



**REGION 2**

**UNIVERSITY TRANSPORTATION RESEARCH CENTER  
RFP COVER SHEET**

**Title:** Verification/Development of Seismic Design Specifications for Downstate Zone

RFP Number: C-09-04

Sponsor: NYSDOT

Date Issued: May 14, 2009 (Revised: 5/26/09)

Final Proposal Due at UTRC: **July 8, 2009** (submit through the UTRC Online Submission System at [www.utrc2.org](http://www.utrc2.org))

**RFP Closing Date: July 8, 2009**

**If you plan to apply:**

Please contact Penny Eickemeyer at [peickemeyer@utrc2.org](mailto:peickemeyer@utrc2.org) (cc: [ckamga@utrc2.org](mailto:ckamga@utrc2.org)) to let us know you are assembling a proposal. We will make sure you receive any additional information that becomes available about this RFP.

**Proposal submission guidelines:**

Please submit your proposal electronically to UTRC at [www.utrc2.org](http://www.utrc2.org). All proposals must include the UTRC cover page (<http://www.utrc2.org/research/assets/Technical-CoverSheet.doc>)

We will confirm that the proposals make comparable budget assumptions and will deliver the electronic proposals to the sponsoring agency by the closing date.

**Funding available:**

Up to \$200,000 is available from NYSDOT. Facilities and Administrative Costs (or Indirect Costs) charged by academic institutions are included in the above amount.

Budget forms can be downloaded at

<http://www.utrc2.org/research/assets/budget-Template.xls>

**For questions about this RFP, please contact:**

Paul Hoole, Director

Research and Policy Studies Section,  
6th Floor New York State Department  
of Transportation 50 Wolf Road,  
Albany, NY 12232

For questions about budget preparation, please contact: Camille Kamga,  
[ckamga@utrc2.org](mailto:ckamga@utrc2.org)

**New York State Department of Transportation**  
**Request for Proposals**  
**SPR # C-09-04: Verification/Development of Seismic Design Specifications for Downstate Zone**

May 13, 2009 (Revised: 5/26/09)

**RESEARCH PROBLEM STATEMENT**

The *New York City Department of Transportation (NYCDOT) Seismic Design Guidelines Report* was updated by Weidlinger Associates to reflect current state-of-the-art knowledge in September 2008 (<http://www.utrc2.org/research/rfps/C0904/NYCDOT-Guidelines.pdf>) and is under consideration by NYSDOT to replace the December 1998 version if technically and practically appropriate. This project is to review the September 2008 report and to prepare provisions in the form of NYSDOT Blue Pages to incorporate the report into the *AASHTO LRFD Bridge Design Specifications* and the *AASHTO Guide Specifications for LRFD Seismic Bridge Design*. These guidelines are for use in the Downstate Zone which consists of New York City, Rockland County, Westchester County and Nassau County

**OBJECTIVES**

Independently assess the effectiveness of the approach used in the report and its conclusions. Prepare provisions to be incorporated in the *AASHTO LRFD Bridge Design Specifications* and the *AASHTO LRFD Seismic Design Guide Specifications*.

**PROPOSED RESEARCH TASKS**

*Task descriptions are intended to provide a framework for conducting the research. NYSDOT is seeking the insights of proposers on how best to achieve the research objectives. Proposers are expected to describe research plans that can realistically be accomplished within the constraints of available funds and research period. Proposals must present the proposer's current thinking in sufficient detail to demonstrate their understanding of the issues and the soundness of their approach to meeting the research objectives.*

Tasks:

1. Review the *NYCDOT Seismic Design Guidelines Report (September 2008)* in its entirety. The following subtasks do not include reviewing the Risk Engineering report, *Seismic Hazard for New York City (2002)*, which developed the hard rock ground motion spectra.
  - a. Evaluate the methodology and assumptions used in the development of the report.
  - b. Critically comment on the results of the report.

In performing these subtasks, it is expected that the reviewers will contact Weidlinger Associates to offer them input to this project.

