

NJDOT RESEARCH QUARTERLY PROGRESS REPORT

Date: report submission date

| | | | |
|---|---|---|---|
| RFP Number: | 2014-15-11 | Task Order Number | 328 / RU Acct 4-38782 |
| Project Title: Evaluation of Raised Pavement Markers (RPMs) | | | |
| NJDOT Project Manager: S.M. Mamun-Ar Rashid | Customer: | Principal Investigator: Xiang Liu, Ph.D. | Research Institution: Rutgers University |
| Project Starting Date: September 01, 2015 | Original Project Ending Date: September 01, 2017 | Modified Completion Date: | Period Covered: 01/01/2016-03/31/2016 |

Project Budget Status:

| Tasks | Task 1 | Task 2 | Task 3 | Task 4 | Task 5 | Task 6 | Task 7 | Task 8 | Totals |
|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------|
| Year 1 Budget | \$7,670.64 | \$22,201.32 | \$31,426.58 | \$71,986.45 | \$18,400.35 | \$0.00 | \$0.00 | \$5,251.07 | \$156,936.41 |
| Task % per Total Budget: | 4.89% | 14.15% | 20.03% | 45.87% | 11.72% | 0.00% | 0.00% | 3.35% | 100.00% |
| <i>Year 1 - % Complete:</i> | 100.00% | 100.00% | 70.00% | 8.00% | 0.00% | 0.00% | 0.00% | 64.86% | 38.89% |
| Quarterly Report, 1st Qtr. 2016 | Task 1 | Task 2 | Task 3 | Task 4 | Task 5 | Task 6 | Task 7 | Task 8 | Subtotals: |
| % of Task This Quarter | 0.00% | 30.00% | 60.00% | 8.00% | 0.00% | 0.00% | 0.00% | 64.86% | 22.10% |
| To be Invoiced this Quarter | \$0.00 | \$6,660.39 | \$18,855.94 | \$5,758.92 | \$0.00 | \$0.00 | \$0.00 | \$3,405.84 | \$34,681.09 |
| Total Billing To Date: | \$7,670.64 | \$22,201.32 | \$21,998.60 | \$5,758.92 | \$0.00 | \$0.00 | \$0.00 | \$3,405.84 | \$61,035.32 |

Project Objectives:

This project is to develop a comprehensive analytical framework to assist in evaluating the cost-effectiveness of raised pavement markers (RPMs) and their promising alternatives or modifications, so as to maximize the life-cycle net benefits from investment in roadway safety measures. The specific research objectives of the study will include:

1. Review and document 1) the state of the art for evaluation of RPMs and relevant alternatives; and 2) state of the practice on the use of RPMs, with a particular emphasis on the relationships among the use of RPMs (or alternative safety devices), crash risk, road characteristics, visibility, installation, and maintenance cost.
2. Development of qualitative and quantitative methods to evaluate the safety impacts and costs of RPMs on different types of roadways in New Jersey.
3. Identification and comparison of RPM alternatives or modifications through a multi-criteria evaluation such as safety effect, cost, durability and maintainability.
4. Cost-effectiveness assessment of RPMs and its alternatives given specified traffic and roadway conditions.
5. Development of asset management recommendations for installation, monitoring, and maintenance of RPMs and alternatives, in accordance with NJDOT policy and future considerations.

Project Abstract:

Raised pavement markers (RPMs) are delineation devices used to improve preview distances and guidance for drivers in inclement weather and low-light conditions. Currently, RPMs are installed along all centerlines and skip lines, regardless of traffic volume, roadway geometry and roadway classification in New Jersey. This study is conducted in three stages. **First**, this research will evaluate the use and effect of RPMs given specified road classification, geometry, and traffic factors. If the safety effects vary significantly with locations, it may result in a statewide variation in the cost-effectiveness of RPM implementation. **Second**, this research will identify promising modifications or alternatives to the current use of RPMs. The study will evaluate each alternative's respective merits and costs given specified roadway and traffic characteristics; weigh their benefits and costs through consistent, measurable criteria; and optimize their usage. **Third**, this research will discuss the installation, monitoring and maintenance of RPMs and its alternatives for maximizing their life cycle net benefits.

1. Progress in this quarter by task:

Due to lack of detailed RPM installation date and network-level hourly traffic volume, the project team has been attempting several approaches to evaluate the safety effectiveness of RPMs. We are also communicating with NJDOT to request hourly traffic volume information on certain locations. Because of the significant additional effort needed for data collection and investigation, the project is a bit behind the original schedule. Once the data issues are prudentially resolved, we will proceed with remaining tasks.

