

Missouri Department of Transportation
Kevin Keith, Director

573.751.2551
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1.888.ASK MODOT (275.6636)

October 21, 2011

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 “TRyy1203 entitled, Polyurethane Foam Infill for Fiber-Reinforced Polymer (FRP) Bridge Deck Panels”. 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 deliver all proposals to the Construction and Materials Contract Administrator indicated in the attachment by November 30, 2011. More information about project contracting in general can be found at: www.modot.mo.gov/services/OR/orRFP.htm.

Sincerely,



Bill Stone
Research Administrator



Request For Proposals (RFP)

Project Specific Requirements:

This document contains information and requirements for only this RFP. A “Standard Requirements” document contains additional needs for all research proposals and contracting. Submitters should review both this document and the Standard Requirements document, available from the Construction and Materials Contract Administrator (identified at the end of this document) or:

www.modot.org/services/OR/orTemplates.htm

TRyy1203 Polyurethane Foam Infill for Fiber-Reinforced Polymer (FRP) Bridge Deck Panels

Background:

The goal of the proposed research is to develop, test, and evaluate fiber-reinforced, polyurethane foams to replace the costly honeycomb construction currently used to manufacture FRP bridge deck panels. The initial idea was to use full-depth FRP panels but it has been further refined into the use of developing and testing of partial depth panels. FRP could make it cost effective in comparison to the precast panels MoDOT currently uses and at the same time the FRP will provide a much longer service life.

Objectives:

The anticipated deliverable from this study will be an FRP bridge deck panel that is resistant to deicing chemicals and deterioration yet competitive with reinforced concrete on a first-cost basis. Furthermore, at one-fifth the weight of reinforced concrete, the FRP bridge deck panels will reduce the shipping costs as more panels can be put on a single truck, and it should be easier to place the light panels in place as forming on the girders.

Although still in their infancy, fiber reinforced polymer (FRP) bridges have shown great promise in eliminating corrosion concerns and providing bridges that meet or exceed the Federal Highway Administration’s (FHWA) goal of 100-year life spans. Although cost effective in terms of life cycle analyses, first costs have limited the application of FRP bridges, as most state Departments of Transportation have limited funds to meet ever increasing demands. One area that has shown some headway is the use of FRP bridge decks, the location where the majority of corrosion-related damage normally occurs. However, first costs still hamper their widespread use.

Closed-cell, high-density polyurethane foams offer a cost-effective alternative to the complex honeycomb construction currently used in FRP bridge deck panels, thus lowering initial cost. Structural sandwich panels with a polyurethane foam infill are commonly used in automobiles, aircraft, and prefabricated buildings. Most importantly, several recent advances in polyurethane foam formulations have resulted in a material that can resist the localized compressive stresses and fatigue loading beneath a truck wheel, making this type of sandwich panel construction a viable alternative for bridge decks. Once these panels can compete against reinforced concrete on a first-cost basis, their significantly longer life expectancies could save considerable money for MoDOT and the residents of Missouri.

MoDOT desires to have developed tested and evaluated a partial depth structural sandwich panel made from FRP and polyurethane foam. It is envisioned to be a substitute for the current precast concrete deck panels, currently allowed as stay-in-place forms for our standard 8½” thick reinforced concrete deck. The FRP panel should provide good structural support and composite action with the cast-in-place concrete. All load testing and environmental tests will be carried out on this prototype FRP panel in this study to see if it is feasible to move on to the next step, use of FRP panels to construct a new deck. An added value of the research is that it could advance the use of this technique in future full depth panels and other possible structural applications.

Project Requirements and Deliverables:

The major requirement is to develop, test, and evaluate a full scale fiber-reinforced, polyurethane foam core manufactured FRP bridge deck panel in the laboratory. The nominal size of MoDOT’s current reinforced concrete panels is 3 in. thick with a maximum length of 8 ft. and a width depending on the type of girders being used for the superstructure but limited to 9 ft.-6 in. wide. (The standard drawings for precast prestressed panels are at the website: http://www.modot.mo.gov/business/standard_drawings2/precast_panel_new_title_block.htm) A novel design which proposes different dimension but would still be a partial depth FRP panel and have a reinforced concrete riding surface may also be considered.

The following tasks are proposed as a minimum for the project and may be modified if needed.

Task 1: Literature Review – a short summary of current state-of-the-art information on FRP panels using polyurethane cores along with a list of references found and used for this study.

Task 2: Develop a design for a partial depth deck panel similar to MoDOT’s precast deck panels used for forming concrete bridge decks. The following design and constructibility issues should be addressed::

- should be LRFD design.
- should address composite action of panel and concrete deck.

- should address coefficient of thermal expansion differences. FRP will be different from concrete.
- should address sealing between transverse edges of panels (if only to prevent excessive grout or water leakage), and lay down on girders (three-legged stool problem).
- Also, it must meet Sec 703.3 of the Missouri Standard Specifications (http://www.modot.mo.gov/business/standards_and_specs/Sec0703.pdf) on construction forms and falsework. Since these panels are lighter, there logically may be concerns with stability during placement, during placement of steel and during pours especially on curved and/or superelevated structures. (Note: Currently precast deck panels are permitted on curved structures and superelevated decks - can the proposed FRP panel meet the same criteria for use)

A presentation on a proposed prototype to MoDOT's Technical Advisory Panel will be required to complete this task.

