PCI Precast/Prestressed Concrete Institute

REQUEST FOR PROPOSALS

Development of Precast Girder Transport Vehicle Stability Analysis Parameters

Project:

The PCI Committee on Bridges and the PCI Research and Development Council have identified stability of slender girders during transportation as a critical topic for public safety and industry credibility. Better definition of critical design parameters is required for best evaluation of product stability.

Proposer Qualifications:

The proposing agency shall have demonstrated experience in precast, prestressed concrete bridge girder design, production, handling and transportation. Further, the proposer shall be experienced in research techniques required to accomplish the objective stated in the attached Research Project Statement.

Proposal Requirements:

The Proposal shall include identification of the agency, the Principal Investigator, and all staff and partners that will provide work to the Project including complete contact information. It shall further include a description of related experience and available testing facilities. Detailed items to also be included in the proposal are described in the attached Research Project Statement.

The Project is defined in the attached Research Project Statement. The Proposal shall include intended scope of work, schedule and a lump sum cost. By Board resolution, PCI limits university indirect costs to 15 percent for funded projects.

A sample PCI Research and Testing Agreement is attached and will be used as the contract form for the project. Any exceptions to terms of the agreement shall be noted in the proposal.

Proposals shall be submitted no later than **12:00pm Central Daylight Time on August 24, 2020**. The submittal shall be electronic in pdf format. Submit electronically to:

technical@pci.org
Precast/Prestressed Concrete Institute
8770 West Bryn Mawr Avenue
Chicago, IL 60631

Proposal Review:

Proposals received by the stated deadline will be reviewed by an Industry Advisory Committee composed of representatives from the Research and Development Council and the Committee on Bridges. This group shall make a recommendation to the Research and Development

Council for final project approval and proposer selection. PCI reserves the right to reject all proposals. It is anticipated that the final selection will be made by October 1, 2020.

Payment Schedule:

Payments to the successful agency shall be made according to the following schedule:

40% of lump sum cost upon notice to proceed
50% of lump sum cost upon delivery of draft deliverables
10% of lump sum cost upon acceptance of final deliverables and submittal of Journal paper

Attachments:
Research Project Statement
Sample PCI Research and Testing Agreement

Research Project Statement

Development of Precast Girder Transport Vehicle Stability Analysis Parameters

Statement of Purpose

Section 8.10.3 of the PCI Bridge Design Manual (BDM) describes a method for measuring the rotational stiffness of a girder transport vehicle. Approximate rotational stiffness values are provided; however, they are based on very limited data and must be used with caution until more data are available. It is proposed that PCI fund and support a study to (1) more clearly quantify transport vehicle stability analysis parameters, most importantly rotational stiffness and (2) define a protocol for specifying and verifying those parameters for contracting.

Background Information

Lateral stability of precast, prestressed concrete bridge girders is a life safety issue whose importance is not always understood or properly addressed. Safety to the traveling public is a significant concern when girders are transported from a precast manufacturing facility to a job site. PCI published "Recommended Practice for Lateral Stability of Precast, Prestressed Concrete Bridge Girders"[1] in 2016 to provide a rational basis for addressing stability concerns. In its ninth edition, the AASHTO LRFD Bridge Design Specifications[2] incorporated language suggesting designers utilize the recommended practice by PCI. Studies by Mast[3] conclude that the stability of girders sitting on flexible supports is governed by the rotational stiffness of the support rather than the girder. Mast describes methods of estimating rotational stiffness of a transport vehicle and reports an expected range of values with and without leaf springs to mechanically balance the load. Mast cautioned that these values are based on a limited number of measurements and should be used with caution until more data are available from the field. Seguirant[4] reports measurements of rotational stiffness for a transport vehicle configured to carry a 168 ft long, 180 kip deck bulb tee girder. The Washington State Department of Transportation, Bridge Design Manual[5] provides a matrix of rotational stiffness and center-to-center wheel spacing that can be assumed for design purposes. All of these data are from one region of the country and are strongly biased towards the transport equipment available in that region. No other measurements of rotational stiffness are known to have been reported. Efforts to implement the recommended practice have been complicated by a lack of guidance for establishing rotational stiffness of transport vehicles. Transport vehicles with many different suspension systems and mechanical load balancing capabilities are available, each of which are likely to have unique rotational stiffness characteristics. The PCI Committee on Bridges, Girder Stability Subcommittee, would like to provide guidance in a second edition of the recommended practice for establishing transport vehicle parameters including rotational stiffness.

