**Request for Research Proposal**

**RFRP-19-003**

**Evaluation of Concrete Substructure Crack Control Guidelines**

This request is open to Florida universities with an executed Master University Agreement on file with the Florida Department of Transportation.

Details of the Services are described in Exhibit “A”, Scope of Services, attached.

The basis form of Agreement shall be a task work order issued under the Master University Agreement by the Research Center.

The maximum amount of funding available is $150,000.00 and the anticipated timeframe for the project is 30 months.

**Proposal Format Instructions:**

1. The University is encouraged to limit the proposal to no more than 30 pages. The cover page should contain the contact information for an Administrative contact and the Principal Investigator.
2. Provide a Technical Plan demonstrating a solid knowledge of the problem and its background. It should not be a duplication of the RFRP. A scientific and practical approach to the resolution of the problem should include analytical procedures, knowledge accumulation (research), and innovative concepts. The Proposer should explain the approach and means to be used in accomplishing the tasks and where difficulties may be anticipated and resolved.
3. Provide a Management Plan which describes the organizational structure, management style, the methodology to be used on quality control and service reliability and to maintain schedules, as well as the means of coordination and communication between the organization and the Department. The Proposer should provide the names of key personnel on the Proposer’s team, as well as a resume for each individual proposed and a description of the functions and responsibilities of each key person relative to the task to be performed. The research team must include at least one member with major concrete bridge design experience, including experience in the design and plans production of major bridge substructures. Proposer should summarize the team’s experience with the following items, broken down by team member

* Mechanics and design of mildly reinforced concrete and prestressed concrete
* Designing and detailing of concrete bridge substructure elements on FDOT projects
* Design code requirements for durability and serviceability of prestressed and non-prestressed concrete element (FDOT Structures Manual, AASHTO Bridge Design Specifications, ACI318, fib model code, etc).

IV. Provide a Work Plan with estimated project hours by skill classification.

**Price Format Instructions:**

I. The Price information shall be submitted separately on the form provided and a detailed budget to support the lump sum amounts identified for each deliverable. Indirect cost is limited to 10%.

**Proposal Evaluation:**

A Technical Review Committee will review and evaluate each proposal submitted. The Committee will evaluate each technical proposal and assign a Technical Score based on the criteria identified below.

Technical Plan 50 points

Management Plan 40 points

Work Plan 10 points

**Price Evaluation**

The Research Center will view the price information and assign points based on price evaluation formula. The criteria for price evaluation shall be based upon the following formula:

(Low Price/Proposer’s Price) x Price Points = Proposer’s Awarded Points

Price 10 points

**Technical Questions are due by 3:00 PM on November 7, 2018**

Technical questions should be submitted to [patti.brannon@dot.state.fl.us](mailto:patti.brannon@dot.state.fl.us) with the subject line

RFRP-19-003 Technical Questions

**PLEASE EMAIL PROPOSALS TO:**

Patti Brannon at [patti.brannon@dot.state.fl.us](mailto:patti.brannon@dot.state.fl.us)

Include in the subject line the following information: RFRP-19-003 Evaluation of Concrete Substructure Crack Control Guidelines

**PROPOSAL ARE DUE BY 5:00 PM ON January 9, 2019.** Proposals received after this date and time will not be accepted.

The Research Center will notify all proposers of the final decision on January 30, 2019.

**Special Notes:**

**Proposal will be rejected if more than one proposal is received from a University.**

**The Research Center intends to award the contract to the responsible and responsive proposer whose proposal is determined to be the most advantageous to the Department.**

Any questions related to this request should be directed to Patti Brannon at [patti.brannon@dot.state.fl.us](mailto:patti.brannon@dot.state.fl.us) or (850) 414-4616.

