SPR RESEARCH PROGRAM
SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

27-27: Developing Testing and Acceptance Criteria for Binder Source Changes under Oregon's BMD Framework

PROBLEM SUMMARY

Oregon is implementing a performance-based Balanced Mix Design (BMD) process based on SPR852. Initial pilot sections have performed well, and BMD is expected to improve long-term pavement performance, reduce maintenance, and lower greenhouse gas (GHG) emissions. However, as ODOT transitions to performance-based specifications, existing concerns related to asphalt binder source variability have become more evident.

Field and laboratory observations show that asphalt mixtures produced with identical PG binders can exhibit significantly different rutting and cracking resistance. These differences become critical when suppliers change or when crude oil sources or refinery processes are modified during construction. Because current ODOT specifications only require compliance with PG grade and do not address binder chemistry or source disclosure, mixtures with the same PG grade may perform very differently. This inconsistency in binder properties and its impact on long-term performance expose ODOT and contractors to high levels of risk during construction and throughout the pavement service life.

ODOT OBJECTIVES

- Quantify how binder source variation affects rutting, cracking, stiffness, fatigue, and aging performance of Oregon asphalt mixtures within the BMD framework.
- Develop and validate a practical 1-2 day screening and BMD revision protocol that can be applied when a binder source change occurs during construction.
- Establish clear trigger criteria, testing thresholds, and specification language to manage binder source variability without unnecessary testing costs and burden.

BENEFITS

This study supports Oregon Transportation Plan goals for asset preservation, reliability, and sustainability, and aligns with RAC 2023 priorities for climate action and cost-effective management.

The research will reduce the risk of premature pavement failures caused by binder source variability and allow ODOT to proactively manage supplier or refinery changes. A rapid construction-period screening and BMD revision protocol will protect performance without repeating the full BMD process.

Overall, this work will strengthen ODOT's transition to performance based BMD specifications by improving consistency in acceptance decisions, reducing construction delays and disputes, and protecting ODOT's long-term investment in durable and sustainable pavement infrastructure.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 36 months.
Estimated Project Budget: $378,000
ODOT Support:
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Jeff Shambaugh, State Pavement Engineer, Jeff.Shambaugh@odot.oregon.gov (971) 301 0903

FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:
https://www.oregon.gov/odot/Programs/ResearchDocuments/27-27.pdf

SPR RESEARCH PROGRAM
SECOND-STAGE PROBLEM STATEMENT
FY 2027

PROBLEM NUMBER AND TITLE

27-27 Developing Testing and Acceptance Criteria for Binder Source Changes under Oregon's BMD Framework

RESEARCH PROBLEM STATEMENT

A comprehensive Balanced Mix Design (BMD) process is currently being implemented in Oregon based on the findings from SPR852. Several pilot sections were constructed in 2023, and all sections have been performing well without any premature failures or unexpected performance issues related to BMD. BMD is expected to optimize the asphalt mix design process, resulting in significant long-term cost savings, reduced maintenance, and reduced greenhouse gas (GHG) emissions for ODOT. However, ODOT's transition towards performance-based BMD specifications started to reflect issues related to the variability of asphalt binder sources.

Asphalt binder suppliers must conduct a series of experiments, following AASHTO M320/M332, to determine the performance grade (PG) of the binder. Recent field and laboratory observations have shown that asphalt mixtures produced with asphalt binders of identical performance grades may exhibit significantly different rutting and cracking resistance. This issue is more critical and challenging when the contractor changes their binder suppliers or the suppliers alter crude oil sources or refinery processes in the middle of the construction season or during a major construction project due to cost and availability reasons. These changes were observed to result in significant differences in asphalt mixture stiffness, cracking resistance, and aging behavior, potentially leading to premature failures, construction issues, and highly variable BMD performance test results.

