



## **Pacific Earthquake Engineering Research Center (PEER)**

### **PEER Transportation Systems Research Program Request for Proposals: Solicitation PEER 09-01**

#### **Research strategy**

PEER has continuing funding from the State of California related to the seismic performance of transportation systems. The purpose of this research is to lessen the impacts of earthquakes on California's transportation systems, including highways and bridges, port facilities, high speed rail, and airports. We expect that the research will utilize and extend PEER's performance-based earthquake engineering (PBEE) methodologies and integrate fundamental knowledge, enabling technologies and systems. We further expect that the research program will integrate seismological, geotechnical, structural, and socio-economical aspects of earthquake engineering, and involve computational, experimental and theoretical investigations.

The coordination and integration of projects within the Transportation Systems Research Program (TSRP) will consider how individual projects fit into a matrix described by: (1) project contributions to fundamental knowledge, enabling technologies, or systems integration, and (2) project contributions to advances in the areas of network systems, bridges, ports, or railways. Some projects may be focused in one specific cell of this matrix, while other projects may span across several cells. It is anticipated that investigators will work together as members of an overall team, sharing information and ideas needed for other projects.

The PEER Transportation Systems Research Program is being developed and coordinated with ongoing research efforts of the PEER Lifelines program, Caltrans, and potentially other State DOT's, and with the input and suggestions received from researchers and practitioners in the PEER community. The planning of projects over the next three to five years is taking into consideration how projects may be funded by different organizations, and coordinated to facilitate collaboration and timely exchanges of information. This may result in some research topics being funded in later years so that they benefit from knowledge or tools generated in earlier years.

The number of projects funded under the current PEER TSRP will be ramped up between 2008 and 2010. Commitments will be made to fund some multi-year projects. Some of the 2008-09 funds will be used to develop tools and information needed to initiate subsequent projects. The 2008 call for proposals resulted in the funding of several proposals. The list of the funded projects is posted on the PEER website at: <http://peer.berkeley.edu/transportation/projects.html>. PEER Solicitation 09-01 is the first of two solicitations related to transportation systems research that will be issued in 2009.

This RFP focuses on a select number of topics for the PEER TSRP, taking into consideration the above described coordination with other research programs and the timeline and sequencing of long term efforts. The specific topics are listed at the end of this RFP.



A series of planning meetings and workshops will be held in 2009 to further develop the research plan for coming years and provide input on subsequent solicitations. For example, it is anticipated that meetings will be held on seismic performance of transportation networks (March 2009), performance of structures crossing faults, innovative methods for rapid construction and damage control for bridges, seismic issues for ports, and the modeling of abutments for bridges.

The PEER TSRP is coordinated by a Transportation Research Committee (TRC) consisting of Ross Boulanger, Yousef Bozorgnia, Joel Conte and Stephen Mahin. The TRC is committed to fostering a diverse mix of educational and collaborative opportunities across the PEER community. This includes opportunities for researcher and practitioner interactions. The TRC may approach proposers to negotiate possible revisions to scope and budget to better fit overall program goals.

Many of the projects are interrelated and it is anticipated that investigators selected will interact with the TRC and other PEER investigators to help achieve the overall goals of the TSRP. Investigators are expected to attend two coordination meetings each year. To maximize development of accessible computational tools that can be used to model transportation systems, it is expected that the primary computational framework used in these investigations will be OpenSees.

### **Process & important dates**

Proposals should be submitted using the **attached form**. The project description should not exceed two pages, and a two page biographical sketch of the PI(s) should be included along with a one page draft budget. Final budgets with campus Sponsored Project Office (SPO) approval can be prepared after selection of successful proposals and agreement on scope and budget.

Proposals **should be submitted on-line** at:

[http://peer.berkeley.edu/transportation/request\\_for\\_proposals.html](http://peer.berkeley.edu/transportation/request_for_proposals.html)

The **key dates** for responding to Solicitation PEER 09-01 are:

**March 20, 2009:**      **Proposals due online.**  
**April 10, 2009:**      Successful proposals will be identified, and paperwork for funding initiated.

The proposals will be reviewed by a small ad hoc review committee and administered by the TRC.

In 2009, PEER will hold a series of meetings and workshops to refine and extend the strategic research plan. You will be informed of opportunities for participation in these activities later. The next solicitation is anticipated mid 2009 so that funded projects can be initiated by the end of summer.

### **Budgetary constraints**

Budgets should be limited to one month of summer support (or its equivalent) for the PI, one graduate student researcher, reasonable miscellaneous funds (travel to two PEER



coordination meetings per year, other travel, computing, and supplies), and any other costs specific to the type of proposals (e.g., costs of experiments, meetings, etc.). Due to the source of funds for the TSRP, the indirect costs recovery rate for University of California campuses is zero. Other campuses and organizations are also strongly encouraged to waive their overhead.