**Exhibit A – Scope of Service**

Evaluation of Concrete Substructure Crack Control Guidelines

**Background Statement**Ensuring durability over the design life of structures is the primary goal of crack control in concrete bridge substructures. In January 2006, the Department implemented a crack control design policy that limits service steel stresses to 24 ksi for mildly reinforced pier columns, pier caps, and bent caps (ref: Structures Design Guidelines (SDG) 3.10.A). This policy has been expanded and refined over the years and currently limits tension stresses in the outer layer of reinforcing for all substructure elements (footings, pier columns, pier caps and bent caps) under construction loads and the AASHTO LRFD Bridge Design Specifications Service III Load Combination. According to the commentary of SDG 3.10.A, the tensile limit of 24 ksi is intended to ensure the durability of concrete substructure elements by limiting crack widths. However, the 24 ksi criteria does not predict crack width magnitude and spacing. Severe cracks are unacceptable from a structural durability point of view and can result in negative public perception. From the standpoint of both durability and appearance, many fine cracks are preferred over a small number of wide cracks.

To our knowledge the crack control design policy of SDG 3.10.A was not formally validated prior to implementation, even though it usually controls the design of concrete substructure elements on FDOT bridge projects. There has been debate over the years that this design policy provides an inconsistent solution to limit crack widths in concrete substructures. Additionally, the crack control requirement of SDG 3.10.A can be difficult and cumbersome for designers to implement, especially for pier columns.

**Project Objective(s)**The objective of this research is to provide a better understanding of how to compute and minimize crack widths in concrete substructures subjected to pure bending or a combination of axial loads and bending through an extensive literature review and analytical evaluation. It is expected that the research will either validate or improve the current requirement of SDG 3.10.A or identify a more elegant method for predicting crack width and spacing in concrete substructure elements, thereby allowing the Department to provide the best guidance possible to engineers designing bridges for the Florida Department of Transportation. The research shall also consider higher grades of mild reinforcement with yield strengths exceeding 60 ksi. In general, substructure elements are designed with only mild reinforcement, which is the primary focus of the research. However, there are cases where mild reinforcement in combination with prestressing tendons as a potential strategy to limiting crack widths need to be considered in the study.

This research seeks to obtain the following items related to concrete substructure elements:

* Recommendations on crack width and spacing calculation methods
* Design and detailing guidelines for how to minimize crack width and optimize distribution of reinforcing
* Acceptable design crack width limitation based on the Department’s environmental classifications of Slightly, Moderately, and Extremely Aggressive
* Potential experimental testing to validate proposed design guidelines

**Project Kickoff Teleconference**

The principal investigator will schedule a kickoff meeting that shall be held within the first 30 days of task work order execution. The kickoff meeting will consist of a webinar at least 30 minutes in length. The purpose of the meeting is to review the tasks, deliverables, deployment plan, timeline, and expected/anticipated project outcomes and their potential for implementation and benefits. The principal investigator shall prepare a presentation following the template provided at <http://www.fdot.gov/research/Program_Information/Research.Performance/kickoff.meeting.pdf>

The project managers, principal investigator, and research performance coordinator shall attend. Other parties may be invited, if appropriate.

**Anticipated Tasks:**Task 1 – Literature Review and Synthesis

Perform an extensive literature review on the most up-to-date research for predicting and minimizing crack widths in reinforced concrete. Include a review of design guidance and requirements of AASHTO, State DOTs, bridge owners, agencies, and industry organizations (ACI, PCI, etc.) regarding predicting crack widths in reinforced concrete. The literature review should include international codes, specifications, publications and guidelines. Focus will be given to substructure elements.

Based on the findings of the literature review, provide a synthesis on the state of practice of computational methods and design criteria for predicting crack widths in reinforced concrete. The synthesis will identify and recommend one or more computational methods and criteria for computing crack widths for inclusion in the analytical study (Tasks 2 and 3). Threshold criteria will be based on the Department’s environmental classifications of Slightly, Moderately, and Extremely Aggressive. Computation methods chosen for inclusion in the analytical study must be relatively simple and practical to perform such that the criteria can be checked without the need for sophisticated structural software applications. The designer should be able to perform the check by hand calculation or by using tools such as Excel© or MathCAD©.