2. If in Task 1, the reviewers agree with the methodology and assumptions used, review Section 10 of the *NYCDOT Seismic Design Guidelines Report* that proposes modifications to the AASHTO Design Codes. Determine the appropriateness of these modifications and develop them into a form that can be adopted as New York State Blue Pages to be used with both the *AASHTO LRFD Bridge Design Specifications* and the *AASHTO Guide Specifications for LRFD Seismic Bridge Design*.
3. Determine the effects of adopting the *NYCDOT Seismic Design Guidelines Report*

(September 2008) along with the recommended provisions developed in Task 2 on the design of bridges in the Downstate Zone. Accomplish this task by creating parallel design examples of two different bridge categories, “Critical” and “Essential”, for Soil Categories “A” to “E”, located in the New York City area. Each bridge category is to be analyzed twice, once using the spectra curves of the *AASHTO LRFD Bridge Design Specifications* and a second time using spectra curves of the *NYCDOT Seismic Design Guidelines Report (September 2008)*. The seismic analysis tasks for the examples must be presented in written form such that the methodology and results can be easily followed and verified. Detail the differences between the two resulting analyses. The differences in the level of effort that a designer would find using the two analysis approaches is the desired outcome.

4. Estimate the design and construction cost difference compared to the *AASHTO LRFD Bridge Design Specifications* incurred in implementing the Report’s recommendations.

## **RESEARCH PRODUCTS**

- Interim reports after each of Tasks 1 through 3 are completed.
- Proposed necessary amendments to the *AASHTO LRFD Bridge Design Specifications* and the *AASHTO Guide Specifications for LRFD Seismic Bridge Design*, in the form of New York State Blue Pages, based on the September 2008 study and the finding of this study.
- Parallel worked bridge analysis examples based on the *AASHTO LRFD Bridge Design Specifications* and the *NYCDOT Seismic Design Guidelines Report (September 2008)*.
- A final report that summarizes all the tasks performed, including recommendations and implementation strategy.

## **URGENCY / EXPECTED BENEFITS**

NYSDOT has adopted the *AASHTO LRFD Seismic Design Specifications* for the Upstate Zone. The *NYCDOT Seismic Design Guidelines Report (September 2008)* proposed for use in the Downstate Zone has some key differences with the current *AASHTO LRFD Bridge Design Specifications*. The final report and/or review and verification process will allow the *Seismic Design Guidelines Report (September 2008)* to be appropriately used with the *AASHTO LRFD Specifications* for the Downstate Zone. This evaluation will promote a consistent statewide seismic design policy.

## **RESEARCH PERIOD**

18 Months.

Task 1 is expected to take six months, Task 2 is expected to take two months, Task 3 is expected to take six months and Task 4 and the preparation of the final report are expected to take four months.

## **FUNDING**

**\$200,000** has been budgeted for this project, exclusive of administrative fees. New York State believes this is a reasonable estimate for the total cost of the work being requested.

The net cost to New York State is one of the selection criteria. When compared to competing proposals, a proposal that requires fewer New York State dollars will receive a higher score on the cost component of the selection criteria. The value of New York State funds required could be reduced through efficiencies (fewer hours per task and / or lower cost per hour) or through cost-sharing where other funds substitute for New York State funds.

Proposals with a New York State cost over the budgeted amount will also be considered, provided the New York State cost, exclusive of administrative fees, does not exceed the budget estimate by more than 10%. (Note: Cost-sharing funds may increase the total project cost further.)

If a sufficient number of potential Principal Investigators indicate in writing that they believe the research cannot be reasonably conducted within these funding constraints and there are only a limited number of proposals submitted within the funding constraints, New York State reserves the option of not proceeding with the work or revising the budget estimate and issuing a new Request for Proposals. Potential Principal Investigators who believe the budget estimate is unreasonable should write to:

Paul Hoole, Director  
Research & Policy Studies Section, 6<sup>th</sup> Floor  
New York State Department of Transportation  
50 Wolf Road  
Albany, NY 12232

## **BACKGROUND**

The final draft for the *New York City Department of Transportation (NYCDOT) Seismic Design Guidelines Report* was completed in September 2008. Weidlinger Associates Inc. provided engineering input and general coordination to accomplish all the tasks of the technical report. A copy of the report will be furnished to interested investigators.