Task 3: Devise a testing procedure to test the structural and environmental properties of the prototype panel. A presentation will be required of the proposed test plan and approval obtained from the Technical Advisory Panel to complete this task. Laboratory testing should include load testing and deflection testing and other tests deemed necessary to prove the strength, durability, fatigue and safety of the panels, along with how to mitigate reflective cracking in the concrete surface. Additionally some tests to determine how well the panels stand up to the harsh environment that a bridge deck is subject to will be necessary.

Task 4: Conduct all tests from the procedure decided upon, and approved, and provide preliminary reports and outcomes on a regular basis to MoDOT.

Task 5: The final objective would be a panel that could ultimately be substituted for the standard precast concrete panels in a MoDOT bridge project.

- Evaluate design and tests of panels and make recommendations on the use of the panels in a future construction project.
- Recommendations should include the serviceability and estimated first cost of the panels and the delivered in-place cost..
- Also addressed should be advice on fabrication of the panels and any erection details different than the present precast panels. Additionally, consideration for what to look for on bridge inspections of the panels and any recommended maintenance procedures.

Interim Presentations: Interim presentations shall be scheduled near the completion of each Task to update MoDOT on the progress and the direction of the project. This is in addition to the necessary communication between the Principal Investigator(s) and MoDOT contacts throughout the project. The purpose of the interim presentation is to evaluate the progress and determine if any mid-project corrections are necessary.

Project Schedule:

The following is an estimate of the project timeline or information on key dates within the project, presuming the project starts December 19, 2011. Proposals need to include a work plan with a proposed timeline. While alternative timelines will be considered, an extension is unlikely. The project timeline will be finalized during the contracting phase.

Monthly: E-mail and phone communications with MoDOT contacts are required to provide on-going updates of progress.

Last working day of each quarter: Quarterly updates on work accomplished during the quarter are due on or before the last working day of any March, June, September, and December during the course of the project. A technical memo is required with a simple listing of progress on each of the Tasks spelled out in the Requirements and Deliverables above, any test results, laboratory work, etc. that has been accomplished during the quarter.

February 10, 2012: A summary of a literature search on past use of closed-cell, high-density polyurethane foams in construction of FRP bridge deck panels should be submitted to MoDOT.

Last Day of the month: A technical memo is required with a simple listing of results from the research, a list of recommendations based on the list, and a preliminary list of ideas to implement the recommendations.

Presentation of design for partial depth deck panels and testing plan: When a design is finalized and before fabrication of a prototype panel for testing, a presentation is required. A proposed testing plan will also be presented at this presentation. The contractor will present the results, recommendations, and implementation ideas to MoDOT and other stakeholders. 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.

April 1, 2013 : A draft final report is required. One or more revisions should be anticipated. A final report must have the standard documentation form completed and should have sections consistent with the typical research report.

April 30, 2013: Review of drafts will be completed. The time between review and next due date is to allow for final changes and formatting.

May 31, 2013: A completed final report is due. Additional time between this due date and the end of the contract is to complete any final corrections. Thus, it is important to complete the finals by this due date instead of by the end of the contract.

June 14, 2013: Final invoice is due.

June 28, 2013: Contract ends.

Special Notes:

Project budget is not to exceed \$120,000. A budget is not to be included in the proposal, but will be required for the contract and must be within this limit.

Reporting templates and standard report forms are available from the Construction and Materials Contract Administrator or the web site:

www.modot.org/services/OR/orTemplates.htm

RFP Requirements:

- Proposals must be no more than 12 pages with a font size no less than 11 points. This length limit does not include forms or resumes attached to the proposal.
- The “Standard Requirements” document provides further details and links to the required forms. It is available from the Construction and Materials Contract Administrator or at: www.modot.org/services/OR/orTemplates.htm
- Proposals will be evaluated by an agency and stakeholder team with knowledge and backgrounds in relevant areas for this project. Selection of the successful proposer will be based on the proposer’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.

RFP Schedule:

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

Date:	Action:
October 21, 2011	MoDOT posts RFP to the website: www.modot.mo.gov/services/OR/orRFP.htm
November 7, 2011	Written comments or questions must be submitted to Construction and Materials Contract Administrator.
November 21, 2011	MoDOT will post written responses publicly on the website: www.modot.mo.gov/services/OR/orRFP.htm
November 30, 2011	Written proposals must be submitted to Construction and Materials Contract Administrator.

December 9, 2011 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.
- Standard contracts, forms, attachment templates and additional information are available from the Construction and Materials Contract Administrator or the web site: www.modot.org/services/OR/orTemplates.htm

Contact Information:

Proposals must be either hand delivered by close of business; or faxed, emailed, or mailed by midnight (Central Standard Time) according to time stamp or postmark; on the due date indicated below. Please reference the project title since more than one RFP may be due at one time. Electronic proposals are encouraged. They may be faxed or emailed to the Construction and Materials Contract Administrator:

Karmen.Stockman@modot.mo.gov

Fax: 573-526-4324

Proposal packages suitable for duplicating may be submitted by mail or hand delivery to:

Construction and Materials Contract Administrator

Missouri Department of Transportation

830 MoDOT Drive

PO Box 270

Jefferson City, MO 65109