

# **REQUEST FOR PROPOSALS**

## **LTRC No. 14-1GT, SIO No. 30001424**

### **Calibration of Region-Specific Gates Equation for LRFD**

#### **PROBLEM STATEMENT**

The geotechnical design section in the Louisiana Department of Transportation and Development (LADOTD) uses the modified Gates equation to verify pile capacity in the field, especially on smaller projects where static load tests and dynamic monitoring are not practical. The resistance factor ( $\phi$ ) associated with the Gates equation is 0.40. However, based on AASHTO design methodologies, the worst-case resistance factor used in design is 0.50, which presumes a pile design with no field verification.

This discrepancy creates a problem of penalizing the target pile capacity needed during field observation if the Gates equation is used, which is not reasonable. In general, it is believed to be theoretically better to field verify any pile capacities, rather than the very conservative worst-case approach. This inconsistency has created confusion among designers, consultants, district personnel, and inspectors in Louisiana. It would be beneficial to examine whether a refined calibration of the Gates equation would allow for an increase in resistance factor to match or exceed the “worst-case”  $\phi$ -value (0.50) assumed in design. Recalibration of the resistance factor for the Gates equation could reduce confusion among designers, inspectors, and other users of the pile data tables in the plans. It is counterintuitive to require field verification of a pile capacity that is higher than the ultimate capacity determined during design. Refinement of the resistance factors also serves to refine our state-of-practice in Load Resistance Factor Design (LRFD) and imposes fewer penalties (in terms of rejecting piles) due to a potential increase in confidence level of the Gates method.

Such a refinement may be possible by calibrating the resistance factor in specific districts or geological areas. The proposed research needs to compile relevant pile driving data into a database (the database would include end-of-drive, restrike, and static load test information such as driving resistances, CAPWAP capacities, pile set, etc.); compare Gates equation capacity predictions to CAPWAP and other methods; and use LRFD methods to calibrate the resistance factor for the Gates equation. If trends exist, develop resistance factors for relevant categories such as location, geology, friction piles vs. end bearing piles, etc.

#### **OBJECTIVES**

The objective of this project is to recalibrate the Gates equation using Louisiana data and update the resistance factor of LRFD using the modified Gates equation. The research is anticipated to encompass, at a minimum, the following tasks:

#### **TASK 1 - Literature Review and Data Collection**

This will include a literature search of previous and on-going nationwide research projects and case studies on the subject. A search on the Transportation Research Information Services (TRIS) database is a minimum. LADOTD will provide the research team the

available relevant pile driving data (end-of-drive, restrike, and static load test information such as driving resistances, CAPWAP capacities, pile set, etc.). The research team is also expected to work closely with the geotechnical engineers and staff of LADOTD to collect other relevant data from LADOTD and other possible sources and compile the available relevant pile driving data into a database (the database would include end-of-drive, restrike, and static load test information such as driving resistances, CAPWAP capacities, pile set, etc.). It is also beneficial for the research team to understand the current practice of using the Gates equation in the Department to meet the needs of design engineers.

#### **TASK 2 – Data Analysis and Assessment**

The research team will analyze the data collected and investigate the discrepancies between the prediction of Gates equation and field pile testing data from construction projects, and calibrate the current Gates equation using LRFD method (TR Circular No. E-C079) to calibrate the resistance factor for the Gates equation. A guideline for using such a factor should be developed, including a risk assessment and the limitations of such a new factor. The examples of various applications are expected. A detailed discussion on the limitation in such applications will be very useful. Elaboration of details on the data processing and analysis is required for a qualified proposal.

#### **TASK 3 - Database Development**

Develop a geographic information system (GIS) based Louisiana pile driving testing database of data collected according to LADOTD's requirements, which can be imported to the current geotechnical GIS database. The format and structure of the database should be approved by LADOTD.

#### **TASK 4 – Benefit-cost Assessment**

Prepare a benefit-cost assessment on the potential implementation for the results and recommendations. The proposal shall contain sufficient detail to explain the methodology the research will be using for this assessment.

#### **TASK 5 - Prepare Final Report**

The research team will prepare a final report to document the entire research effort. The final report should include all the data and results generated by this study. The research team is expected to present the research results to LADOTD personnel at the conclusion of the study.

#### **SPECIAL NOTES**

- A. Task descriptions are intended to provide a framework for conducting the research. LTRC is seeking the insight of proposers on how best to achieve the research objectives. Proposers are expected to describe research plans that can be realistically accomplished within the constraints of available funds and contract time. Proposals must present the candidate's current thinking in sufficient detail to demonstrate their understanding of the problem and the soundness of their approach.
- B. LTRC projects are intended to produce results that will be applied in practice. It is expected that the implementation of the results of this research into practice will evolve as a concerted effort during this project. The final report must contain an implementation plan to include, as a minimum, the following:
  - a. The "product" expected from the research;
  - b. A realistic assessment of impediments to successful implementation;

- c. The activities necessary for successful implementation; and
- d. The criteria for judging the progress and consequences of implementation.
- C. To assist in the implementation process, the investigators of this research shall present the final results to LADOTD officials in an oral presentation to be held in Baton Rouge, LA at LADOTD Headquarters after acceptance of the final report.
- D. The proposal should include travel to meet with the Project Review Committee for a “kick off” meeting, presentation of interim report, and presentation of the final report at a minimum.
- E. LTRC’s mission includes the support of higher education in Louisiana. Consultant and out-of-state institutions submitting proposals are encouraged to cooperate and collaborate with Louisiana universities for the purpose of sharing of knowledge and increasing transportation expertise in the academic community.
- F. To equitably answer any questions regarding this Request for Proposals, the Louisiana Department of Transportation and Development (LADOTD) website, <http://notes1/agrestat.nsf/WebAdvertisements?OpenPage> will be updated with questions and answers and related documents regarding the project. The LADOTD makes these documents available for informational purposes only to aid in the efficient dissemination of information to interested parties. The LADOTD does not warrant the documents against deficiencies of any kind. The data contained within this web site will be periodically updated. Interested parties are responsible to be aware of any updates. Questions regarding this RFP should be submitted in writing to the LTRC contact person. Questions must be received by close of business seven calendar days prior to deadline date.

#### **ESTIMATED COST OF RESEARCH**

\$90,000

#### **ESTIMATED COMPLETION TIME**

14 months (*The draft final report is due 11 months after the initiation of the study. Last three months of the contract is for LTRC review and approval of the final report*)

#### **LTRC PRIMARY CONTACT**

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#### **AUTHORIZATION TO BEGIN WORK**

October 2013 (Estimated)

#### **PROPOSAL FORMAT**

All proposals are required to be formatted according to LTRC Manual of Research Procedures available on the web site: [www.ltrc.lsu.edu](http://www.ltrc.lsu.edu). Chapter 2 of that manual provides guidance on proposal development.

#### **PROPOSAL SELECTION**

The Project Review Committee selected for this project will review, evaluate, and rank all proposals received using the criteria established on the attached proposal review form.

**DEADLINE FOR RECEIPT OF PROPOSALS**

Ten copies of the proposal must be received by LTRC by the close of business July 19, 2013. Proposals to be submitted to:

Mr. Harold Paul  
Director  
Louisiana Transportation Research Center  
4101 Gourrier Ave.  
Baton Rouge, LA 70808

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