Deliverable 1: Upon completion of Task 1, the University will submit to the Research Center at [research.center@dot.state.fl.us](mailto:research.center@dot.state.fl.us) a detailed written report containing the findings of the literature review and synthesis.

Task 2 – Develop Study Parameters

The principal investigator, through coordination with the Project Managers and technical experts within the Department, will develop study parameters to evaluate and compare the Department’s current criteria of SDG 3.10.A and the criteria identified in the synthesis under Task 1. The analytical study, to be performed in Task 3, will include a representative sample of the substructure elements identified in SDG 3.10.A with varying shapes and sizes. Pier column cross sections will include circular, square, rectangular, rectangular with large chamfers, rectangular with circular ends, and special shapes used on past FDOT projects. Selected hollow columns should be included in the study. Pier cap cross sections are generally rectangular, as are pile footings. Consider the added complexities of columns with axial loads in combination with biaxial bending. Live load to dead load ratios, as well as environmental site conditions, should be considered.

It’s anticipated that finite element modeling will be used as a baseline in the analytical study to compare the Department’s current method of limiting crack widths to the computational method(s) identified in the Task 1 synthesis. The Finite Element Method (FEM) software shall be capable of evaluating cracking of concrete.

Deliverable 2: Upon completion of Task 2, the University will submit to the Research Center at [research.center@dot.state.fl.us](mailto:research.center@dot.state.fl.us) a written report to include a detailed summary of the proposed analytical study to be performed in Task 3.

Task 3 – Perform Analytical Study

Perform the comprehensive analytical study based on parameters developed under Task 2 and provide a comprehensive summary of the results.

Deliverable 3: Upon completion of Task 3, the University will submit to the Research Center at [research.center@dot.state.fl.us](mailto:research.center@dot.state.fl.us) a detailed written report of the results of the analytical study.

Task 4 – Recommended Design Guidelines

Evaluate the results of Task 3 and develop design guidelines recommendations to the Department for controlling crack width and spacing in concrete substructure elements. The recommendations will either validate or improve the Department’s current criteria of SDG 3.10.A or provide a new method for predicting crack width and spacing. Recommended methods must be relatively simple and practical to perform such that the criteria can be checked without the need for sophisticated structural software applications. The designer should be able to perform the check by hand calculation or by using tools such as Excel© or MathCAD©.

Deliverable 4: Upon completion of Task 4, the University will submit to the Research Center at [research.center@dot.state.fl.us](mailto:research.center@dot.state.fl.us) a detailed written technical report containing recommendations on design guidelines for minimizing crack widths in reinforced concrete.

Task 5: Draft Final and Closeout Teleconference

Deliverable 5a: Ninety (90) days prior to the end date of the task work order, the university will submit a draft final report to [research.center@dot.state.fl.us](mailto:research.center@dot.state.fl.us)

The draft final report will contain the presentation of all of the executed research tasks and findings in a format outlined by the Guidelines for University Presentations and Publication of Research document.

The draft final and final reports must follow the Guidelines for University Presentation and Publication of Research available at <http://www.dot.state.fl.us/research-center/docs/T2/University.Guidelines.2015.pdf>

The report must be well-written and edited for technical accuracy, grammar, clarity, organization, and format.

Deliverable 5b: Thirty (30) days prior to the end date of the task work order, the principal investigator will schedule a closeout teleconference. The principal investigator shall prepare a PowerPoint presentation following the template provided at <http://www.dot.state.fl.us/research-center/Program_Information/Research.Performance/closeout.meeting.reqs.pdf>. At a minimum, the principal investigator, project managers, and research performance coordinator shall attend. The purpose of the meeting is to review project performance, the deployment plan, and next steps.