The current ODOT processes and specifications do not require the disclosure of the binder's crude source or chemical composition, assuming that the binders with the same PG grades reflect uniform performance, and also to avoid any practical issues during the material production process. The only current requirement at the binder level is the expectation to meet the binder PG grade specified by ODOT for different climate regions and traffic levels in Oregon. However, since the PG grades of the binders are specified in 6 °C intervals and the current AASHTO M320/M332 does not have any components to address the difference in the chemistry of the binder, asphalt binders with identical PG grades can perform significantly differently in the field and laboratory. This inconsistency in binder properties and the resulting impact on the long-term performance of the asphalt mixtures **expose ODOT and contractors to high levels of risk** during the construction process due to the possibility of having an asphalt mix that performs significantly worse than it was designed for in the volumetric and BMD processes.

RESEARCH OBJECTIVES

The primary objective of this research study is to quantify how asphalt binder source variation (supplier change, crude source change, or refinery process change) affects the rutting resistance, cracking resistance, stiffness, fatigue life, and aging behavior of Oregon asphalt mixtures within the performance-based BMD system. This objective will be addressed using local aggregates and RAP sources and by testing binders with identical PG grades but from different sources .

A second objective is to develop and validate a simple and practical *"binder source change response protocol"* that can be applied during construction when the binder source (or other mix constituents)

changes after the initial BMD is completed. This protocol will focus on identifying the minimum set of quick binder-level and mixture-level screening tests (e.g., MSCR, ΔTc or equivalent low-temperature indicators, and a rapid mixture rutting/cracking screening test such as Ideal RT or another practical alternative) that can be completed within 1-2 days to determine whether the existing BMD remains valid or whether a revised mix design is required.

The third objective is to develop clear criteria, decision thresholds, and implementation guidance that will allow ODOT to integrate this protocol into BMD acceptance. This effort will include recommendations on testing frequency, trigger points for additional testing, and revisions to specification/contract language to reduce risk while avoiding unnecessary testing burden.

WORK TASKS, COST ESTIMATE AND DURATION

This research study will include the following major tasks:

1) Literature Review: A focused literature review will be conducted to document prior research on binder source variability, PG grading limitations, binder chemistry effects, and rapid screening tools.

2) Laboratory Mix Design and Performance Testing: Binders from multiple sources with identical PG grades will be characterized using standard PG testing and selected performance-related parameters (e.g., MSCR, ΔTc, Glover-Rowe). Mixtures using local materials will be designed through the current BMD process and tested to quantify the effect of binder source changes on rutting and cracking performance.

3) Field Binder Source Change Simulations: A controlled source change simulation will be conducted by completing an initial BMD using Binder Source A and then switching to Binder Source B with the same PG grade. A reduced set of rapid screening tests will be applied to determine whether the original BMD remains valid.

4) Practicality, Cost, Time, and Effectiveness Assessment: The simplified construction period protocol will be evaluated for turnaround time, cost, equipment needs, and reliability.

5) Development of Guidelines and Specifications: Draft specification language and Quality Assurance (QA) procedures will be developed to address binder source disclosure, verification requirements, screening test triggers, and testing frequency.

6) Final Report and Technology Transfer: A final report will document all findings, protocols, and recommendations. Practical guidance documents and training materials will be developed, and workshops will be conducted to support statewide implementation.

Key Deliverables:

1. **Binder Source Change Management Framework:** Clear definition, disclosure requirements, and trigger criteria for binder source changes.
2. **Rapid 1-2 Day Screening and BMD Revision Protocol:** Practical testing procedure to verify or adjust mix design during construction.
3. **Decision Flowchart and Acceptance Criteria:** Step-by-step process for determining when the original BMD remains valid.
4. **Specification and QA Update Package:** Draft contractual language and testing frequency recommendations for statewide implementation.
5. **Implementation and Training Guide:** Practical guidance documents and tools for stakeholders.
6. **Final Research Report:** Complete documentation of findings, validation results, and implementation roadmap.

Estimated Project Length: **36** months.
Estimated Project Budget: $378,000

EXPECTED ODOT IMPLEMENTATION ACTIONS

Based on the findings of this research study, ODOT is expected to implement a structured binder source change management process within the current performance based BMD framework. This process would clearly define what constitutes a binder source change (e.g., supplier change, crude source change, refinery or process modification), establish disclosure and verification requirements, and integrate a practical rapid screening protocol that can be applied when a source change occurs during production.

