

# Research Stage 1 Problem Statement

**PROPOSED TITLE:** Evaluation of Ultra-High Performance Concretes for Longevity and Climate

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

Ultra-high performance concretes (UHPC) have advanced considerably, and ODOT has already invested in developing a low-carbon, nonproprietary UHPC mix through SPR865 that is nearly ready for deployment in new transportation infrastructure. UHPCs offers high compressive and tensile strength, exceptional toughness, the ability to use smaller and lighter sections, and reportedly improved chloride resistance and durability. These durability benefits are especially important because UHPCs are expected to provide service lives exceeding 75 years. Its high strength and toughness may also enhance performance during extreme events such as earthquakes or overloads.

To ensure that ODOT's investment in UHPC produces long-term durability, safe performance, reduced maintenance costs, and lower lifecycle environmental impacts, further research is needed. This research will determine whether UHPC used in Oregon can endure millions of load cycles from truck traffic over nearly a century, while simultaneously experiencing chloride exposure from winter deicing and coastal environments, and still retain the strength, ductility, and toughness required to perform during the Cascadia earthquake or other failure event. The work will evaluate UHPC materials in bridge system applications to confirm that they can deliver the intended long service life under Oregon's unique climate, service demands, and hazard conditions.

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

The research will produce Oregon-specific UHPC material and performance measures needed to support safe and dependable deployment in ODOT transportation projects, including:

- Standardized testing and evaluation methods that reliably predict long-term durability and end-of-service performance of current and emerging UHPC formulations under repeated traffic loading, environmental exposures, and overload/seismic events.
- Design specifications, standardized details, and design examples for UHPC use in bridge systems, including updates to the ODOT Bridge Design Manual. These should ensure that UHPC components can meet required seismic/overload performance even after decades of service and environmental degradation.
- Training and outreach materials to support implementation by ODOT engineers and consultants, including guidance on the new standards, specifications, and design practices.
- Demonstration applications on pilot projects to validate design procedures, construction practices, QA/QC processes, and long-term performance measurement metrics for Oregon conditions.

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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.**

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**4. Other comments:**

This research is necessary for ODOT to confidently advance UHPC from promising laboratory results to safe, cost-effective, and enduring deployments in Oregon transportation projects. Without Oregon-specific testing, design guidance, and demonstrations, ODOT cannot be confident in the long-term durability, seismic performance, or lifecycle benefits of UHPC in real-world conditions. The proposed research fills these gaps and provides the technical foundation needed to justify investments in UHPC for transportation projects.

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**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:

- While climate is not the focus of this research, the research outcomes have direct impacts on climate. Concrete materials contribute significantly to GHG. Present materials have shorter design lives and thus will require more frequent replacements and maintenance than those purportedly available with UHPCs. The impacts on GHG emissions can be comparatively assessed for different UHCP and conventional materials, operational lives, and hazard resilience

(5g and 5h). This study seeks to assess whether the expected benefits and long life can be achieved in Oregon considering our environmental exposure conditions and seismic hazards (5j).

### 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**?

☒ Yes

☐ No

☐ Unsure

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

- The proposed research is essentially evaluating the safety of transportation structures constructed with UHPC. That safety includes that of the motoring public who make use of it daily, and the security of all Oregonians who will necessarily rely on transportation systems, of which bridges serve as critical links, to perform as intended during the most critical of moments, such as during and after an earthquake (5n). Choosing to bring to service the best available material technology, UHPC, if it can achieve longer life that is to be evaluated by this work, with reduced maintenance needs, will reduce ODOT crew's exposure to dangers working on open roadways and reduce motorist exposure to construction zones (5o). Selecting one material over another at design is making a strategic investment with the expectation that it will safely serve as intended (5q).

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## 6. Corresponding Submitter's Contact Information:

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

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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.