

# Research Stage 1 Problem Statement

**PROPOSED TITLE:** *Impact of Updating Operational Level Bridge Seismic Design Criteria*

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

The 2025 ODOT Bridge Design Manual (BDM) requires that bridges designated as recovery or critical be designed to remain operational during a full-rupture Cascadia Subduction Zone Earthquake (CSZE) (Section 1.17.2.3). These include highway bridges on the State Seismic Lifeline Routes. US Geological Survey (USGS) provided the methodology for determining CSZE design spectra, but these would result in the need for complex individual scenario calculation for each bridge design. To promote consistency and efficiency in design, an online tool was developed in 2016 by Portland State University (PSU) to generate the CSZE design spectra for any Oregon location, simply based on latitude, longitude, and site classification. Due to its simplicity, this tool has been widely used in both ODOT and non-ODOT projects throughout Oregon, resulting in significant time and projects' design cost savings. Several major developments in CSZE methodology calculation by USGS and the Pacific Earthquake Engineering Research Institute (PEER) over the past decade have rendered this tool outdated. The USGS seismic source models have been updated twice (2018 and 2023) and now include new rupture models for the CSZ slab based on the latest science and added basin effects for the Portland and Tualatin basins. In addition, and perhaps the most consequential update since the development of the original CSZE tool, is the introduction of new Ground Motion Prediction Equations (GMPEs) developed specifically for the Cascadia region as part of PEER's New Generation Attenuation-Subduction (NSG-Sub) project in 2021.

The current CSZE tool is outdated, but the most effective way to update it and ensure it meets the requirements outlined in the BDM while still retaining its utility is less clear. Two possible solutions have been discussed with ODOT and USGS, including probabilistic and deterministic approaches. The probabilistic approach would involve changing the current BDM requirement from a deterministic full-rupture CSZE to a probabilistic uniform hazard spectrum corresponding to a selected return period that is approximately comparable to the deterministic CSZE. This would represent a major shift from the current approach but offers potential benefits in implementation and long-term maintenance, as the required data may potentially be easier to obtain and update from existing USGS tools that USGS is expected to revise with future science developments (approximately every 4 to 6 years). The second solution is to maintain the current deterministic approach in the BDM and update the rupture model for the CSZ slab, incorporate basin effects for the Portland and Tualatin basins, and replace the outdated GMPEs in the existing tool with the NGA-Sub ground motion prediction models.

There is a critical need to research the impact of each potential solution on ODOT's design practice. The research objective is to evaluate the impact on design that these different methodology approaches would have on the resulting ground motions across various locations in the state and provide recommendations for the most logical approach in characterizing ground motions for the Operational Level seismic performance criteria. The implementation plan would then include the development of a design tool in order to realize the statewide consistency and the design cost savings as the existing tool had delivered.

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

The final product will be a quantitative based comparison of the different methodologies for ODOT's Operational Level seismic performance design criteria. Once a decision is made by ODOT on the most appropriate approach, a new CSZE tool will be developed that incorporates the latest advancements in seismic hazard analysis for the Cascadia region. This tool will aim to incorporate flexibility in maintenance, given the frequent updates to the National Seismic Hazard Model by USGS (with major updates occurring every 4 to 6 years). The new tool will be developed on a platform preferred by ODOT based on input from ODOT's IT team.

The experience gained in developing the original CSZE tool by PSU in 2016 will help ensure that the new tool builds on the successful features of the original version that contributed to its widespread use, while fully incorporating the significant advancements made over the past decade.

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## 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.

Name	Title	Email	Phone
Albert Nako	Seismic Standards Engineer	Albert.NAKO@odot.oregon.gov	971-283-5558
Peter Dusicka	Professor, PSU	dusicka@pdx.edu>	503-725-4280
Andrew Makdisi	Research Civil Engineer, USGS	amakdisi@usgs.gov	303-273-8670

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## 4. Other comments:

## 5. State of Oregon Decision Making Lenses

State decision making lenses are a part of the state of Oregon's policy structure. State policy and federal policy are not always aligned. The state will prioritize research according to state policy, however ODOT may be required to skip prioritized proposals based on constraints placed on the use of federal funds. If state funds are available ODOT will attempt to fund prioritized research that is deemed ineligible for federal funding.

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 a high value research need.

## Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. To that end, we seek research that reduces carbon emissions from construction activities and materials, and from maintenance equipment and operations. Oregon envisions a transportation system that is resilient, this means a system that is durable in the face of seismic events and extreme weather to avoid negative impacts, withstand them or bounce back quickly to resume system function. We seek research that improves the ability of the transportation system to adapt or cope with more frequent and extreme weather events. This may include innovations in data and data sharing, construction materials and project design, communication, emergency planning and response, and more. Similarly, we seek research that avoids negative impacts on key habitats and ecosystems that can buffer or reduce damage to infrastructure and improve 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](#).

5a. 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 gases (GHG)?

☐ Yes

☒ No

☐ Unsure

5b. 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

5c. Will 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

5d. Will 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

5e. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, or monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☒ Yes

☐ No

☐ Unsure

5f. Will 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

5g. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

The proposed tools will enhance efficiency and consistency in the seismic design of new bridges classified as recovery and critical. Consequently, this effort will directly contribute to improving the seismic resilience of Oregon's transportation network following a major earthquake.

### Equity

Equity can have many dimensions and impacts relating to communities and transportation. It is important that problem statement proposals clearly explain the equity dimensions or impacts being examined. Oregon commits to social equity in the OTP, specifically 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.* We seek research that studies elements of this goal or applies analysis to specific transportation topics to ensure the resulting research recommendation is consistent with agency equity goals. For definitions and details please review the equity vision, goals, and objectives of the [ODOT Strategic Action Plan](#) and [Oregon Transportation Plan](#).

5h. Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐ Yes

☒ No

☐ Unsure

5i. 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

5j. 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

5k. 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

5l. If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

## 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](#).

5m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐ Yes

☒ No

☐ Unsure

5n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐ Yes

☒ No

☐ Unsure

5o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐ Yes

☒ No

☐ Unsure

5p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐ Yes

☒ No

☐ Unsure

5q. Will solving the **transportation issue** support improving safety through **investing strategically**? 5r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

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## 6. Corresponding Submitter's Contact Information:

Name:	Arash Khosravifar	
Title:	Associate Professor	
Affiliation:	Portland State University	
Telephone:	503-725-4280	
Email:	karash@pdx.edu	

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## 7. ODOT Sponsor Contact Information (Required if Submitter is not an ODOT employee)

Name:	Albert Nako	
Title:	Seismic Standards Engineer	
Crew Number:		
Telephone:	971-283-5558	

Email:	Albert.NAKO@odot.oregon.gov	
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This form is not a grant application or contract document. Please do not include proprietary information on this form. Once this form is received ODOT may revise and publish the problem statement. If selected, ODOT will assign investigator(s) of the department's choosing to conduct research.