Scope of Work

The following is an anticipated work scope. The research team will be expected to have a strong background in precast, prestressed concrete bridge girder lateral stability theory and be familiar with vehicle transport of long span precast concrete bridge girders.

Survey and interview precast concrete bridge girder fabricators and heavy haul transport companies offering girder transport services to determine the types of hauling equipment used, to understand the rotational stiffness characteristics of that equipment, and to obtain other characteristic parameters used in stability analysis such as center of rotation location, height to bottom of girder above the center of rotation, and center-to-center wheel spacing (including adjustable width axles). Transport companies should be able to offer insights beyond the transport of concrete bridge girders because stability is a concern for all loads transported.

Survey and interview hauling equipment manufacturers, particularly their designers and engineers, to gain knowledge about mathematical models for assessing rotational stiffness, the rotational stiffness characteristics of their products including the effect of load leveling systems, such as hydraulics rams, and possible reduction in rotational stiffness associated with age and use of the equipment. Equipment manufacturers should be able to provide information about the other characteristic parameters relevant to girder stability analysis. Equipment manufacturers may also be able to provide information and guidance, relative to stability analysis, of the effect different steering systems, such as crab steering, has on hauling, maneuvering, and stability.

Evaluate and possibly propose new methods of determining rotational stiffness with respect to the types, features, and capabilities of contemporary hauling equipment.

If necessary, propose modifications to girder lateral stability theory to account for the characteristics and behavior of contemporary girder transport vehicles.

Measure the rotational stiffness, and other relevant parameters, of a variety of haul vehicles with different suspension systems. Perform statistical analysis to determine average values and variances. Recommend conservative parameters including rotational stiffness per axle.

Develop a protocol for verifying girder transport vehicle characteristic parameters, most notably rotational stiffness, for use by contracting parties so that these parties can have certainty a girder transport vehicle is capable of safely moving a load. Verification is likely to include measurement and reporting of transport vehicle characteristic parameters at some regular frequency (annually, per job, other as determined and recommended by research).

Tasks

Task 1: Conduct a comprehensive study to determine types and characteristics, including rotational stiffness, of transport vehicles used to haul precast concrete bridge girders. The study should include a literature review and assessment to identify relevant technical

information related to theories and guidance for assessing load stability on transport vehicles and rotational stiffness of transport vehicles, survey and interview precast girder fabricators, haulers, and haul equipment manufacturers, review of current girder stability theory to determine if the rotational spring model is sufficiently accurate given the types of transport equipment in use today and, if necessary, develop or revise stability models and theory.

Task 2: Conduct a field measurement program to obtain and quantify transport vehicle characteristic parameters used in lateral stability analysis, including but not limited to center of rotation location, height to bottom of girder above the center of rotation, center-to-center wheel spacing, and rotational stiffness, and recommend conservative values for design and analysis.

Task 3: Develop a protocol for specifying contractual requirements for transport vehicle characteristics, most importantly rotational stiffness, and verifying transport vehicle satisfies the requirements. Identify and review similar protocols for hauling loads from other industries. The protocol is to include a standardized method and reoccurrence interval for evaluating transport vehicle characteristics.

Outcome

This research project would quantify the characteristic parameters of girder transport vehicles and would provide a framework for specifying and verifying these parameters under contract. This will ease the challenge in wide-spread implementation of PCI's recommended practice for lateral stability analysis.

Estimate of Time Required

This research project is estimated to take 18 months.

