Oregon Department of Transportation

Stage 1 Research Problem Statement

Number*: 25-58*

Proposed Title: Developing Rapid and Sustainable Soil Stabilization Guidelines for Efficient Pavement Repair and Maintenance in Oregon

1. Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

In pavements, improving the structural capacity of base and subbase layers can have significant benefits, including reducing the thickness of the overlying asphalt (flexible pavements) or concrete layer (rigid pavement). Chemical stabilization with geopolymers is gaining popularity to achieve this sustainably. In addition, the durability of the stabilized layer can be improved by evaluating the effect of local environmental conditions and mineralogical composition. However, current design and construction methods do not emphasize local soil and environmental conditions. Moreover, the current methods lack the rapid response capability essential for emergency situations, such as sudden pavement failures or post-disaster repairs, where immediate action is crucial. Therefore, developing recommendations and design guidelines incorporating these conditions can improve the long-term performance of pavements.

2. Document how this **transportation issue** is important to Oregon and will meet the Oregon Research Advisory Committee Priorities

Constructing durable pavements using efficient and effective methods is of high importance for Oregon and central to ODOT's mission to provide a safe and efficient transportation system. Integrating sustainable rapid stabilization techniques aligns with ODOT's objectives of enhancing infrastructure resilience and reducing the environmental impact of repair activities. Considering the expansion, repair, and maintenance of pavements in different regions of Oregon, durability and performance are of high importance. Failure to consider the effect of the local soil composition and environmental conditions can significantly deteriorate the pavement during the performance period. In addition, the pavement design would favor increasing the overlying asphalt or cement concrete layer thickness. This subsequently increases material usage, carbon footprint, and cost. Chemical soil stabilization effectively improves durability and mitigates the need for a thick asphalt or concrete layer. Incorporating the effect of local environmental conditions such as freeze-thaw, wet-dry, and dynamic moisture changes would further enhance the durability and enable opportunities for developing custom specifications for the state of Oregon. Evaluating the engineering properties of stabilized Oregon soils can also help determine level 2 and 3 (e.g., Mr, and qu) parameters for use in the AASHTOWare (formerly known as Mechanistic-Empirical Pavement Design Guide-MEPDG) design software.

3. What **final product or information** needs to be produced to enable this research to be implemented?

This study will evaluate the engineering, economic, and sustainable benefits of incorporating chemical stabilization during the design and construction of pavements. In addition, this study will develop practical evaluation metrics that consider local soil mineralogical and environmental conditions. The major research product is the improved evaluation and design guidelines, which will be implemented in ODOT's Pavement Design Guide and Geotechnical Design Manual. The revised guidelines can help save costs (optimized material

usage) and improve the durability of pavements. Following review and approval by the ODOT pavements and geotechnical groups, this work will be used by ODOT pavement and geotechnical engineers and its engineering consultants.

In addition, laboratory investigation of this research will determine design parameters (e.g., level 2 and level 3 input parameters) for use in the AASHTOWare software. This process can further help in selecting the optimum thickness of the asphalt or concrete layer, which is critical to improving the long-term performance of the pavements. Additional research products include increased confidence in selecting appropriate evaluation methods and stabilizer dosage for pavement construction.

The proposed research tasks are:

1. Literature review: Perform a literature review on soil stabilization data for soil in Oregon. Review the locations of aggressive soils (e.g., organic soils, shrink-swell soils) and environmental conditions (e.g, humidity and temperature) in Oregon.
2. DOT/ industry survey: Perform a DOT/industry survey to identify the state of practice for stabilizing soils.
3. Identify candidate soils: Identify candidate soils in Oregon for stabilization. The PIs will use ODOT personnel interview results and data from the Literature review to achieve this.
4. Laboratory investigation: Evaluate the effect of mineralogical composition and environmental conditions on the engineering performance of stabilized soil materials. Specifically, the focus is on determining the optimum stabilized dosage rate using conventional laboratory investigations (e.g., resilient modulus, unconfined compressive strength, wet-dry durability, freeze-thaw durability)
5. MEPDG: Quantify the impact of soil stabilization on overall pavement performance and determine the reduction in pavement thickness that can be created by improving the resistance of the unbound layers.
6. Revise existing guidelines: Generate recommendations regarding the dosage rate for different Oregon soils and propose revisions to ODOT's pavement design and Geotechnical Design guide.
7. Develop new guidelines and recommendations: Develop guidelines evaluating the performance of stabilized soil materials. In addition, Develop rapid deployment strategies: Establish clear, actionable procedures for the immediate implementation of sustainable soil stabilization methods in emergency scenarios.
8. Report: Document findings and submit a final report.

4. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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5. Other comments:

The proposal also intends to conduct a preliminary cost-benefit analysis to estimate potential savings for ODOT through the adoption of sustainable rapid stabilization techniques, highlighting both direct cost reductions and the value of minimized disruption to traffic and communities.

6. Corresponding Submitter's Contact Information:

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