SPR RESEARCH PROGRAM
SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

27-54 Implementation-Ready Design and Construction Practices for Pile Clamps in Bridge Maintenance Shoring

PROBLEM SUMMARY

ODOT Bridge Maintenance crews use pile clamps (friction collars) to temporarily support bridge loads during timber substructure repairs. Although this practice has been used successfully for decades, it lacks standardized design guidance, defined safety margins, and formal installation criteria. Consequently, consulting engineers and local agencies are often hesitant to specify pile clamps in engineered shoring designs, leading to more intrusive, costly, or less efficient temporary support methods. This research will develop practical, implementation-ready design, construction, and inspection guidance tailored to short-duration shoring operations, enabling confident and consistent use of pile clamps in engineered applications across Oregon. This further reduces ODOT's risk in deployment of these systems.

ODOT OBJECTIVES

The objective of this research is to develop clear, practical, and adoptable guidance for the safe use of pile clamps in temporary bridge shoring. The research will deliver validated design methods, defined safety margins aligned with temporary maintenance conditions, and standardized construction and inspection practices suitable for incorporation into ODOT manuals and consultant and local agency acceptance.

BENEFITS

There are over 300 bridges with timber pile caps, and over 1000 individual pile caps, in Oregon that are impacted by the proposed research. By defining appropriate safety margins, and developing design, installation, and inspection standards for this specific application, the research will reduce ODOT's risks while enhancing worker safety and protecting the travelling public. Wider acceptance will further reduce construction times, minimize environmental impacts by reducing in-water and terrestrial foundation work, and overall cut project costs, while improving maintenance efficiency across Oregon's aging bridge inventory.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 24 months.
Estimated Project Budget: $400,000.
ODOT Support: Clayton Davey; Senior Structural Design Engineer, clayton.j.davey@odot.oregon.gov
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FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:
https://www.oregon.gov/odot/Programs/ResearchDocuments/27-54.pdf

SPR RESEARCH PROGRAM
SECOND-STAGE PROBLEM STATEMENT
FY 2027

PROBLEM NUMBER AND TITLE

Implementation-Ready Design and Construction Practices for Pile Clamps in Bridge Maintenance Shoring

RESEARCH PROBLEM STATEMENT

ODOT Bridge Maintenance forces routinely use pile clamps (also referred to in the industry as friction collars) to temporarily support bridge superstructure loads during substructure repairs, most commonly for timber pile cap replacement. These devices allow crews to transfer load directly to timber piles when space on the cap is limited or when conventional shoring would require work in waterways. In practice, pile clamps improve efficiency, reduce environmental disturbance, and minimize worker and public exposure time.

Pile clamps develop resistance through a combination of clamping force (friction) and mechanical resistance provided by transverse bolts or similar connectors. While ODOT maintenance crews have used these systems successfully for decades, broader implementation across Oregon remains limited. Local agencies and consulting engineers are often hesitant to rely on friction-based resistance without standardized design guidance, defined safety margins, and formal construction and installation criteria.

Although pile clamps are used only during short-duration and controlled maintenance operations, engineers currently lack clear design direction to ensure safety of the temporary support. In the absence of standardized guidance, designers either avoid the system entirely or apply overly conservative safety factors. This uncertainty contributes to reluctance among consultants, limits broader use, and increases risks to ODOT.

Without this research, these shoring systems may exceed ODOT's level of risk tolerance for their continued use. ODOT and local agencies would then have to rely on less efficient temporary support methods that increase costs, construction duration, environmental disturbance, and worker exposure.

RESEARCH OBJECTIVES

The objectives of this research are to establish clear, practical design guidelines, construction practices, and inspections tailored specifically to temporary shoring conditions with these systems. These guidelines will recognize that 1) loads are known and controlled during jacking operations, 2) duration of loading is short, 3) installation is performed by trained crews, and 4) systems can be visually inspected during use. By defining appropriate safety margins and installation standards for this specific application, the research will reduce uncertainty while maintaining worker safety and protecting the travelling public. The overall goal of this research is to develop validated, implementation-ready guidance for the safe and reliable use of pile clamps in bridge maintenance shoring applications.

Specific objectives include:

- **Characterize Load Transfer Behavior:** Quantify how load is shared between friction resistance, bolt resistance, bearing, and clamp components.
- **Validate Performance Under Field-Representative Conditions:** Evaluate performance under conditions representative of Oregon bridges, focusing on Douglas Fir timber piles with variable moisture content, surface condition, and fit-up tolerances.

- **Identify Governing Limit States:** Define and document potential failure or service limit conditions including slip, bolt shear, timber crushing, timber splitting, and clamp yielding.
- **Develop Practical Safety Guidelines for Temporary Use:** Establish recommended safety margins and design checks appropriate for short-duration shoring operations including the influence of loads on the superstructure during use. Recommendations will reflect the temporary nature of the work, inspectability during use, and ODOT's risk tolerance for maintenance activities within national design frameworks.
- **Define Installation and Quality Control Procedures:** Develop installation requirements including clamping force procedures, geometric tolerances, inspection criteria, and field documentation practices.
- **Prepare Implementation Materials:** Produce example calculations, standard details, and draft specification language suitable for use by ODOT engineers, consultants, and local agencies.