Deliverables

1) Interim Reports (1-3 pages) delivered at the following intervals allotting two weeks for review and comment by research committee prior to initiation of next subtask:
   a) Conclusion of literature review and assessment describing findings and conclusions
   b) Prior to survey and interviewing fabricators, haulers, and equipment manufacturers describing who will be engaged, what questions will be asked, and how responses will support the research objectives
   c) After analysis of survey and interview results describing findings and conclusions
   d) Prior to collecting field measurements including matrix of vehicles, suspension types, and parameters to be measured. Also describe any proposed or anticipated changes to stability theory.
2) Detailed Final Report to include
   a) Literature review and assessment
   b) Findings and conclusions from survey and interviewing fabricators, haulers, and

equipment manufacturers

c) All measurement parameters (also to be provided in electronic tabular format)
d) Recommendations for transport vehicle parameters for stability analysis in a format which can be incorporated in the recommended practice document
e) Recommended revisions to PCI BDM including but not limited to Section 3.5.6, Section 8.10, and Section 8.10.3, in a format that can be incorporated directly into the PCI BDM.
f) Protocol for specifying contractual requirements for transport vehicle and verifying transport vehicle satisfies the requirements.

3) PCI Journal Article describing the research project, findings, and results
4) Summary Report for *ASPIRE*
5) Presentation to one or more the following PCI committees at PCI Convention or Committee Days: R&D, Bridge Producers, Committee on Bridges.

Budget
$100,000

References

1. PCI (Precast/Prestressed Concrete Institute). 2016. "Recommended Practice for Lateral Stability of Precast, Prestressed Concrete Bridge Girders." CB-02-16-E. Chicago, IL: PCI.
2. AASHTO, *LRFD Bridge Design Specifications*, 9th Edition, American Association of State Highway and Transportation Officials, Washington, D.C., 2020.
3. Mast, Robert F. 1993. "Lateral Stability of Long Prestressed Concrete Beams: Part 2." *PCI Journal*, V. 38, No. 1 (January–February): pp. 70–88.
4. Seguirant, S. J., "New Deep WSDOT Standard Sections Extend Spans of Prestressed Concrete Girders", PCI JOURNAL, Vol. 43, No. 4, July/August 1998, pp. 92-119.
5. WSDOT, *Bridge Design Manual*, M 23-50, Washington State Department of Transportation, Olympia, WA, 2019.

SAMPLE RESEARCH AND TESTING AGREEMENT

THIS RESEARCH AND TESTING AGREEMENT (the "Agreement"), effective as of the ___ day of _____, 20__ (the "Effective Date"), is by and between Prestressed Concrete Institute, an Illinois not-for-profit corporation located at 200 West Adams Street, Suite 2100, Chicago, IL 60606 (hereinafter referred to as "PCI") and_____ _____(hereinafter referred to as "University").

In consideration of the premises, the mutual covenants herein contained and intending to be legally bound, the parties hereto agree as follows:

Article 1 – Definitions

1.1 "Project" shall mean the performance of the scope work as defined in the research proposal entitled _____ and dated _____. The scope of work is incorporated herein by reference as set forth in full in attachment A.

1.2 "Agreement Term" is from the Effective Date through _____ [date].

1.3 "Principal Investigator" shall mean the individual(s) identified as such in the research proposal for Project, who is/are the University faculty and/or staff member(s) responsible for supervision and administration of the Project.

1.4 "Intellectual Property" shall mean individually and collectively all inventions, improvements, copyrights, patents, proprietary information or discoveries that are conceived or made (i) by University or (ii) jointly by PCI and University in performance of Project.

1.5 "Report" shall mean the periodic or final summary of work performed by University related to the Project.

1.6 "Material Breach" for the purpose of this Agreement shall mean any event, situation, condition, or lack of performance in accordance with the work plan defined in Attachment A which causes the Project to be significantly modified, delayed or cancelled.

1.7 "Completion of Work" shall mean the completion of goals, objectives and other measurements as defined in Attachments A.

1.8 "Acceptance of Final Paper" shall mean the acceptance by PCI of the final deliverables defined in Attachment A at its sole discretion. The intent shall be a judgment of the quality of the deliverable and not a judgment on the results of the research.

Article 2 – Conduct of Project

2.1 University shall use reasonable efforts to commence the Project promptly after the Effective Date.

2.2 In the event that the Principal Investigator becomes unable or unwilling to continue Project, and a mutually acceptable substitution is not available, University and/or PCI shall have the option to terminate said Project, subject to the provisions of Article 8, by giving written notice to the other party of such termination.

