Oregon Department of Transportation

Research Stage 1 Problem Statement

Number 26-45 – "Evaluation of Non-Destructive Testing of Concrete Bridge Members for Refined Bridge Load Ratings at ODOT"

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

Load posting of a bridge can have devastating social and economic consequences for the affected communities. Often, a posting is not the result of inadequate capacity or a deficiency but due to a lack of available as-built plans and affiliated information such as design specifications and materials testing results. Bridge foundations are of particular interest, as their configuration and detailing are often unknown. Imaging and image fusion using GPR and ultrasonic array data offers a practical solution that has not been evaluated and adopted sufficiently in bridge assessment. The resulting final images are digital cross-sectional views of the interior of a concrete member, allowing bridge engineers to accurately examine, visualize, and ascertain pertinent geometric and material properties when as-built information is not available, ultimately enabling accurate and refined load rating.

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

The final product is a detailed practical guide and procedures to enable NDT professionals to perform imaging and image fusion based on GPR and ultrasonic array measurements of concrete bridge members, allowing bridge engineers to perform refined load ratings based on the resulting images. The guide will present the applications and limitations of imaging and image fusion, describe step-by-step procedures and codes to perform them, as well as discuss expected uncertainties and errors associated with the results. To produce this information, imaging and image fusion will be evaluated on laboratory specimens as well as some selected in-service concrete bridge members. A training workshop and educational materials will be developed and made available in an open access format. The workshop will consist of theory and hands-on application in a real-world setting. The plan is to continue to offer the workshop in the following years, which ensures that the research has a lasting impact.

3. (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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4. Decision making lenses

Please complete the following three sections. Your answers to these questions will be applied on a programmatic basis to support agency decisions. Answering yes to the questions below is not required. Resolving a narrowly focused technical research problem may meet agency needs without answering yes

to any of the following questions. The ODOT Research Section will seek a balanced portfolio some projects will answer yes to one of the three categories below (e.g. climate, equity, and/ or safety) and other projects in a different category.

We are looking for an overall program balance and no one project is expected to balance all categories. Generally, a research problem statement is expected to be able to answer yes with clear and verifiable information in only one of the three categories below, some projects may be able to answer yes in two or even three categories. Some projects (i.e. needs focused on specific elements of infrastructure design), may have no yes answers but may still be high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. Every mile driven in Oregon is powered by a clean source of fuel. We seek research that supports construction and maintenance operations are carbon neutral and investments in mobility that support travel by low and no emission modes. While every research project may not result in a reduction in emissions, transportation investments overall support emission reductions to achieve state goals.

Oregon envisions a transportation system that is resilient in the face of seismic and climate events and impacts to the degradation of the natural environment are reduced. Our vision includes a transportation infrastructure is built in a way that avoids impacts on key habitat and results in better environmental conditions for wildlife and native vegetation. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4f. Will addressing the **transportation issue** identified as a need in Question 1 develop, or validate methods for the estimation, measurement, or monitoring of transportation generated greenhouse gasses (GHG)?

☐ Yes ☒ No ☐ Unsure

4g. If climate or GHG is not the focus of this **transportation issue** identified in this problem statement, will the research apply a GHG analysis to transportation infrastructure, planning, operations, maintenance, or materials?

☐ Yes ☒ No ☐ Unsure

4h. Will the addressing the **transportation issue** include development or testing of construction practices, methods, or materials to establish potential reductions in greenhouse gas emissions?

☐ Yes ☒ No ☐ Unsure

4i. Will the solving the **transportation issue** in question 1 study or support the reduction of vehicle miles traveled and single occupancy vehicle travel or support transition to electric vehicles (or other types of zero emission vehicles) or low-carbon alternative fuels?

☐ Yes ☒ No ☐ Unsure

4j. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐ Yes ☒ No ☐ Unsure

4k. Will the solving the **transportation issue** in question 1 lead to work that may result in better environmental conditions for wildlife and native vegetation?

☐Yes ☒No ☐Unsure

4l. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

The underlying objective of the proposed research is to enable refined load ratings for optimal asset management. If bridge service-life can be extended and unnecessary bridge replacements be avoided, GHG emissions can be minimized and avoided, respectively.

Equity

Equity can have many dimensions and impacts relating to communities, and transportation. It is important that problem statement proposals clearly explain in what capacities are equity dimensions or impacts being examined within problem statements. It is a goal of the OTP to "Improve access to safe and affordable transportation for all, recognizing the unmet mobility needs of people who have been systemically excluded and underserved. Create an equitable and transparent engagement and communications decision-making structure that builds public trust". Proposed research may have the intent of studying elements of this goal or apply analysis to specific transportation topics to ensure the resulting research recommendations is consistent with our equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4a Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☒No ☐Unsure

4b If the **transportation issue** is not focused on transportation equity, will the primary topic be assessed for equity benefits or impacts within the research project?

☒Yes ☐No ☐Unsure

4c Is the implementation of potential findings from this research likely to directly involve participation from an identified group that would benefit from an equitable process or outcome?

☐Yes ☒No ☐Unsure

4d Is the intended final product or information expected to support ODOT's equity efforts (Including but not limited to supporting one of the equity related objectives of the ODOT's Strategic Action Plan or Oregon Transportation Plan) ?

☐Yes ☒No ☐Unsure

4e If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

A posted bridge can render a route non-functional more quickly than, for example, poor pavement condition. In cases where an emergency vehicle (EV) or a special hauling vehicle (SHV) is denied rapid access to a community because of a posting, dramatic consequences may result. Moreover, bridges with poor documentation are more likely located in rural communities with limited alternate routes, which means the consequences of load posted bridges may be more severe compared to urban communities where there are more options. By avoiding unnecessary postings, this research will thus also directly support economic equity and community vitality while maintaining public safety.

Safety

Research outcomes may include interventions and countermeasures to prevent or reduce the frequency of crashes or other causes of transportation-related injury or death; or may include measures to reduce severity of injury (including prevention of death) after a crash or other injurious event. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan, Oregon Transportation Safety Action Plan and Oregon Transportation Plan.

4m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐Yes ☒No ☐Unsure

4n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☒No ☐Unsure

4o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐Yes ☒No ☐Unsure

4p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐Yes ☒No ☐Unsure

4q. Will the solving the **transportation issue** support improving safety through **investing strategically**?

☐Yes ☒No ☐Unsure

4r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

None.

5. Other comments:

Other State DOTs as well as local agencies such as the Portland Bureau of Transportation and Multnomah County Bridge Section might also be interested in and benefit from the final product.

6. Corresponding Submitter's Contact Information:

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