WORK TASKS, COST ESTIMATE AND DURATION

Task 1 – Literature and Practice Review

Review national temporary works guidance [1], vendor information [2, 3, 4], and DOT practices related to friction collars and similar systems. Identify existing approaches to safety margins and inspection practices.

Task 2 – Analytical Modeling

Develop analytical tools to estimate capacity of components and evaluate sensitivity to variability in clamp force, substructure properties, superstructure loads, and installation conditions.

Task 3 – Experimental Validation

Conduct laboratory tests of representative pile clamp configurations on representative timber piles to evaluate: Load-slip response; Ultimate capacity; Failure modes; Effect of moisture and surface condition; Influence of installation parameters.

Task 4 – Development of Safety Margins and Design Checks

Evaluate variability observed in testing. Calibrate safety margins based on experimental observations and develop simple design checks suitable for consultant use. Ensure alignment with ODOT practices for temporary operations.

Task 5 – Installation and QA/QC Guidelines

Prepare installation procedures, inspection checklists, and acceptance criteria.

Task 6 – Preparation of Implementation Materials and Technology Transfer

Develop draft specification language, design examples, and conduct outreach with ODOT Bridge Maintenance, Bridge Engineering, consultants, and local agencies.

Key Deliverables: The key deliverables from this research are: Validated capacity and behavior characterization; Recommended safety margins for temporary shoring applications with these systems; Design steps; Installation and inspection guidance; Design examples and standard details; Draft specification language for ODOT adoption; and a Final report detailing research methods, findings, and recommendations.

Estimated Project Length: 24 months.
Estimated Project Budget: $400,000. Depending on extent of experimental effort.

EXPECTED ODOT IMPLEMENTATION ACTIONS

Following completion of the research, to implement the outcomes, ODOT would: Incorporate design guidance and details into Bridge Maintenance manuals; Issue a technical guidance memorandum for consultant use; Publish standard details for temporary shoring applications; Provide training to Bridge

Maintenance personnel and local agencies; Integrate recommendations into temporary works or bridge design guidance documents. Implementation will require coordination among Bridge Maintenance, Bridge Engineering, ODOT Research, and local agencies and consultants. Implementation of research products often adds costs to ODOT. By contract, implementation of this project's outcomes will lead to maintenance cost reductions while simultaneously reducing risks to ODOT.

POTENTIAL BENEFITS

This research supports RAC priorities related to **Safety, Process and Equipment Improvements**, and **Cost Reduction in Asset Maintenance**. By establishing appropriate safety margins and standardized design, construction, and inspection practices, the project will enhance worker and public safety while reducing engineering uncertainty. Formalizing this long-standing maintenance practice into implementation-ready guidance will improve consistency, shorten maintenance operations, limit intrusive temporary works, reduce environmental impacts, and lower project costs. The result is a practical, workforce-ready solution that strengthens stewardship of public resources and improves maintenance efficiency across Oregon's aging bridge inventory.

PEOPLE

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REFERENCES

[1] https://www.fdot.gov/docs/default-source/construction/training/selfstudy/structuresparti/2012SITCPart1Chapter5.pdf

[2] https://www.fdot.gov/docs/default-source/structures/edc/files/PBESconcepts.pdf

[3] https://www.formtechinc.com/documents/forming-systems/steel-form-system/Max-A-Form-application-guide.pdf

[4] https://deslinc.com/round-friction-collars

[5] https://constructionenterprisesinc.com/bridge-brackets/round-friction-collars/

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: This research supports climate goals by promoting less invasive temporary shoring practices for bridge maintenance, which reduce the need for in-water work, heavy equipment use, and additional foundation construction. These efficiencies minimize environmental disturbance, lower construction-related emissions, and contribute to more sustainable stewardship of Oregon's bridge inventory.

Equity: This research advances equity by developing practical, cost-effective guidance that enables consistent and efficient bridge maintenance across Oregon, including in rural and underserved regions with many timber substructure bridges. By reducing project costs, timelines, and disruptions, it helps ensure more equitable access to safe transportation infrastructure for all communities.

Safety: This research directly improves safety by providing validated design methods, appropriate safety margins for temporary shoring, standardized installation and inspection practices, and clear failure mode identification for pile clamps. These outcomes reduce risks to maintenance crews and the traveling public during bridge repairs, formalize a long-used but undocumented practice, and align with ODOT's risk tolerance for controlled, short-duration operations. (Safety is a core focus of the research.)

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: Bridge Section
- Identify any issues of concern raised by an ODOT partners. Note expected mitigation that addresses these concerns.