



105 West Capitol Avenue
P.O. Box 270
Jefferson City, Missouri 65102

Missouri Department of Transportation
Patrick K. McKenna, Director

1.888.ASK MODOT (275.6636)

August 4, 2022

Dear Research Partner:

The Missouri Highways and Transportation Commission requests proposals from qualified organizations—namely private consultants, universities, and research organizations—to furnish professional services as described in the following request for proposal to be coordinated by the Research Unit of the Construction and Materials Division.

Please submit a proposal for project **TR202204** entitled, “**Design Coefficients of Friction for MoDOT PTFE Bearings.**” Your submittal must include a work plan, the proposed project team and its background, and any related projects now active or recently completed by your firm. The project team must be led by a licensed professional engineer in the state of Missouri and the final report must be sealed, in accordance with the provisions of Chapter 327 RSMo.

The selection committee will use Qualification Based Selection. A “not to exceed” budget amount is included in the RFP to assist with the required scope, but budgets are not to be included with the proposal submissions, and will not be presented to the selection committee.

Please submit all proposals to MoDOTResearchRFP@modot.mo.gov by **October 5, 2022 10:00 AM (Central)**. More information about project contracting in general can be found at <https://www.modot.org/information-researchers> under RFP documents.

Sincerely,

Jen Harper
Research Director



Our mission is to provide a world-class transportation system that is safe, innovative, reliable and dedicated to a prosperous Missouri.

www.modot.org

Background

PolyTetraFluoroEthylene (PTFE) bearing pads are used in MoDOT designs when elastomeric expansion bearings are not capable of handling the required expansion length. PTFE bearings provide a sliding surface for expansion accommodation and allows for rotation of the beam end. MoDOT specifies either filled or unfilled flat PTFE bridge bearings.

MoDOT bridge designers typically perform multiple force distributions (temperature, wind and braking) based on the level of engagement of the PTFE bearing. One analysis is performed for the pre-slip scenario where the substructure is treated like a fixed bent and the maximum force applied to the bent is based on the design coefficient of friction. A post-slip analysis is then performed where zero force is applied to the bent. If the design coefficient of friction is high enough the post-slip analysis may be disregarded.

MoDOT specifies a coefficient of friction limited to 0.12 for 1st breakaway and no more than 0.06 after 1st breakaway when tested at 800psi. Designers have typically used the 0.06 value in their design computations for force distribution and that value is reflected in a note on the plans. Some manufacturers have expressed concern with being able to meet these requirements. Per AASHTO LRFD BDS the design friction coefficients for unfilled and filled PTFE at 800 psi is 0.074 and 0.198 respectively at 68 deg. F. Values increase to 0.188 and 0.368 at -13 deg. F. If designers follow the MoDOT specifications then the filled PTFE and/or cold values may be conservatively used, but this leads to friction forces that are sizable. The dynamic friction force can be larger than the forces that would be applied to a fixed bent that is just allowed to deflect. This nullifies the benefits of using the sliding expansion bearing. Using unfilled PTFE values can result in similar design issues. Dimpled lubricated PTFE can provide coefficients of 0.034 (68 deg. F) and 0.051 (-13 deg. F), but we have not typically used them since the belief is that the dimples capture dirt and tear up the bearing. The dimpled design also requires a mechanism for confinement of the PTFE to prevent flattening of the dimples which leads to a larger footprint for the bearing. MoDOT Design Guidelines for bridge bearings can be found in [EPG article 751.11](#). MoDOT Design Guidelines for force distribution can be found in [EPG article 751.2.4](#). PTFE specifications can be found in section 1038.4. MoDOT Standards and Specifications can be found [here](#).

Objectives

The main objectives of this research study are:

1. Determine what design coefficients of friction MoDOT designers should use for our standard Type N PTFE bearings when distributing forces for substructure design. Is there a methodology for force distribution with PTFE bearings that better reflects the benefit of using PTFE bearings than is outlined in 751.2.4 and above.

2. Are dimpled lubricated bearing pads an effective alternate and what should be added to the specifications to address the concerns MoDOT has with contamination? MoDOT specifications can be found [here](#). PTFE specifications can be found in section 1038.4. Standard drawings for Type N PTFE bearings can be found here: TYPE N PTFE Bearings for [Prestressed Girders](#) for [Steel Girders](#).

Project Requirements

Task 1: Project Management

The Contractor will facilitate a kickoff meeting with MoDOT to review the work plan, scope, and schedule; and establish a protocol for regular ongoing communication and coordination with the team. This proposal will serve as the Draft Work Plan, to be discussed in the kickoff meeting. Upon comments received during the meeting and/or in writing, the Contractor will incorporate those comments into a Final Work Plan.

The Contractor will schedule and conduct a quarterly status meeting to review progress for the previous period and anticipated work for the next period. The Contractor will also develop minutes for the kickoff meeting and each of the quarterly status meetings.

Task 2: Literature Review

The Contractor will conduct a literature review to identify studies conducted on design of substructure elements with PTFE bearings and the design and maintenance of dimpled lubricated PTFE bearings. Additionally, the Contractor shall look at other state DOTs to see how other states are designing with PTFE bearings and what details are used for dimpled lubricated pads.

