

Quarterly Progress Report:

Project Number and Title: 1.8: Enhancing Intelligent Compaction with Passive Wireless Sensors

Research Area: Thrust # 1, Monitoring and Assessment for Enhanced Life

PI: Ehsan Ghazanfari, The University of Vermont

Co-PI(s): Hamid Ossareh, The University of Vermont

Reporting Period: 3/1/2020 to 6/30/2020

Submission Date: 6/30/2020

Overview:

During the past quarter, we continued to analyze the data (IC, pavement quality indicators (PQI), and nuclear gauge density (NGD)) that we collected from field tests in Route 117 (Vermont) reclaimed asphalt pavement project. In addition, we looked into data from another RSB project in Vermont to: (i) assess the reliability of IC measurement values (ICMV) to changes in the density and stiffness of the compacted material, and (ii) potential utilization of ICMVs as a function of vibration amplitude and frequency (Figure 1 is an example of analyzed data) in the control system, with the goal of optimizing the compaction process, and spatial variability of the ICMVs using geo-statistical tools. In addition, we continued the work with sensor manufacturing vendors to fine tune the viable options for design/ruggedization of the pressure sensors to survive the extreme pressure and temperature during compaction process. We have selected two sensor/sensing systems that seem to serve our objective. The performed work in previous months helps us move closer toward the next steps of the project and to improve the IC performance and facilitate the process of geomaterial compaction and pavement performance monitoring.

Table 1: Task Progress

Task Number	Start Date	End Date	% Complete
Task 1: IC in sub-base/asphalt	07/01/2018	08/30/2020	80%
Task 2: Passive sensor	06/01/2019	02/30/2021	50%
Task 3: Integration options/performance eval.	03/01/2021	06/30/2021	0%
Overall Project:	07/01/2019	06/30/2021	45%

Table 2: Budget Progress

Project Budget	Spend – Project to Date	% Project to Date*
\$254,732	\$108,549	41.30%

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events

Title	Event	Type	Location	Date(s)
Presentation title	Name of event (i.e. TIDC 1 st Annual Conference)	i.e. Conference, Symposium, Seminar,		
None				

Table 4: Publications and Submitted Papers and Reports

Type	Title	Citation	Date	Status
	The accepted ASCE Geo-Congress 2020 conference paper, reported in previous quarterly report, is now published.			
	The submitted conference paper (4 th International Conference on Transportation Geotechnics), reported in previous quarterly report, is still under review.			

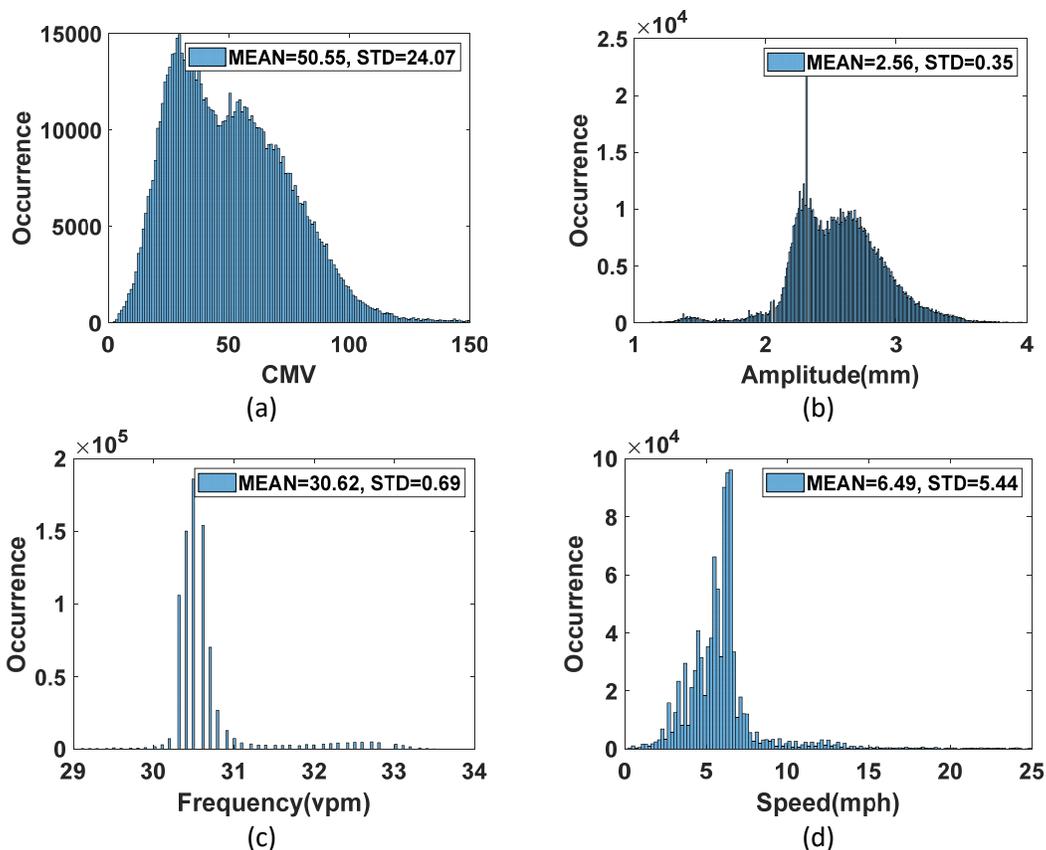


Figure 1. Example of analyzed IC data: (a) IC measurement values, (b) amplitude, (c) frequency, and (d) roller’s speed

Participants and Collaborators:

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members			
Individual Name	Email Address	Department	Role in Research
Ehsan Ghazanfari	Ehsan.ghazanfari@uvm.edu	Civil & Environmental Engineering	Principal Investigator
Hamid Ossareh	Hamid.Ossareh@uvm.edu	Electrical and Biomedical Engineering	Co-Principal Investigator

Table 6: Student Participants during the reporting period				
Student Name	Email Address	Class	Major	Role in research
Maziar Foroutan		Ph.D.	Civil & Environmental Engineering	Graduate Research Assistant
Ahmad Ghazanfari		M.S.	Electrical and Biomedical Engineering	Graduate Research Assistant

Table 7: Student Graduates			
Student Name	Role in Research	Degree	Graduation Date
None			

Table 8: Research Project Collaborators during the reporting period						
Organization	Location	Contribution to the Project				
		Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
None						

Table 9: Other Collaborators			
Collaborator Name and Title	Contact Information	Organization and Department	Contribution to Research

Name: Callie Ewald

Title: Geotechnical Engineering Manager

Organization: Vermont Agency of Transportation

Location (City & State): Berlin, Vermont

Email Address: callie.ewald@vermont.gov

Changes:

In the past quarter (for the most part), we did not have access to the research laboratories in the College of Engineering and Mathematical Sciences (CEMS) due to Covid-19 pandemic. As a result, some of the research activities including (i) the laboratory experiments to verify the accuracy of the sensing system to changes in the density and stiffness of the compacted material, and (ii) design/ruggedization of the pressure sensors to survive the extreme pressure and temperature during compaction process were delayed. To mitigate the negative impact of these delays on the overall progress of the project, we shifted our focus to other research activities including potential utilization of ICMVs as a function of vibration amplitude and frequency in the control system.

Planned Activities:

- (i) analysis of the collected data from IC field tests aiming at IC performance improvement
- (ii) continue evaluation of design and ruggedization approaches for the passive sensors in IC compaction