2.3 PCI shall promptly provide University with such information or documents of whatever form or nature, or undertake such actions, as University may reasonably require in order to conduct the Project.

Article 3 - Reports and Conferences

3.1 Project reports will be provided by University to PCI as set forth in the Project proposal and a final report will be submitted by University at the conclusion of the Agreement Term or earlier termination of this Agreement.

3.2 PCI shall have the right to reproduce, publish, and disseminate any written reports or deliverables delivered to PCI by the University pursuant to this Agreement. Ownership and copyright for such reports or other materials shall vest in PCI.

3.3 During the Agreement Term, representatives of University will meet with representatives of PCI at such reasonable times and places as set forth in the Project proposal to discuss the progress and results of, as well as ongoing plans or agreed upon changes in the Project.

Article 4 – Compensation and Expenses

4.1 It is agreed to and understood by the parties hereto that except as may be otherwise agreed by the parties in writing, total costs to PCI for the Project hereunder shall not exceed the sum of _____ ($_____). Payment to University shall be made by PCI according to the following schedule:

[*as defined in the project RFP*]

4.2 University shall retain title to all equipment, materials, and supplies purchased and/or fabricated by it with funds provided by PCI under this Agreement unless otherwise stated in Attachment A.

Article 5 – Publicity and Use of Name

5.1 Neither party shall be allowed to use the name of the other party or its representatives in any advertising regarding the Project without the prior written consent of the other party. The University shall identify PCI as the sponsor in any publicity, advertising or news release regarding the Project. PCI shall be allowed to use the name of the University and the Principal Investigator for announcements of the project and for Project updates to the PCI membership and such announcements and updates shall not be considered advertising.

Article 6 - Publications

6.1 University may catalog and place reports of the Project in the University library and may issue publications based on the Project. The research results not proprietary to PCI, as agreed by PCI, may be used in University research and education programs. University shall provide PCI the opportunity to review any report or publication and will, upon the request of PCI, withhold publication for up to 90 days.

Article 7 – Intellectual Property

7.1 Title to all Intellectual Property developed in the course of performance of the Project, whether or not protectable by patent, trade secret, or copyright, shall reside in the party whose personnel conceived the subject matter and diligently pursued reducing the subject matter to practice, and such party may perfect legal protection therein in its own name and at its own expense. Jointly made or generated Intellectual Property shall be jointly owned by the parties unless otherwise agreed in writing.

Article 8 – Agreement Term and Termination

8.1 This Agreement shall become effective upon the Effective Date and shall continue in effect for the Agreement Term unless sooner terminated in accordance with the provisions of this Article. The parties hereto may, however, extend the Agreement Term for additional periods as desired under mutually agreeable terms and conditions which the parties shall reduce to writing and sign.

8.2 Either party may terminate this Agreement upon thirty (30) days prior written notice in the event of a Material Breach by the other party of any term or provision hereof, provided such breach remains uncured at the end of said thirty (30) day period. Such notice of a breach shall include a reasonable description of the facts surrounding the alleged breach and a proposed course of action to cure said breach, if applicable.

8.3 PCI shall pay the University any costs which have accrued or been encumbered up to the actual date of termination under this Article and shall not be relieved of the obligation to

pay such costs because of termination under this Article.

8.4 Termination of this Agreement by either party for any reason shall not affect the rights and obligations of the parties accrued prior to the effective date of termination of this Agreement.

8.5 No termination or expiration of this Agreement, however effectuated, shall release the parties hereto from their respective rights and obligations under Articles 3, 5, 6, 7, 8, 9, 10, 12, 13, 16, and 17, which such Articles shall survive in their entirety any termination or expiration of this Agreement.

Article 9 - Arbitration

9.1 In the event of any conflict or claim arising out of or relating to any provision of this Agreement or breach thereof, the parties shall make a good faith effort to resolve such conflict amicably between themselves, and if thereby failing, resolution by submission to mediation under the Construction Industry Mediation Rules of the American Arbitration Association, and if thereby failing, resolution by arbitration under the Construction Industry Arbitration Rules of the American Arbitration Association. The location of any mediation or arbitration shall be within the metropolitan area of Chicago, Illinois.