One of the project's initial tasks was to review the *NYCDOT Seismic Hazard Study (December 1998)* for New York City and the surrounding region, defined by the counties of Rockland, Westchester and Nassau. A revised report on *Seismic Hazard for New York City* was prepared by Risk Engineering, Inc. and released in April of 2002. In this report, based on the evaluations and interpretations made by six consulting firms familiar with the seismicity and ground motion of the New York City Region, rock ground motion spectra were derived for different return periods. These results are for hard rock in the New York City region with a shear wave velocity ( $v_s$ ) equal to 2.83 km/sec (9,000 ft/sec).

In June of 2004, it was unanimously agreed between NYCDOT, NYSDOT & FHWA to adopt the new hard rock ground motions which were to become a part of the final *NYCDOT Seismic Design Guidelines Report*.

Following the adoption of hard rock motions, a report entitled *NYCDOT Seismic Design Guidelines for Bridges* was released by Weidlinger Associates to include regional specific soil-site effects. The various tasks accomplished are as follows:

- Data from previous geotechnical bridge studies performed within the five boroughs were compiled.
- A series of generalized subsurface soil and bedrock profiles were developed to be representative of the ranges of soil profiles, overburden thicknesses, and rock types found within NYC.
- A fully probabilistic approach, utilizing Random Vibration Theory (RVT), in conjunction with the new hard rock ground motions from the *Seismic Hazard for New York City (2002)*, was used to develop vertical and horizontal Uniform Hazard Spectra (UHS). This served as the starting point from which design rock and soil response spectra were derived. The method allowed computation of soil Uniform Hazard Spectra (UHS), while

preserving the hazard level of the very hard rock UHS. The method accounted for, in a rigorous probabilistic manner, variations and uncertainties in:

- Soil stiffness, stress-strain non-linearity, and material damping
- Depth of soil to rock
- Stiffness of the rock under the soil

Using the probabilistic methodology both horizontal and vertical UHS were calculated.

- Generic horizontal and vertical design spectra were derived using the calculated UHS as the starting point. Generic design V/H ratios to be used in site-specific studies to generate site specific vertical motions were also produced. All the generic soil curves are presented as a function of three parameters:
  - Soil Class
  - Depth to Rock
  - Rock Class Under the Soil
- Generic design curves were validated:
  - Comparisons to SHAKE site specific analyses: A total of 24 projects were identified throughout NYC having in-situ shear wave velocities measurements, and site-response SHAKE calculations, using the 2002 time history records were conducted. The results were compared to the generic curves. Site-specific vertical spectra were obtained for the sites selected, by multiplying the site-specific horizontal spectra to the appropriate design V/H ratios. Then comparisons of the site-specific vertical spectra, with the corresponding vertical generic response spectra were performed.
  - One-to-one Horizontal Comparisons between RVT and SHAKE Results: implemented using one of the basic target profiles used in probabilistic methodology to generate the horizontal UHS at Soil Class E sites for the 1500-yr earthquake. *180 SHAKE runs were needed for this comparison.*
  - Comparisons between Horizontal Soil Generic Design Spectra and Other Codes were also performed.
- Recommendations for liquefaction evaluation were provided, establishing provisions for the assessment of soil liquefaction. Included are recommendations for earthquake magnitude and peak ground surface accelerations, which are critical parameters for evaluating liquefaction potential and have not been included in previous Guidelines.
- Recommendations for Site-specific Studies were included, providing guidelines and minimum requirements that must be satisfied when Site-specific Studies are performed. These include:
  - Procedures to establish soil horizontal design acceleration response spectra and corresponding time-histories for soils on top of different Rock Classes.
  - Procedures to establish soil vertical design acceleration response spectra and corresponding time-histories for different soils on top of different Rock Classes, by multiplying design horizontal spectra by appropriate period-dependant V/H design ratios.
  - Recommendations to evaluate the effects of the depth to the rock surface (when the depth to rock is larger than 100 ft, and the rock is not reached).
  - Recommendations to account for uncertainties in the soil properties through parametric variation of the soil shear wave velocity profile.