ODOT may revise specifications and QA procedures to incorporate binder level screening and simplified mixture performance checks that can be completed within 1-2 days. Clear decision criteria will be established to determine whether the original BMD remains valid or requires a rapid revision. Finally, ODOT may develop implementation guidance documents, specification language updates, and training materials (technical guides, checklists, and short instructional videos) to support consistent statewide application. These materials will help ODOT staff and industry partners apply the new binder source evaluation procedures and rapid BMD revision process effectively and confidently during active construction projects.

POTENTIAL BENEFITS

This study supports Oregon Transportation Plan goals related to asset preservation, system reliability, and sustainability, and aligns with RAC 2023 priorities for climate action, process improvements, and cost-effective infrastructure management. This research study will reduce the risk of premature failures and inconsistent mixture performance that may occur when binders with identical PG grades behave differently due to source and chemistry variation. By clearly linking binder level properties to mixture level BMD test results, ODOT will gain a better understanding of the performance risks associated with midseason supplier changes and refinery or crude source shifts. This will allow ODOT to proactively manage binder variability rather than react to unexpected field performance problems.

A major benefit of this study will be the development of a simple and practical 1-2 day screening and BMD revision protocol that can be implemented during construction. This approach will allow contractors and ODOT to quickly verify whether the original BMD remains valid after a binder source change or whether limited adjustments are required without repeating the full BMD testing program developed under SPR852 (which can take weeks). This will protect pavement performance while minimizing construction delays, reducing unnecessary testing burden, and improving consistency and transparency in acceptance decisions.

Overall, the proposed work will strengthen ODOT's transition to performance based BMD specifications by introducing a realistic construction-period QA and decision making framework. It will improve asphalt pavement reliability, reduce disputes and rework associated with binder variability, and protect ODOT's long-term investment in durable, cost-effective pavement infrastructure.

PEOPLE

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STAFF REVIEW PAGE

LITERATURE CHECK

TRID&RIP

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

ODOT DECISION LENSES

Climate: Avoiding premature failures due to rutting and cracking is crucial to better manage ODOT's resources. For this reason, early failures caused by binder source changes or related variability must be prevented through a practical and reliable experimental procedure. Failure to identify and address binder-related issues during construction will reduce the service life of the pavement structure and require early maintenance or rehabilitation. More frequent maintenance will significantly increase GHG emissions from material production and construction activities, while the associated traffic congestion during work zones will further increase emissions.

High roadway roughness levels on roads managed by ODOT will also negatively impact the environment through increased fuel consumption and tire wear. According to a recently completed ODOT/FHWA research study (Coleri et al., 2025), reducing current pavement roughness levels by 20% could save approximately $73 million per year in fuel and tire wear costs for road users. The associated annual emissions reduction was estimated at approximately 193,000 metric tons of CO_2 per year, while ODOT's total annual emissions from all operations were calculated to be 182,592 metric tons of CO_2 (Proudfoot and Toneys, 2022). These findings indicate that strategies to enhance the long-term performance of asphalt pavements are essential to maintain low roadway roughness and rolling resistance, thereby reducing both GHG emissions and user costs.

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

Safety: Although this research is primarily focused on pavement performance and material variability, there are indirect safety benefits associated with improved long-term pavement durability. Premature rutting, binder bleeding (significantly reduces skid resistance), and cracking can negatively affect surface smoothness, skid resistance, and water drainage, potentially increasing hydroplaning risk and reducing vehicle control under wet conditions. In addition, minimizing early rehabilitation and maintenance activities will also reduce the frequency of work zones, which are associated with increased crash risks and worker exposure. Therefore, by improving consistency in asphalt mixture performance and avoiding premature failures related to binder source changes, this research may indirectly contribute to improved roadway safety and reduced exposure to transportation related injuries.

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 Project Delivery
    - ODOT Pavement Services Unit

- Identify any issues of concern raised by an ODOT partners. Note expected mitigation that addresses these concerns.
    - None