

SPR RESEARCH PROGRAM

SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

26-57 Evaluate Safety Outcomes Considering Performance-Based Design Approaches

PROBLEM SUMMARY

As Oregon undertakes a major update to its Strategic Highway Safety Plan (SHSP) or TSAP, it is anticipated that the update will incorporate principles of the Safe System Approach (SSA), which emphasizes safe roadways as a key element. Oregon relies on a comprehensive Highway Design Manual to guide project development. Recent efforts, such as NCHRP 830: A Performance-Based Highway Geometric Design Process (Neuman et al., 2016), have proposed a shift from fixed tabular standards to a performance-based design approach that evaluates how design choices influence measurable outcomes. However, these efforts remain largely conceptual, lacking a specific, actionable performance template. They also address a broad range of considerations, including context, cost, schedule, operations, and safety.

ODOT OBJECTIVES

This study will examine safety outcome opportunities that could be achieved through considering performance-based design approaches, including:

- review existing research on driver performance regarding design consistency, limit states, and outcomes;
- directly address horizontal curve design and superelevation rates, corridor pedestrian and bicycle safety risk and safety investments, and intersection safety through designs seeking to reduce entry speeds and collision angles;
- evaluate outcomes of performance-based design for the top three safety focus areas related to highway design (roadway departures crashes, intersection crashes, and those involving pedestrians and bicycles);
- describe how to implement performance-based design on 1R and 3R investment programs as those are sizeable program areas, in addition to the Highway Design Manual; and
- develop a guidance document that outlines a phased approach to implementing performance-based design.

BENEFITS

This study may benefit travelers in Oregon through decreased risk of injury or death. Implementing performance-based design may provide designers greater flexibility to define approaches more likely to reduce crashes.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 18 months.

Estimated Project Budget: \$150,000

ODOT Support:

- Heidi Shoblom, State Roadway Engineer, Heidi.E.SHOBLOM@odot.oregon.gov

FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:

<https://www.oregon.gov/odot/Programs/ResearchDocuments/26-57>

SPR RESEARCH PROGRAM

SECOND-STAGE PROBLEM STATEMENT

FY 2025

PROBLEM NUMBER AND TITLE

26-57 Evaluate Safety Outcomes Considering Performance-Based Design Approaches

RESEARCH PROBLEM STATEMENT

Both nationwide and in Oregon, fatal and serious crashes have increased markedly. As Oregon undertakes a major update to its Strategic Highway Safety Plan (SHSP) or TSAP, it is anticipated that the update will incorporate principles of the Safe System Approach (SSA), which emphasizes safe roadways as a key element. Oregon relies on a comprehensive Highway Design Manual to guide project development. Recent efforts, such as NCHRP 830: A Performance-Based Highway Geometric Design Process (Neuman et al., 2016), have proposed a shift from fixed tabular standards to a performance-based design approach that evaluates how design choices influence measurable outcomes. However, these efforts remain largely conceptual, lacking a specific, actionable performance template. They also address a broad range of considerations, including context, cost, schedule, operations, and safety. The effort is, as should be expected, also focused on the full complement of design – including context, cost, schedule, operations, and safety.

RESEARCH OBJECTIVES

The aim of this research is to examine safety outcome opportunities that could be achieved through considering performance-based design approaches. Establishing a research-informed design process specifically aimed at safety and integrated with Safe Systems approaches and aligned with the upcoming Strategic Highway Safety Plan update, the yearly update of the Oregon Highway Design Manual, and consistent with the Transportation Safety Action Plan, offer a timely opportunity to affect process and procedures to improve safety outcomes in Oregon.

Objectives of this study to meet this aim include:

- review existing research on driver performance regarding design consistency, limit states, and outcomes;
- directly address horizontal curve design and superelevation rates, corridor pedestrian and bicycle safety risk and safety investments, and intersection safety through designs seeking to reduce entry speeds and collision angles;
- evaluate outcomes of performance-based design for the top three safety focus areas related to highway design (roadway departures crashes, intersection crashes, and those involving pedestrians and bicycles);
- describe how to implement performance-based design on 1R and 3R investment programs as those are sizeable program areas, in addition to the Highway Design Manual; and
- develop a guidance document that outlines a phased approach to implementing performance-based design.

This research will provide a framework for integrating research findings and performance results into Oregon's highway design standards incrementally, ensuring continuous improvement and alignment with safety priorities. It will also detail specific steps and timelines for incorporating these findings into Oregon's highway design practices, ensuring alignment with safety and investment priorities. By targeting these areas, this research will establish a solid foundation for performance-based design that enhances safety and

supports broader transportation goals.

WORK TASKS, COST ESTIMATE AND DURATION

Task 1: TAC Meeting #1 will bring the TAC and research team together to review the project needs and schedule, covering ODOT's current practices regarding tabular and performance-based design standards.

