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: *10/01/2019 to 12/31/2019*
Submission Date: *12/26/2019*

Overview:

During the past months, we continued to analyze the data (IC, nuclear gauge density (NGD), pavement quality indicators (PQI)) that we collected from field tests in Route 117 (Vermont) reclaimed asphalt pavement project to verify the reliability of IC measurement values (ICMVs) to changes in the density and stiffness of the compacted material. The analysis included potential utilization of ICMVs as a function of vibration amplitude and frequency 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. 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**	**Percent Complete**
Task 1: IC in sub-base/asphalt	07/01/2018	04/30/2019	70%
Task 2: Passive sensor	05/01/2019	01/30/2020	40%
Task 3: Integration options/performance eval.	11/01/2019	06/30/2020	0%

Table 2: Budget Progress		
Entire Project Budget	**Spend Amount**	**Spend Percentage to Date**
$148,581.92		

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events				
Title	**Event**	**Type**	**Location**	**Date(s)**
Implementation of Intelligent Compaction (IC) for Pavement Construction in Vermont	VTrans Research Symposium	Symposium	VTrans	09/11/2019
Implementation of Intelligent Compaction (IC) for	STEM Complex Celebration	Symposium	University of Vermont	10/04/2019

Pavement Construction in Vermont				

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 selected for podium presentation.				
Conference paper (4th International Conference on Transportation Geotechnics)	Geo-statistical evaluation of the intelligent compaction performance in a reclaimed base project	Foroutan, M., Ghazanfari, E., Geo-statistical evaluation of the intelligent compaction performance in a reclaimed base project, 4th International Conference on Transportation Geotechnics, August 30–September 2, 2020; Chicago, Illinois	11/30/2019	Under review

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

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**
N/A						

Changes:

None to report.

Planned Activities:

(i) Analysis of the collected data from IC field tests aiming at IC performance improvement
(ii) Continue exploring viable options for design and ruggedization of passive sensors in IC compaction
(iii) Planning field tests for upcoming construction season