Project schedule status:

On schedule On revised schedule Ahead of schedule Behind schedule

Task 1 – Literature Review

In this task, we have been assembling and reviewing international studies related to the use of RPMs. A draft version of Task 1 report has been completed and submitted to NJDOT for review.

Task 2 – Survey

In order to identify statewide use of RPMs and its alternatives or modifications, we have developed a web-based survey tool to obtain the information about RPM installation, maintenance and replacement. We have received the responses from 22 states (as of April 1, 2016). We have summarized survey results in Task 2 report.

Task 3 – Methodology Framework and Data Collection

The objective of this task is to develop an analytical framework to evaluate the safety-oriented cost-effectiveness of RPMs, compared to their alternatives or modifications. The safety benefit of RPMs (or alternatives) will be assessed in terms of the expected reduction in accident risk attributed to implementation of RPMs. For each roadway segment, we will estimate its expected accident count, accounting for its historical accident record, traffic volume, number of lanes, shoulder width, and other influencing factors. The implementation costs of RPMs and their alternatives include the expenses on installation, inspection, replacement or repair. These costs will be estimated based on the literature, survey and communication with NJDOT.

2. Proposed activities for next quarter by task:

Task 4 : Evaluate cost-effectiveness of RPMs

Based on the results from Tasks 1 to 3, the objective of Task 4 is to quantify the cost-effectiveness of RPMs under different traffic volumes and roadway characteristics. Considering that the benefit-to-cost ratio of RPMs is likely to be location-dependent, we will screen all of the locations with RPMs and evaluate their respective cost-effectiveness on the annual basis. The crash data and roadway straight-line diagram data, both from NJDOT, are being analyzed at CAIT. The analysis results will include the safety effectiveness of RPMs by traffic volume, number of lanes and other factors. The implementation costs of RPMs (including installation cost, inspection and maintenance cost) will be collected based on literature review, survey and communication with NJDOT.

The deliverable of the proposed activities in the next quarter will be a preliminary analysis of cost-effectiveness of RPMs at different locations in New Jersey.

3. List of deliverables provided in this quarter by task (include deliverable date):

Task report 2 – Survey report (April 10, 2016)
Task report 3 – Methodology for evaluation of RPMs and data collection
(partially completed, the entire completion is expected on May 15, 2016)

4. Progress on Implementation and Training Activities:

None

5. Problems/Proposed Solutions:

None

| | |
|----------------------------------|--------------|
| Total Project Budget – Year 1 | \$156,936.41 |
| Modified Contract Amount: | |
| Total Billing To Date | \$61,035.32 |
| Year 1 - % Complete | 38.89% |
| % of Total Project Time Expended | 58.33% |

NJDOT Research Project Manager Concurrence: _____ Date: _____

PROJECT SCHEDULE - YEAR 1

| Project Title | EVALUATION OF RAISED PAVEMENT MARKERS (RPMS) | | | | | | | | | | | | FY: 2016 | Month: March |
|---|--|------|------|-----|------|-----|-----|-----|-----|-----|------|------|---------------------------|--------------|
| Project No. | 2014-15-11 | | | | | | | | | | | | | |
| Principal Investigator | Xiang Liu, Ph.D. | | | | | | | | | | | | | |
| | MONTHS | | | | | | | | | | | | Estimated % Completion | |
| RESEARCH TASK | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| 1 - Literature Review | 50% | 100% | | | | | | | | | | | | 100.00% |
| 2 - Survey on the use of RPM and its alternatives | | 50% | 100% | | | | | | | | | | | 100.00% |
| 3 - Develop a cost-benefit analysis framework | | | | 50% | 100% | | | | | | | | | 70.00% |
| 4 - Evaluate cost-effectiveness of RPMS | | | | | | 17% | 33% | 50% | 67% | 83% | 100% | | | 8.00% |
| 5 - Evaluate cost-effectiveness of RPM alternatives | | | | | | | | | | | | 100% | | 0.00% |
| 6 - Installation, Monitoring and Maintenance Practices on RPM | | | | | | | | | | | | | | 0.00% |
| 7 - Research Implementation and Training | | | | | | | | | | | | | | 0.00% |
| 8 - Agency Briefing, Quarterly / Final Reports and Presentation | | | 25% | | | 50% | | | 75% | | | 100% | | 64.84% |
| Overall % Complete | | | | | | | | | | | | | | |
| Project | 2% | 12% | 20% | 30% | 40% | 48% | 56% | 64% | 72% | 80% | 87% | 100% | | |
| Overall % Complete | | | | | | | | | | | | | | |
| Actual | 2% | | | 17% | | | 39% | | | | | | | 38.89% |