- Minimum requirements to establish lower bound horizontal design spectra as a fraction of the corresponding generic spectra.
  - Recommendations to account for the effects of liquefaction in site-specific studies.
  - Recommendations for time history analysis of bridge structures.
  - Recommendations for the incorporation of spatial variation effects in the analysis of bridges including soil effects.
  - Different requirements for critical and non-critical bridges site-specific studies.
- Recommendations for use/integration with AASHTO documents were included providing recommendations for the use of either the 2008-2009 Interim AASHTO-LRFD Bridge Design Specifications or the 2008-2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design in conjunction with the NYCDOT Guidelines.
  - A flow diagram outlining the steps in the seismic design procedures of the provisions was also provided. It was envisioned that the flow diagram would give the Engineer a simple reference to perform the design process.
  - The second part of the Guidelines, the **Commentary**, was included providing additional explanations to the various sections of the provisions document, including explanations to the RVT methodology; derivation process of the rock and soil generic horizontal design spectra; derivation process of rock and soil generic vertical design spectra; derivation process of the soil V/H design ratios; and further details on the requirements for site-specific studies.
  - Appendices A through J of the Commentary are provided as supporting material. For example, **Appendix A** provides three examples of Rock Class and Soil Site Class determination, selection of Soil Generic Horizontal and Vertical Design Spectra, and selection of parameters to perform a liquefaction evaluation.

Key Differences between the NYCDOT Seismic Design Guidelines Report (September 2008) and the LRFD Specifications

- In the *AASHTO LRFD Bridge Design Specifications*, a 1,000 year return period is the basis of Normal/Other category of bridges whereas the *NYCDOT Seismic Design Guidelines Report (September 2008)*, is based on a 1,500 year return period.  
For the Upstate Zone of NY state, the NYSDOT has adopted the following ‘Seismic Hazard Levels and Performance Criteria’:
1. The ‘Normal’ category of bridges are to be analyzed for a single earthquake hazard design level event having a 7% probability of being exceeded in 75 years (1,000 year return period) and may suffer significant damage.
  2. The ‘Essential’ category of bridges are analyzed for a single earthquake hazard design level event having a 7% probability of being exceeded in 75 years (1,000 year return period) with repairable damage performance criteria.
  3. The ‘Critical’ category of bridges are to be analyzed for two levels: a lower level event having a 7% probability of being exceeded in 75 years (1,000 year return period) with minimal damage performance criteria, and an upper level event having a 3% probability

of being exceeded in 75 years (2,500 year return period) with repairable damage performance criteria.

- Two rock types, soft and hard, are defined in the LRFD Specifications whereas, in NYSDOT Guide Specifications, three rock types soft, hard and very hard are defined.
- Depth to rock ( $H_r$ ) definition: In LRFD Specifications, it is defined as a distance from the bottom of footing to the top of rock surface. In NYCDOT report, it is defined as a distance from the top of ground surface to the top of rock surface.
- Vertical Motion Spectra: In LRFD Specifications, vertical spectra analysis is only required for Seismic Design Category D bridges while the proposed NYCDOT report recommends vertical spectra analysis for all bridge types in any design category.
- Liquefaction Analysis / Evaluation: As per the proposed NYCDOT report, a liquefaction evaluation assessment is required for all bridges which is not the case per LRFD Specifications.
- Seismic Performance Zones: Classification criteria are different in LRFD Specifications and NYCDOT report.

#### **SPECIAL NOTES**

- **Proposals are due by close of business, July 8, 2009.** This Request for Proposals is being offered to the University Transportation Research Center (UTRC) members only. Members should submit proposals through the Administrator of this consortium. The receipt of an electronic PDF copy of the proposal by NYSDOT on or before the above due date is satisfactory, providing hard copies follow within a week.
- **Seven (7) hard copies** of the proposal should be provided.
- The Principal Investigator shall submit brief, written status reports, at least quarterly. Meetings shall be held as needed, but shall not be less than three (3): one prior to the project commencement; one upon the completion of Task 1; and one just prior to the completion of the final report.
- Proposals should indicate direct and indirect costs, hourly rates and hours by task, travel costs, and material costs to assist NYSDOT in understanding how the total cost for the work was estimated. The winning proposal will result in a fixed cost contract based on details provided.
- Please provide a Budget Chart which shows for each task the deliverable and cost. Task headings in the Budget Chart are to match the scope task headings.
- Please include a Gantt Chart, showing the duration (start to finish) for each task in terms of months (i.e. Month 1, Month 2, etc) since the actual start date is an estimate.
- If the proposal involves a joint venture or sub-consultants, it must be clear as to how tasks will be distributed or shared in the scope of work.
- The final report on the research will be expected to contain, at a minimum, the information described in Attachment A, *Requirements for the Final Report*.