### **Other requirements**

For this solicitation, strong preference will be given to funding proposals by principle investigators from *PEER core institutions*. *PEER Business and Industry Partners (BIPs)* interested in this solicitation are encouraged to collaborate with the researchers at PEER's core institutions and submit a joint proposal.

### **Specific research topics for this solicitation:**

Proposals are solicited for research on the following topics. Note that projects will not necessarily be awarded in all topic areas, and multiple projects in some areas are possible. PEER will provide the ground motion ensembles to be used in Topics 3 and 4.

#### **1. Ground motion studies for improving PBEE analysis and design**

Assessment and design of structures based on PBEE methodologies depend on the ground motion ensembles selected to characterize earthquake hazards. PEER is interested in research that would help assess and improve how these ground motions are selected for various types of PBEE studies. The focus of this work is not to improve the efficiency of the Intensity Measures used to characterize records, or to minimize the number of records that are needed to estimate median response, but rather to understand better how recorded and various types of simulated ground motions may be used to improve understanding of the overall performance of multi-degree-of-freedom transportation structures. The specific topics of interest include:

- (a) Comprehensive comparison of engineering characteristics of recorded and simulated ground motions for the near- and far-field areas in the western US. The simulated ground motions can be numerically and/or stochastically generated (Target project duration: 1 year).
- (b) Improvement of Incremental Dynamic Analysis (IDA) methodology, with applications to multi-degree-of-freedom systems (Target project duration: 1-2 year).

#### **2. Enhancing the economy and seismic performance of a high-speed rail system**

This project would perform a state-of-the-art review at the international level regarding seismic design issues for high speed rail systems, summarize best practices, and identify any high priority research topics that PEER in partnership with others could undertake to improve economy, while increasing confidence in seismic performance. The PI may be expected to communicate effectively with the international high speed rail community, engineering representatives of the California High Speed Rail Authority and others, and consider the specific conditions that are anticipated along the proposed alignment of a planned high-speed train system in California. The PI would seek connections with national and international organizations and individuals with seismic expertise on high-speed-



train systems, including arranging technical meetings and exchanges. The PI would coordinate (in conjunction with the TRC) participation in such meetings of a small group of PEER researchers (faculty, researchers, or students) and Business and Industry Partners. International travels for the PI and students to collect data and information from the international high-speed-rail communities are encouraged. The PI would seek input from these and other sources as part of putting together the state-of-the-art report and recommendations for priority research topics (Target project duration: 1 year)

### **3. Detailed PBEE studies of a next generation bridge system**

It is desired to apply the PEER PBEE methodology to assess the seismic performance of a particular type of next generation bridge, and in so doing improve the underlying theoretical and empirical basis of the PEER PBEE methodology as needed, and identify the characteristics of the bridge system that are most effective in improving performance. Previously, detailed PEER investigations have been performed on partially prestressed, reinforced concrete self-centering bridges and conventional reinforced concrete bridges situated on firm soil sites as well as on sites susceptible to liquefaction. Currently, a pilot PBEE study is underway to assess the relative performance of a simplified bridge system constructed using rapid modular construction or fiber reinforced concrete, or employing rocking foundations, self-centering technologies and seismic isolation. Proposals are now being sought that extend these studies to include in-depth consideration of issues related to one particular type of bridge system. Specific issues of interest include bridges (a) having curved, irregular or other configurations that might induce higher than expected demands, (b) situated on soil conditions that may impose special demands, or (c) incorporate advanced technologies such as foundations that are permitted to uplift, modular or precast construction procedures, seismic isolation or other innovative strategies. Due to budget limitations, proposals should focus on one such issue. The accepted team is expected to work with the Transportation Research Committee to develop the testbed bridge configuration. This testbed may be used by others for future PBEE assessments of other bridge types. Multi-investigator teams may be proposed to cover the range of expertise needed. (Target project duration: 2 year)

### **4. Application of advanced technologies to improve bridge performance**

A number of opportunities exist to reduce the construction cost, accelerate construction speed and minimize post-earthquake damage for bridge systems. Current PEER investigations focus on the use of fiber reinforced concrete and seismic isolation in bridge construction. Proposals for new research projects are requested related to other advanced technologies, including use of hollow cast-in-place or precast columns, various forms of self-centering columns in monolithic or precast structures, new materials (engineered cementitious composites, special steels, etc.), innovative approaches for confinement of non-circular columns, composite members including stay-in-place forms, and so on. Due to budget limitations, proposals should focus on one approach. Proposals including laboratory testing are encouraged. (Target project duration: 2 years)