Task 3: Design Coefficients

Determine if the design coefficients for filled and unfilled flat PTFE bearings specified in AASHTO LRFD Bridge Design Specifications are overly conservative when predicting the friction forces exerted on the bent. Is the typical design coefficient used by MoDOT adequate? Recommendations for EPG Guidance language shall be developed.

Task 4: PTFE Dimpled Lubricated Bearings

Provide recommendations on the maintenance required on these types of bearings to keep them free from dirt and debris that can lock up the bearing and cause tearing. Recommendations on the drawing details shall be developed including confinement of the PTFE. Recommendations for EPG Guidance and construction specification language shall be developed.

Task 5: Develop Report, Research Summary and Presentation

The Contractor will develop a final report detailing the tasks completed during the project, including any and all findings generated during the project's duration. The Contractor will provide a 1-2 page research summary that states the project objectives, findings and conclusions. A presentation for MoDOT staff, summarizing important or significant details of the project is required. Please refer to the Publications Guidelines for the report and research summary, which can be found on the website.

Project Deliverables

For templates and forms for reports and plans, visit <https://www.modot.org/information-researchers>.

Email Communications

E-mail and phone communications between the Principal Investigator(s) and MoDOT contacts as necessary are required to provide on-going updates of progress throughout the project

Data Management Plan

The plan is a formal document that describes the data that is acquired, created or produced during the project, specifies who owns it and who can access it as well as information on how it will be described, managed, analyzed, stored, shared and preserved during and after the project is over. Please refer to templates on the [website](#).

Quarterly Reports

Quarterly reports should be submitted throughout the project on the last day of March, June, September and December. The quarterly reports are not intended to replace any additional correspondence between the research team and MoDOT needed to keep the project moving. Please refer to template on the [website](#).

Interim Presentation

An interim presentation shall be scheduled near the mid-point of the project to update MoDOT on the progress and the direction of the project. The purpose of the interim presentation is to evaluate the progress and determine if any mid-project corrections are necessary.

Draft Final Report and Research Summary

These drafts should be final products except for revisions based on MoDOT's review. A final report must include a completed Technical Report Documentation page. Please refer to **Publication Guidelines** and summary template on the [website](#).

Final Report and Final Research Summary

After MoDOT's review is complete and documents have been edited to MoDOT's satisfaction, final documents should be submitted as a Word documents (unless otherwise instructed). Please refer to **Publication Guidelines** and summary template on the [website](#).

Other Deliverables

Design Details for PTFE Dimpled Lubricated Bearings should be developed as well as recommendations for EPG guidance and construction specification language.

Final Presentation

The Contractor will present the results, recommendations, and implementation ideas to MoDOT and other stakeholders. The Contractor will coordinate location, date, and meeting fees with MoDOT. For stakeholder and agency participants, any travel and lodging fees are to be covered by individual attendees or their firms. MoDOT and stakeholders will provide feedback to the contractor, especially related to implementation.

Task-Specific Deliverables

Task	Deliverables
1	Schedule and conduct kickoff meeting. Kickoff meeting minutes. Draft and final work plans. Quarterly project status meetings.
2	A draft of the literature search should be provided to MoDOT once this task nears completion. This draft will be discussed at the next quarterly meeting.
3	Recommendations for changes in the EPG guidance language.
4	Design Details for PTFE Dimpled Lubricated Bearings. Recommendations for changes in the EPG guidance and construction specification language.
5	Final report and research summary. Final project meeting presentation.

Project Schedule

The following is an estimate of the project timeline or information on key dates within the project, presuming the project starts **November 15, 2022**. Proposals need to include a work plan with a proposed timeline. For a sample of a work plan template, see link below. Changes to our estimated project timeline below will be considered, however, timeline extensions cannot be guaranteed. If the Contractor believes the project can be completed sooner, please include

a revised schedule with the proposal. The project timeline will be discussed and finalized during the kickoff meeting.

For report templates and forms, visit <https://www.modot.org/information-researchers>.

Date	Milestone
11/15/2022	A kickoff meeting with MoDOT will be scheduled to discuss project requirements and deliverables. The dates of key milestones and deliverables will be determined from this meeting.
8/1/2023	Interim presentation must be done by this date.
2/28/2024	Draft final report, draft summary report, design drawings, EPG guidance and construction specification language are due.
4/30/2024	Final report, draft summary report, design drawings, EPG guidance and construction specification language are due.
5/31/2024	Final invoice due.
5/31/2024	Contract ends.

Special Notes

Project budget is not to exceed **\$200,000**. A budget is not to be included in the proposal but will be required for the contract and must be within this limit. For a sample Budget template, report templates and forms, see <https://www.modot.org/information-researchers>.

All questions, information, data and/or manual requests regarding any aspect of the RFP details or process for submissions should be submitted to MoDOTResearchRFP@modot.mo.gov by the date and time listed in the "RFP Schedule" section of the RFP. This is the only acceptable method for contact regarding the RFP and contacting MoDOT employees via other methods is prohibited. Not adhering to this rule is cause for disqualification of the proposal.