Task 2: Draft Literature Review will address existing research on driver performance with different design contexts, curve and superelevation design, pedestrian and bicycle safety, and intersection design related to tabular and performance-based approaches.

Task 3: Draft Research Methodology will specify a rigorous approach with performance metrics to evaluate implications of performance-based design through studying (a) before-and-after case study outcomes of previous performance-based design in contexts applicable to Oregon, (b) pilot test performance-based design techniques with design staff through focus groups or similar methods, and (c) propose and evaluate potential changes to the Highway Design Manual.

Task 4: TAC Meeting #2 is intended to set the course for the completion of the project by reviewing the draft research methodology, and informing the research team of necessary changes.

Task 5: Data Collection includes the time and resources necessary to collect quantitative and qualitative performance metrics on proposed performance-based design approaches, using input from the TAC in Task 4.

Task 6: Data Analysis follows the Research Methodology to provide a qualitative analysis of outcomes based on testing of performance-based design in practice.

Task 7: Draft Final Report will summarize all project tasks in a publication-ready Draft Final Report in the prescribed ODOT report format that emphasizes practice-ready findings from the study to support implementation, and also sufficiently describes the research process and analysis to support replication of the study.

Task 8: TAC Meeting #3 will include a review of the Draft Final Report, and Draft Research Note prior to the TAC meeting.

Task 9: Final Report involves editing the Draft Final Report to incorporate edits identified by the ODOT research coordinator following TAC Meeting #3.

Key Deliverables: *Final report that includes a guidance document that outlines a phased approach to implementing performance-based design.*

Estimated Project Length: 18 months.

Estimated Project Budget: \$150,000

IMPLEMENTATION

The project TAC will be instrumental in guiding the project towards implementation across affected ODOT units, both through directing the research team's work during the study, and as key staff to integrate the findings in statewide guidance such as the Highway Design Manual, and into individual projects. Participating designers in pilot tests may also be valuable to communicate how to address challenges in taking a new approach to performance-based design.

POTENTIAL BENEFITS

This study may benefit travelers in Oregon through decreased risk of injury or death. Implementing performance-based design may provide designers greater flexibility to define approaches more likely to reduce crashes.

PEOPLE

ODOT champion(s):

- Heidi Shoblom, State Roadway Engineer, Heidi.E.SHOBLOM@odot.oregon.gov

Additional key staff include:

- Will Woods, Senior Standards Engineer, William.L.WOODS@odot.oregon.gov
- Christopher Henson, Senior Roadside Design Engineer, Christopher.S.HENSON@odot.oregon.gov
- Jiguang Zhao, Traffic Safety Engineer, Jiguang.ZHAO@ODOT.Oregon.gov

Problem Statement Contributors:

Nick Fortey, FHWA Safety and Operations Engineer, Nick.fortey@dot.gov

Greg Griffin, Principal Research Analyst, greg.GRIFFIN@odot.oregon.gov

REFERENCES

Neuman, T. R., Coakley, R. C., Panguluri, S., & Harwood, D. W. (with National Cooperative Highway Research

Program, Transportation Research Board, & National Academies of Sciences, Engineering, and

Medicine). (2016). *A Performance-Based Highway Geometric Design Process*. Transportation

Research Board. <https://doi.org/10.17226/24626>

Srinivasan, R. (2021). *Enhancement of Roadside Design Safety Prediction Models for the Highway Safety*

Manual. <https://rip.trb.org/View/1854201>

STAFF REVIEW PAGE

LITERATURE CHECK

TRID&RIP

☒ A review of TRID & RIP databases found no existing research that answers the research question

“Enhancement of Roadside Design Safety Prediction Models for the Highway Safety Manual” compliments this research problem, as it will coordinate several research products with other performance-based design manuals, including the Green Book and Roadside Design Guide (Srinivasan, 2021).

ODOT DECISION LENSES

Climate: This research is not focused on climate and will not include analysis of climate.

Equity: This research is not focused on equity and will not include analysis of equity.

Safety: Performance-based design can support safety outcomes, such as reducing fatalities and serious injuries for vulnerable road users. Such efforts should also create designed systems that encourage more walking and biking as the focus here is explicitly on system design.

TECHNOLOGY & DATA ASSESSMENT

☒ No Identified T&D output

☐ At the end of this project, the implementing unit(s) within ODOT will need to coordinate the adoption of new technology or data in order to realize the full potential of this research.

CROSS-AGENCY IMPACTS

- List ODOT partners or impacted units.
 - ODOT Engineering & Technical Services Branch
 - ODOT Roadway Engineering Unit
- Identify any issues of concern raised by an ODOT partners. Note expected mitigation that addresses these concerns.
 - The ODOT Traffic Safety and Human Factors Expert Task Group identified that the success of this study is dependent on available data. Therefore, early engagement of the research team with the TAC and others should help review the accuracy and timeliness of data to evaluate performance-based design.