores.

Task 6 - Development of Draft Specification
The research team will refine the draft joint specification based on the review comments provided by NJDOT.

Task 7 - Evaluation of Draft Specification
The research team will conduct the following tests on the cores taken at longitudinal joints.

- Bulk specific gravity
  AASHTO T166 saturated surface-dry specimens
  Corelock vacuum method
- Maximum specific gravity
- Permeability
- Interface bond strength for full-depth cores

The research team will use test results to evaluate 1) the draft specification on longitudinal joint density; 2) the total pay adjustment considering mat air void, joint density, and roughness.

Task 8 - Report and Recommendations
The research team will continue submitting quarterly reports and technical memorandum as the project progresses.

3. List of deliverables provided in this quarter by task (product date):
Presentation of Pay Adjustment Methods, December Quarterly Meeting

The graduate student (Zilong Wang) presented the preliminary research results in the poster session of the 15th NJDOT Research Showcase (Oct. 2013) and the 47th Mid-Atlantic Quality Assurance Workshop (Feb. 2014).

Two technical memorandums will be submitted in this quarterly meeting; one is the draft longitudinal joint specification and another one is the recommendation on interface bond strength requirement.

4. Progress on Implementation and Training Activities:
N/A

5. Problems/Proposed Solutions:
The coring was delayed due to the delay of snow and extreme cold temperature.

The subcontractor's analysis using SpecRisk was delayed because the software only works for Windows XP platform.

Total Project Budget	$236,310
Year 1 Budget	$106,203
Year 2 Budget	$130,107
Total Project Expenditure to date	$177,145
% of Total Project Budget Expended	74.96%

NJDOT Research Project Manager Concurrence: _____ Date: _____