TAP/Kickoff Meeting Minutes
'Seismic Approach to Quality Management of HMA'
NRRA – ICT Team

January 23, 2020, 2:00pm-3:15pm

MnDOT Office of Materials and Road Research (Maplewood, MN)
Video Conference Room

1. **Welcome** J. Richter

2. **Goal of Today's Meeting** J. Richter
   a. Introduce PI's.
   b. PI's to present and share how they plan to successfully complete the project.
   c. Inform TAP and provide an opportunity to ask questions.

3. **Background** J. Richter
   a. Project seeks to apply and modify existing seismic geophysical techniques (specifically, those that utilize surface waves) toward the development of a quality management tool for characterizing new asphalt pavement in terms of shear wave velocity.
   b. 2- year project with hardware & software deliverable.
   c. Relevance of project in midst of litany of pavement test devices and methods.

4. **Project Presentation** C. Park

5. **Q & A**
   a. Richter: Sensitivity of measurements to fluctuating surface topography?
      i. Ryden: It is assumed that array is parallel with road so if road is uneven this could be an issue but can be overcome with reciprocal sources on each side of array. Starting on fresh pavement is ideal. Height of receivers is not much of an issue; attenuation does become an issue but 1 or 2 inches above pavement is acceptable- close as possible is preferred without touching pavement.
   b. Chang: Similarity to PSPA?
      i. Ryden: Principle and outputs are similar but receivers are microphones and arrays are rolling. Processing approach different and more robust since using multichannel approach. 1D models from PSPA vs 2D/3D for this project.
   c. Zegeye: HMA stiffness is highly dependent on temperature and on loading frequency. How do you intend to take into account these factors? Have you thought with what other lab or field stiffness to compare?
      i. Ryden: We output in shear wave velocity but important measurements are frequency (high f) and temperature (surrounding temp); both will be measured and are important for quality management process if this method is pursued down the road. Plan to compare and report results at specific reference temperature
   d. Zegeye: Surface roughness affecting results?
      i. Ryden: No problems with roughness or texture. Bit surface can be sealed or open/rough but haven't had any problems with it.
   e. Embacher: What height of array to specify for contractors?
      i. Richter: To be addressed later.
   f. ?: Calibration of sensor arrays (MEMS microphones)?

       i. Ryden: Unnecessary since acquiring relative measurements. Measuring relative time difference over array. No absolute value read from sensors. Good S/N ratio good enough. Emphasis is on sample rate of data acquisition system and temperature measurements.

g. Dukatz(?): How plan to perform surface temperature measurement?
       i. Starkhammar: Considering incorporating infrared. Focusing on a sensor commonly used in asphalt industry. Wet surface could be a problem for sensor.
       ii. Richter: Can it be measured with current thermal bars?- Siekmeier: Yes.
       iii. Worel: Most testing done a day after construction anyway. Measured temp would be sun heating the road.
       iv. Siekmeier: We don't know how we're going to incorporate thermal measurement in the beginning.
       v. Starkhammar: Movement of car could affect temp measurements. Need a shielded sensor.

h. Zegeye: How to validate measurements/velocities?
       i. Richter: Possibly PSPA?
       ii. Ryden: Prefer resonant testing from cores. PSPA also possible. Important to validate at similar frequency and temperature.
       iii. Park: Accelerometers may also be a possibility.
       iv. Richter: How did resonance testing compare to 2017 device?
       v. Ryden: Very good correlation, especially on new pavements.
       vi. (draft review revealed that Ryden may have suggested that FWD and laboratory resilient modulus could be used)

i. Worel (comment): Shipping of tool overseas; start thinking about how to do that.

j. Chang: Mesh size of array?
       i. Park: Array 6' wide. Receiver row spacing open to suggestion but looking at highest resolution using 1' transverse spacing. 'Mesh' can be controlled.
       ii. Embacher (comment): We would like to overlay the models on other data in Veta (discussion ensued about efficacy of 1' transverse spacing. Have to balance sample frequency and sample rate since will affect data file size).