Article 10 - Disclaimer of Warranties

10.1 University disclaims any and all warranties, both express and implied, with respect to the services to be performed hereunder and any deliverables resulting therefrom, including their condition, conformity to any representation or description, the existence of any latent or patent defects therein, and their merchantability or fitness for a particular use or purpose.

Article 11 - Insurance

11.1 University shall carry the following insurance coverage with companies acceptable to PCI.

11.1.1 Commercial General Liability, including Contractual Liability and Completed Operations/Products Liability coverage, at the minimum limit of $2,000,000 per project/ per occurrence (depending on degree of risk, other limits may be appropriate) and $5,000,000 aggregate;
11.1.2 Automobile Liability at $1,000,000 each accident.
11.1.3 Workers' Compensation at statutory limits and Employer's Liability coverage at a minimum limit of $1,000,000;

11.2 Prior to commencement of the Project pursuant to this Agreement, University shall furnish PCI with proof of insurance, satisfactory to PCI in its sole discretion, evidenced by duly authenticated certificates of insurance, which certificates shall show the

insurance type, amount, class of operations covered, effective dates, and dates of expiration of policies.

Article 12 – Independent Contractor

12.1 In the conduct of the Project hereunder, University and PCI are and shall remain independent contractors and nothing herein shall be construed to create a partnership, agency or joint venture relationship between the parties. Neither party is authorized or empowered to act as agent for the other for any purpose and shall not on behalf of the other enter into any contract, warranty or representation as to any matter. Neither party shall be bound by the acts or conduct of the other. Each party shall be responsible for wages, hours, and conditions of employment of its personnel during the term of, and under, this Agreement.

Article 13 - Governing Law

13.1 This Agreement shall be governed by and construed in accordance with the laws of the State of Illinois.

Article 14 - Notices, Invoices, and Payments

14.1 Notices, invoices, communications and payments hereunder shall be deemed made if given in writing and addressed to the party to receive such notice, invoice, communication or payment at the address given below, or such other address as may hereafter be designated by notice in writing:

If to Sponsor:

Precast/Prestressed Concrete Institute
8770 W Bryn Mawr Ave
Suite 1150
Chicago, IL 60631

If to University:

Article 15 - Force Majeure

15.1 In the event that either party is unable, wholly or in part, to carry out its obligations under this Agreement by reason of acts of God or public enemy, wars, insurrections, civil disturbances, epidemics, labor disputes, failure of government approval, accidents, failure of utilities, material shortages, fires, storms, floods and any other causes, whether of the kind enumerated herein or otherwise, not within the control of the party unable to

perform, then the obligations of this Agreement shall be suspended during the reasonable continuance of any inability so caused.

Article 16 – Non-Discrimination

16.1 University and PCI shall not discriminate against any employee or applicant for employment because of race, color, sex, sexual preference, age, religion, national origin, disability, or because he or she is a disabled veteran or veteran of the Vietnam Era.

Article 17 - Assignment

17.1 This Agreement shall not be assigned by either party without the prior written consent of the other party hereto. This Agreement shall be binding upon and inure to the benefit of the respective successors and permitted assigns of the parties.

Article 18 - Agreement Modification

18.1 Any agreement to change the terms of this Agreement in any way shall be valid only if the change is made in writing and signed by a duly authorized representative of each party hereto.

Article 19 - Entire Agreement

19.1 This Agreement constitutes and expresses the entire agreement of the parties hereto with reference to the subject matter hereof, with all prior promises, undertakings, representations, agreements, understandings and arrangements relative thereto having been herein merged into this Agreement

IN WITNESS WHEREOF the parties have caused this Agreement to be executed, each by its duly authorized representative, to be effective as of the Effective Date defined herein.

UNIVERSITY:	**PRESTRESSED CONCRETE INSTITUTE:**
By:_____	By:_____
Title:_____	Title: _____
Date:_____	Date:_____