FIG. A -- OVERALL PROJECT SCHEDULE

Data Table for Figures B and C (Charts)

| Month | Planned Gross Expenditure | Actual Gross Expenditure |
|-------|---------------------------|--------------------------|
| 0 | - | - |
| 1 | 3,835.32 | - |
| 4 | 46,898.02 | 18,209.74 |
| 7 | 87,919.56 | 32,844.97 |
| 10 | 125,225.55 | |
| 12 | 156,936.41 | |

| Month | Planned Progress (%) | Estimated Actual Progress (%) |
|-------|----------------------|-------------------------------|
| 0 | 0 | 0 |
| 1 | 2 | 2 |
| 4 | 30 | 17 |
| 7 | 56 | 39 |
| 10 | 80 | |
| 12 | 100 | |

Enter the number of months in the first column, the planned gross expenditure for each month in the second column, and then update the third column to reflect the actual gross expenditures for each reporting cycle.

In the Planned Progress column, enter the projected progress for each month. In the Estimated Actual Progress column, enter the actual level of progress for each reporting cycle.

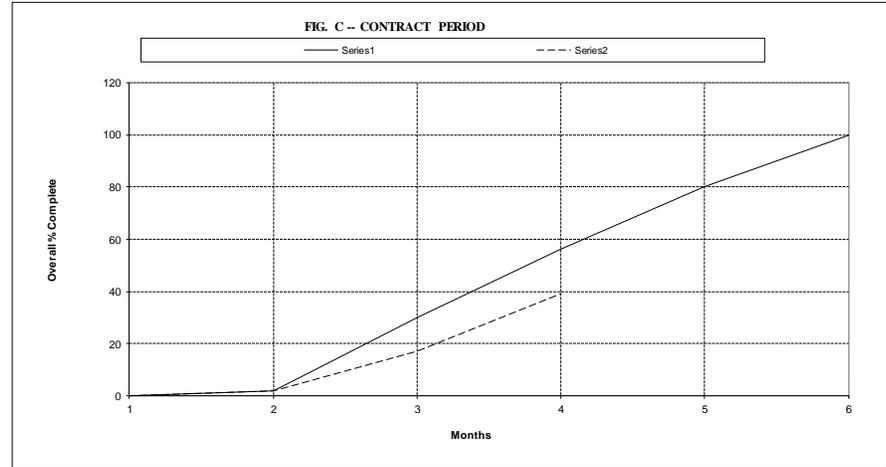
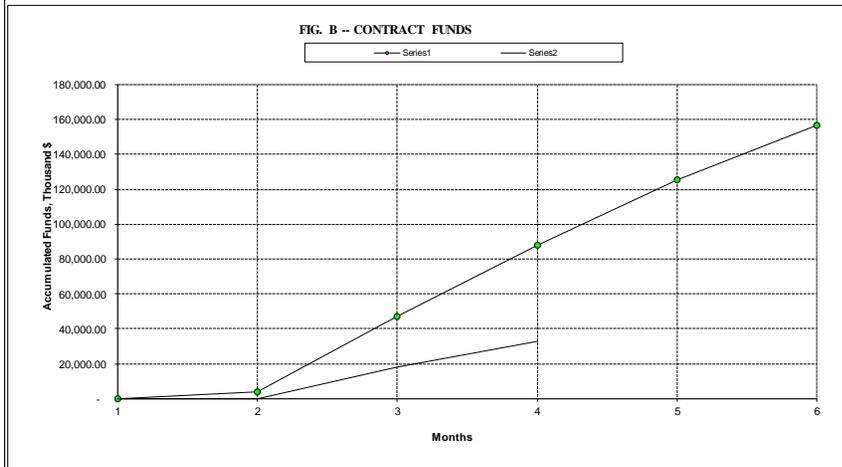


Fig. B is generated using the data provided in Tab 2. It provides a visual representation of funds expended versus planned fund expenditure.

Fig. C is generated using the data provided in Tab 2. It provides a visual representation of anticipated progress versus actual progress.

| | | |
|-----------------------------|----|--------------|
| Year 1 - % Complete | % | 38.89% |
| Contract Amount | \$ | \$156,936.41 |
| To be Invoiced this Quarter | \$ | \$34,681.09 |
| Total Billing to Date | \$ | \$61,035.32 |
| Balance | \$ | \$95,901.09 |

| | | |
|-----------------|---|-----------|
| Time expended | % | 58.33% |
| Starting Date | | 9/1/2015 |
| Completion Date | | 8/31/2016 |

NOTE: Items circled in red are to be updated with each quarterly submission of a report. Please note also the sections on Tab 2.

3835.32 18771.3 31184.73 46898.02 62611.31 75921.82 87919.56 99917.3002 113227.8091 125225.6 137223.3 156936.4