k. Dukatz (comment): Consider acquiring ride measurements.
       i. Embacher: Swedes do this and maybe this could be considered alongside tests in Sweden. We do this in MN while acquiring IRI and ALR. It could tell us if the ride is significantly affecting velocity results.
       ii. Richter: Not part of scope but assuming we can accommodate on our end.

l. Zegeye: Is there a GPS component?
       i. Chang referenced the line number in the scope via IM.
       ii. Starkhammar: We will be incorporating GPS component into system.

m. Worel: Any concern with mesh size of array considering issues with pavers (gear box, augers, e.g.) or density at edges.
       i. Embacher: 1' receiver row spacing will capture irregularities during paving.
       ii. Park: Spacing to be determined later and is based on travel speed, e.g. but can be done.
       iii. Embacher: Perfect world would be 1'. Already better than data density from cores.

n. Worel: Why another device when we're already looking at RDM and IC?
       i. Siekmeier: First, the physics is different.
       ii. Anderson: Want to use something like this during scoping process.
       • Richter: Obstacles to overcome with surface irregularities on existing road. Currently, focusing on freshly paved surface.
       iii. Park: Dielectric is not directly related to stiffness.
       iv. Richter: A unique approach which will characterize via shear wave velocity.

<div style="margin-left:2em">
Provides a future opportunity to harmonize design and QA process since seismic velocity is directly related to mechanical properties and performance.
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v. Zegeye: RDM is an indirect approach to index properties (i.e., density).

vi. Embacher: Dielectric measurements are significantly affected by other properties; shear wave does not have as many obstacles.

vii. Worel: The fact that measurements aren't 'muddied up' by outside influences is encouraging. Just want to be sure we're not reinventing the same wheel.

o. Dukatz: Is this being used as a QC device or acceptance tool?

   i. Embacher: Both since there are fewer factors influencing the measurements (water from rollers, dirty mats, e.g.).

6. **Considerations/Action Items:**
   a. Worel: Suggested collaboration with Swedish Road Administration (Tomas Winnerholt). Worel can help facilitate.
   b. Worel: Suggested good communication and progress going forward since using other states' money; keep website updated.
   c. Worel: NRRA meeting schedule.
   d. Worel: Look into overseas shipping.
   e. Richter: See 5j. Should group be surveyed for preferred dimensions?
   f. Embacher: See 5j. PI's should consider a discussion with vendors (Caterpillar?) regarding preferred sensors for thermal measurments.
   g. Embacher: See 5k. PI's should consider acquiring ride measurements from Swedish Road Administration.

7. **Future TAP Meetings**   J. Richter
   a. No timeline at this point- see Worel comment in 6b.
   b. Quarterly reports may instigate future meetings.
   c. Will stay on top of task schedule.

Attendees:

<u>PI's (web)</u>
Choon Park (Park Seismic - Connnecticut)
Jin Park (Park Seismic - Connnecticut)
Nils Ryden (Lund University/ Norrfee Tech - Sweden)
Josefin Starkhammer (Norrfee Tech- Sweden)

<u>MnDOT/OM&RR</u>
Jason Richter – TL/Geotechnical Engineering Section (present)
Rebecca Embacher - NRRA-ICT Chair/Pavement Section (web)
John Siekmeier - Pavement Section (present)
Tim Anderson - Pavement Section (present)
Eyoab Zegeye - Research Section (web)
Ben Worel – Research Section (present)
Micah Holzbauer – Geotechnical Engineering Section (present)

<u>Caterpillar</u>	<u>MAPA</u>	<u>Mathy Construction</u>
Bryan Downing (web)	Brandon Brever (web)	Ervin Dukatz (web)

<u>Transtec</u>	<u>Caltrans</u>	<u>University of Texas at El Paso</u>
George Chang (web)	Raguparan Thangavelautham (web)	Soheil Nazarian (web)