Research Need Statement 648

I. Need Statement Champions and Information

I.A. Need Statement Champion Information

I.A.1. First and Last Name of Research Champion: Shongtao Dai
I.A.2. Research Champion's Office: MnDOT Materials & Road Research
I.A.3. Research Champion's Phone Number: 651-366-5407
I.A.4. Research Champion's Email: Shongtao.dai@state.mn.us

I.B. Research Co-Champion

I.A.1. First and Last Name of Research Co-Champion: Curt Turgeon
I.A.2. Research Co-Champion's Office: MnDOT Materials & Road Research
I.A.3. Research Co-Champion's Phone Number: 651-366-5535
I.A.4. Research Co-Champion's Email: curt.turgeon@state.mn.us

I.C. Research Needs Title (115 Characters): Asphalt Pavement Cracking Performance Data Analysis

I.D. Project Sponsor: Joint MnDOT and Local Road Research Board

II. Research Need Background and Description

II.A. Research Need Background

II.A.1. Describe the problem or opportunity.

Low-temperature cracking of asphalt pavements (flexible) is a significant issue in northern climates. To address cracking, the Disc-shaped Compact Tension (DCT) test was developed to obtain fracture energy (Gf) and other low temperature fracture performance parameters. MnDOT has evaluated and validated suitability of this test over last decade. During the 2017 and 2018 construction seasons several MnDOT pilot projects implemented use of the DCT for mixture approval. Past and recent research has also demonstrated ability of DCT test to distinguish between good and poor reflective cracking performance.

An extensive database containing DCT test results of Minnesota mixtures has been established. There are more than 2000 test set values (representing over 200 individual mixes) in the database. Within the last year a tool (ESRI GIS Software) to process and visualize annually collected pavement management data has become available, this has significantly upgraded the ability to conduct rigorous analysis of pavement crack in terms of crack widths and severity.

II.A.2. If applicable, describe how this project will build on previous research.

This project is based on recommendations from previous research **"Disc Shaped Compact Tension (DCT) Specifications Development for Asphalt Pavement"** published June 2019, which developed recommended initial fracture energy criteria for mixtures. It recommended "While a limited amount of extended validation will occur through an on-going NRRA flexible team long-term research project, use of existing in-service pavement in Minnesota for further exploration is recommended.".

II.A.3. If applicable, include the title/s or previous research.

"Disc Shaped Compact Tension (DCT) Specifications Development for Asphalt Pavement" - http://dot.state.mn.us/research/reports/2019/201924.pdf

II.A.4. What is the objective of the proposed research?

To leverage efforts undertaken over last decade and to support implementation of previous and on-going research there is need for three research thrusts (to be conducted under a single research study):

(1) Utilize newly available tools for pavement cracking performance analysis to conduct comparative evaluations between DCT test results and field performances. This will help with continued effort to establish threshold values for performance measures that can be used in performance-based specifications and balanced mix design approaches.

(2) Assess viability of cracking performance measured from DCT test beyond fracture energy of the mixtures. Recent research has shown that two asphalt mixtures with distinctly different cracking performances can have similar fracture energies, however very different shape of DCT post peak curve. Within the last couple of years MnDOT developed a representative curve and Post Peak (DCT) Index to consider the post peak curve within cracking performance measure. This study would analyze this measure in context of field cracking performance.

(3) Lastly, there is need to evaluate DCT test results in current database as well as future results through a thorough outlier analysis. Methods such as, ASTM E 178 and Mahalanobis distance methods need to be assessed for their suitability and adoption. Outlier detection and screening will significantly impact cracking performance values that would be used for making mix design and mix acceptance decisions.

III. Strategic Priorities, Benefits, and Expected Outcomes

Section III. is for MnDOT sponsored and co-sponsored projects only; all LRRB projects proceed to section IV.

III.A. MnDOT Strategic Priorities

Instructions: Briefly describe how the project aligns with the following MnDOT Research Strategic Priorities. Complete all that apply.

III.A.1. Innovation & Future Needs: Initial determination of fracture energy (Gf) minimums indicated in current MnDOT pilot specifications for asphalt paving was based mainly upon testing of field core specimen. Over the last 5-plus years, MnDOT has collected and tested over 200 plant produced mixes with known pavement locations, some with exact GPS based positioning. This study will significantly further previous efforts and substantially improve reliability of performance thresholds through use of improved field cracking performance characterization, evaluation of newer and more applicable Post Peak (DCT) Index and thorough outlier analysis. All of these attributes will enhance result in updated material specifications and provide State/County/City personnel with refined, updated data that instills confidence in choosing asphalt mixes with high resistance to thermal and reflective cracking.

IIIA.2. Advancing Equity:

III.A.3. Asset Management:

III.A.4. Safety:

III.A.5 Climate Change & Environment:

III.B. Expected Outcomes

Instructions: Check all expected direct outcomes of this research.

- ☒ New or improved technical standard, plan, or specification
- ☒ New or improved manual, handbook, guidelines, or training
- ☐ New or improved policy, rules, or regulations
- ☒ New or improved business practices, procedure, or process
- ☒ New or improved tool or equipment
- ☒ New or improved decision support tool, simulation, or model/algorithm (software)
- ☐ Evaluation of a new commercial product
- ☐ Other. Please specify below:

III.C. Expected Benefits

Instructions: Select all expected benefits that may be realized if the findings and recommendations from this research is adopted or implemented

III.C.1. Construction Savings Improved quality of construction

III.C.2. Decrease Engineering/Administrative Costs The improved material test method will result in long lasting pavements and save construction costs.

III.C.3. Environmental Aspects Recycling

III.C.4. MnDOT Policy Changed or inform a policy

III.C.5. Lifecycle Reduce maintenance cost

III.C.6. Operations and Maintenance Savings Long lasting pavement performance will reduce maintenance costs

III.C.7. Reduce Risk Choose an item.

III.C.8. Reduce Road User Cost Reduce congestion

III.C.9. Safety Improve worker safety (i.e. workzone safety)

III.C.10. Technology New method of using technology

III.C.11. Other, please describe below:

IV. Technical Advisory Panel

Instructions: Please list the name and affiliation of individuals to consider for the Technical Advisory Panel.

Shongtao Dai, Joe Voels, Jim Bittman, Chelsea Bennet (all MnDOT)

Your assigned Project Advisor is available to answer questions and provide guidance (assigned by the Office of Research & Innovation).
Your Project Advisor is: Marcus Bekele, (651)366-3903, marcus.bekele@state.mn.us