- **The designated contacts for this solicitation are Paul Hoole and Deborah Mooney.** Questions seeking clarification on the RFP will be accepted up to three (3) weeks prior to the due date for proposals and should be e-mailed to: [phoole@dot.state.ny.us](mailto:phoole@dot.state.ny.us) **and** [dmooney@dot.state.ny.us](mailto:dmooney@dot.state.ny.us)
- Principal Investigators should be familiar with and follow the requirements of New York State with regard to the *Compliance Procurement Lobbying Law* and consultant contract procurement. Information can be found on the NYSDOT website under Business Center / Doing Business with NYSDOT / Consultants / Non-Architectural Engineering Information / Active Solicitations: <https://www.nysdot.gov/main/business-center/consultants>

## CRITERIA FOR SELECTION

- **Expertise / Understanding / Approach (Weight: 70%)**

**Expertise:** Relevant experience of the Principal Investigator and other co-investigators in the field of seismic bridge design and having knowledge of the current LRFD Seismic Bridge Design Specifications (Force Based Approach), the AASHTO Guide Specifications for LRFD Seismic Bridge Design (Displacement Based Approach), and the USGS Spectra Curves for the State of New York. The research team shall include members with experience in seismology, bridge engineering and geotechnical engineering.

**Understanding of the Problem:** Does the proposal reflect an understanding of the problem and its relevance to New York State? Does the proposal reflect an understanding of existing data and the current state of knowledge in New York State?

**Approach:** Is the proposed approach clear, especially in how it will build upon and enhance the state of knowledge in New York State? Will it yield the deliverables called for in the RFP? Does the approach show insight that will lead to results that will sufficiently assist New York State in addressing the problem? Is the proposed approach practical given the schedule and total budget? Will the proposed research draw upon all critical sources of pertinent information?

- **Investigators Previous Experience with Similar Projects (Weight: 10%)**  
Successful completion of previous projects by the Investigator(s) will be considered. These projects should be in the area of expertise required for successful completion of this project, such as bridge design, structural engineering, geotechnical engineering and seismic engineering.
- **Cost to New York State (Weight: 20%)**  
The lower the New York State cost, the greater consideration a proposal will receive.

**Requirements for the Final Report**

**Copies of Final Report** – **Twenty-five (25)** hard copies of a bound, final report shall be provided at the conclusion of the research study. An electronic PDF copy of the final report is required as well.

**Required Organization for the Final Report**

Title Page (front cover) - that contains:

- The research number (C#) assigned by the Research & Policy Studies Section of the Policy & Planning Division;
- The name of the research study as stated in the Task Assignment (contract);
- The words “Final Report;”
- The date (month & year) the final report is completed;
- The name(s) of the Consultant(s) / Principal Investigator(s), along with the name(s) of the organization(s) they represent and their address(es); and,
- If the final report has a security classification, it shall be noted on the title page.

Disclaimer (inside cover) - as follows:

**DISCLAIMER**

This report was funded in part through grant(s) from the Federal Highway Administration, United States Department of Transportation, under the State Planning and Research Program, Section 505 of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the United States Department of Transportation, the Federal Highway Administration or the New York State Department of Transportation. This report does not constitute a standard, specification, regulation, product endorsement, or an endorsement of manufacturers.

Form DOT F 1700.7 – complete and insert the standard USDOT form used throughout the country to summarize federally funded transportation research

Table of Contents

Executive Summary - a non-technical summary of the research and its findings

Introduction – a discussion of the problem, its background, and a concise history of research previously completed on the topic, and a discussion of what NYSDOT policies, procedures, and practices are currently in place related to the research topic.

Research Method – a description of the methods used in conducting the research

Findings and Conclusions – a discussion on the analysis of the data (findings) and the conclusions reached based on the findings. Suggestions for additional research, if appropriate, would appear in this section.

Statement on Implementation – a brief discussion on what would need to occur to introduce the results into practice, and a discussion on possible technology transfer activities.

Appendices – as appropriate