Task 6: Final Report

Deliverable 6: Upon Department approval of the draft final report, the university will submit the Final Report in PDF and Word formats electronically to the Research Center at research.center@dot.state.fl.us

The Final Report is due by the end date of the task work order.

**Deliverables Schedule**

*Note: This document will be used by the Research Center to monitor principal investigator performance and activity on the project. The PI should give careful consideration to the time needed to complete tasks and deliverables against current workload. Failure to submit deliverables in a timely manner may result in cancelation of the task work order.*

Remember to include the kickoff teleconference, submittal of draft final report, closeout teleconference and final report. The Research Center must at a minimum receive a deliverable every 6-months on a project. Progress reports are not considered deliverables.

**For planning purposes March 2019 should be used as the anticipated start date of the project.**

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| --- | --- | --- |
| Task / Deliverable Description as provided in the scope | Anticipated Date of Deliverable Submittal (month/year) | TO BE COMPLETED BY RESEARCH CENTER (performance monitoring) |
| Kickoff Meeting/Presentation |  |  |
| Deliverable 1 – Literature Review and Synthesis |  |  |
| Deliverable 2 – Develop Study Parameters |  |  |
| Deliverable 3 – Perform Analytical Study |  |  |
| Deliverable 4 – Recommended Design Guidelines |  |  |
| Deliverable 5a: Draft Final |  |  |
| Deliverable 5b: Closeout Meeting/Presentation |  |  |
| Deliverable 6: Final Report |  |  |

RFRP-19-003

Evaluation of Concrete Substructure Crack Control Guidelines

PRICE PROPOSAL

Task 1 Deliverable (Lump Sum Amount) $

Task 2 Deliverable (Lump Sum Amount) $

Task 3 Deliverable (Lump Sum Amount) $

Task 4 Deliverable (Lump Sum Amount) $

Task 5a and 5b Deliverable (Lump Sum Amount) $

Task 6 Deliverable (Lump Sum Amount) $

Proposer must attach a detailed budget to support the lump sum amount identified per task. If applicable, the following information must be included.

**Use of Subcontractor(s)**

If a subcontractor is to work on the project, describe the work the subcontractor will perform. A scope of work and budget must be provided for the subcontractor.

**Use of Graduate Student(s) and other Research Assistants**

Describe the work any student(s) will perform.

**Equipment**

Florida Administrative Code states “for statewide financial reporting purposes, all tangible personal property with a value or cost of $1,000 or more and having a projected useful life of one year or more must be capitalized. Any hardback book with a value or cost of $25 or more and having a useful life of one year or more that is circulated to students or the general public, and any hardback book with a value or cost of $250 or more that is not circulated must be capitalized. A review of the items on the Exception Property should be performed to ensure items to not fall within this category.

*Universities must adhere to the Department’s $1,000 threshold for equipment or items of lesser value appearing on the Exception Property listing. The university must provide a copy of the purchase invoice/property description/serial number and date of receipt for the equipment with the applicable task invoice.*

A description of the equipment to be purchased must be included with a copy of the quotes obtained. Justification of specific requirements for the project and why the equipment should be purchased instead of leasing (leasing of equipment is preferred) is required for all equipment.

**Expenses**

Describe any expense items to be purchased, if applicable.

**Travel**

***Standard Research Center policy is that travel to conferences is not an allowable expenditure*.**

Describe travel that will take place, including justification of the need for travel, if applicable. Include the traveler’s name/position, location(s), purpose and duration.

*If travel is budgeted, the following text must appear, as worded:*

All travel shall be in accordance with Section 112.061, Florida Statutes. Bills for travel expenses specifically authorized in the agreement shall be submitted using the Department’s Travel Form No. 300-000-06, unless the university provides proof of the Department of Financial Services approval to use an alternate travel form. The Department shall not compensate the University for lodging/hotel in excess of $150.00 per day (excluding taxes and fees).

The maximum amount of travel is limited to $(insert amount). The maximum amount of indirect cost on travel is limited to $(insert amount).