RFP Requirements

- "Contracting Documents" provide further details and links to the required forms. They are available at <https://www.modot.org/information-researchers>.
 - **Contractor's Project Experience:** The proposal must clearly identify the Organization's experience in offering the services requested in this RFP during the past three (3) years. The description should include a list of the agencies which your organization has served during this time period or currently serves. Please

- highlight any work you have done with other state agencies or local governments.
- **Team Member Experience:** Please list all team members (including subcontractors) proposed to work on the project. Attach licenses, certifications and resumes for key personnel.
 - **Contractor's Client References:** Proposals should indicate the name, title, and telephone number of at least three clients within the past three years.
- Proposals must be no more than 10 pages in length with a font size no less than 11 points. This length limit **does not include** the Proposal Submission Form, Contractor's Project Experience, Team Member Experience, Contractor's Client References and optional cover letter (if included, one page maximum).
 - Proposals must be submitted as one combined PDF document. The submission should **only include the required documents** organized in the following order: 1) Proposal Submission Form; 2) Cover Letter (Optional; 1 page maximum); 3) Body of Proposal (including work plan and project schedule); 4) Contractor's Project Experience; 5) Team Member Experience; and 6) Contractor's Client References.
 - The Offeror must respond to this RFP by submitting all the information required herein for its proposal to be evaluated and considered for award. Failure to submit all the required information shall be deemed sufficient cause for disqualification of a proposal from consideration.
 - Proposals will be evaluated by an agency and stakeholder team with knowledge and backgrounds in relevant areas for this project. Selection of the successful Contractor will be based on the Contractor's demonstrated knowledge in the required areas, the merit of the proposed methods and approach in achieving the desired goals, the experience and qualifications of the team, the plan for ensuring implementation of results, and the adequacy and availability of team members to complete the work in a timely manner.
 - Correct proposal submission is one of the evaluation criteria. If submission instructions in this section are not followed, the Contractor **risks an automatic 10-point deduction (out of 100 total points)** when points are awarded during the Proposal Evaluation Process.

RFP Schedule

This document constitutes an RFP from qualified organizations to conduct the TR202204 Design Coefficients of Friction for MoDOT PTFE Bearings study for the MHTC and Missouri Department of Transportation (MoDOT). MHTC reserves the right to reject any and all proposals for any reason whatsoever.

The following RFP Schedule of Events represents MoDOT's best estimate of the schedule that shall be followed. The time of day for the following events shall be between 7:30 am and 4:00 pm, Central Time unless otherwise noted. MoDOT reserves the right at its sole discretion to

expand this schedule, as it deems necessary, without any notification except for the deadline date for submitting a proposal. Time is of the essence for responding to the RFP within the submission deadlines.

The following timeline must be met for a proposal to be accepted.

Date	Action
8/4/2022	MoDOT posts RFP to the website at https://www.modot.org/research-requests-proposal .
8/31/2022 4:00 PM (Central)	Written comments or questions must be submitted to MoDOTResearchRFP@modot.mo.gov . This is the only acceptable method for contact regarding the RFP and contacting MoDOT employees via other methods is prohibited. Not adhering to this rule is cause for disqualification of the proposal. This includes all requests for information, data, and manuals.
9/9/2022	MoDOT will post written responses publicly on the website at https://www.modot.org/research-requests-proposal .
10/5/2022 10:00 AM (Central)	Written proposals must be submitted to MoDOTResearchRFP@modot.mo.gov . Do not consider your proposal submitted until you receive notification of receipt. A notification should be sent by noon of the same day.
10/19/2022	MoDOT will notify submitters about project selection, or if needed about interviews to finalize selection.

Contracting Requirements

The successful team will be required to complete additional documentation and enter into a contract such as a "Standard Research Agreement" or "Task Order." Applicants should be aware of these additional needs so contracting can proceed in a timely manner.

As part of the eAgreements process, MoDOT uses an electronic signature tool, DocuSign, for signing agreements electronically. All parties of the agreement must agree to sign electronically in order to utilize the electronic signature option. If your proposal is selected, you will be informed about how to obtain your credentials for electronic signatures (including how to become a MoDOT vendor if you are not already).

Standard contracts, forms, attachment templates and additional information are available from the website at <https://www.modot.org/information-researchers>.

Proposal Submission

Submission Deadline

Proposals must be emailed by **10:00 AM (Central Time)** according to email time stamp by the submission date in the RFP Schedule to the Research Director's attention (Jen Harper) at: MoDOTResearchRFP@modot.mo.gov. Please reference the project title since more than one RFP may be due at one time. Electronic proposals are required.

Submission Confirmation

You will receive an email confirmation after your proposal has been received. If you do not receive such a confirmation by **12noon (Central Time)** on the day of the deadline, please contact us at MoDOTResearchRFP@modot.mo.gov as soon as possible. Your submission should not be considered received until you have received your email confirmation.