PEER-Bridge Program Request for Proposal (RFP) 25-01
Proposal Submission Deadline: June 30, 2025

Overview of the PEER-Bridge Program

PEER-Bridge Research Program is a streamlined framework of long-standing Caltrans bridge research program. A single master contract was established between Caltrans and PEER, and different projects are executed as Task Orders under the master contract.

Project topics are selected by Caltrans in consultation with PEER Headquarters. PEER administers a request-for-proposal (RFP) for each of these topics. Caltrans and PEER will review the proposals and decide on final selection(s). Selected proposals will be executed as Task Order agreements, and PEER will issue a subaward to the Principal Investigator's university.

In accordance with funding agency requirements, for this RFP, only public universities are eligible to submit proposals. That is, the Principal Investigator (PI) must be affiliated with one of the following universities: UC Berkeley, UC Davis, UC Irvine, UC Los Angeles, UC San Diego, Oregon State University, University of Nevada – Reno, and University of Washington. The Co-PI's or collaborators may be from any public or private institution. Cost for private institutions cannot exceed $50,000.

Proposals are solicited for two topics, described as RFP 25-01 (this one) and 25-02. **To ensure broader participation from the PEER community, a researcher may be the PI or co-PI on only one of the two solicitations 25-01 and 25-02.**

Problem Statement #2 for RFP 25-01

Title

Fatigue Evaluation and Design of Filled and Partially Filled Metal Grid Deck Systems

Objective

This research is to develop rational fatigue evaluation and design criteria based on advanced analysis methods and experimental testing for filled and partially filled metal grid deck systems. The following are the main objectives of this study:

- Conduct fatigue and behavior testing on filled and partially filled grid deck systems to determine critical performance factors that affect the fatigue performance of such systems.
- Develop rational fatigue evaluation and design criteria, including calculation and modeling techniques validated by testing, for each of the grid deck systems studied. This will establish consistent testing protocols and fatigue thresholds for evaluating various deck systems to address durability, strength, service, fatigue (including considerations for HL-93 and permit loading where appropriate), deflection, and other performance factors.
- Prepare recommended revisions to Caltrans Design Specifications for highway bridges based on the research results.
- Develop a methodology to assist designers in the preliminary sizing and selection of appropriate grid deck systems from various manufacturers, potentially for use as an Authorization Criteria for the Caltrans Approved Materials List (AML).

Background

Although not often recognized for their significance by the motoring public, deck elements of highway bridges are important components for an efficient highway system. The robust performance of these components over the long term is critical for smooth daily traffic operations as well as adequate bridge system performance during extreme events. Failure of bridge deck systems results in direct economic costs associated with maintenance, repair, and replacement. These costs include traffic delays to the motoring public, environmental impacts of energy consumption, and generation of construction and demolition waste.

Lightweight grid decks, such as filled and partially grid decks, are becoming more widely used, particularly for bridge construction where deck weight is a critical factor. They can increase the live load capacity and eliminate the need for costly superstructure and substructure, thereby extending the useful life of these structures. Those deck types can also reduce construction times to suit the ABC philosophy of "get in, get out, and stay out." Hence, lightweight grid deck systems can offer many advantages to Caltrans with sufficient in-service performance for bridges. Caltrans needs research that will result in robust fatigue evaluation and design provisions for selected grid deck systems that will provide reliable long-term performance for the intended application.

Causes of deck system failures range from load-induced fatigue due to primary stresses and dynamic loads to degradation of the deck materials or components in an unreasonably short service life. A key issue associated with decks, compared to other superstructure components, is the direct application of wheel loads to the elements. This has the effect of producing millions of strain cycles. Poorly designed and detailed deck components can accumulate damage very quickly. For this same reason, demands on the deck, in terms of durability, vary dramatically from site to site, based on the local traffic conditions.

Presently, there are no recognized uniform comprehensive national specifications for the design, performance, or construction installation of grid deck systems, particularly concerning fatigue design and fatigue details (e.g., punched holes, welds, and sharp corners). It has resulted in questionable in-service performance of some grid deck systems. In addition, manufacturers often have proprietary design information, making it difficult for Caltrans to independently verify designs or develop standardized criteria. What we need is to develop practical design criteria in consideration of manufacturer design specifications and standards.

Requirements

This research as a minimum shall include the following tasks:

- Literature Review: Conduct a comprehensive review to identify available data and knowledge gaps, including a review of existing AASHTO, FHWA, and other State DOT Specifications, standard practices, and define serviceability and strength requirements, and collect information on existing design criteria, calculation methods, and fatigue performance from manufacturers for open, filled, and partially filled metal grid deck systems.
- Development of Experimental and Analytical Programs:
    - Identification of representative filled and partially filled grid deck systems for testing, potentially including systems from different manufacturers.
    - Development of testing protocols for large-scale, high-cycle fatigue tests and dynamic deck loads to simulate in-service conditions. Boundary conditions should accurately reflect the worst-case fatigue and dynamic loading.
    - Develop design criteria for Strength and Service Limit State addressing fatigue concerns by establishing acceptable fatigue stress ranges and thresholds for all steel grid components.
    - Establish factor of safety (FS) associated with system internal composite action including assessment of system composite threshold during all fatigue cycles.
    - Protocols for evaluating the impact of critical fatigue details commonly found in grid deck systems.
    - Consideration of different load types relevant to fatigue (e.g., AASHTO fatigue truck, potential permit load considerations).

- Execute Experimental and Analytical Studies: The experimental study portion is the largest part of the project and will include multiple large-scale high-cycle fatigue tests of various deck systems.
- Develop Evaluation and Design Provisions: Based on the experimental and analytical results, develop:
    - Rational fatigue evaluation procedures and design provisions for filled and partially filled grid deck systems.
    - Proposed calculation and modeling techniques for strength, serviceability, and fatigue, enabling Caltrans engineers to perform independent analyses and designs.
    - Recommendations for fatigue categorization or specific fatigue resistance data (S-N curves/thresholds) for common details found in these deck systems.
    - Guidelines for assessing and ensuring long-term composite action in partially and fully filled systems.
- Final Project Report and Recommendations: Summarize all research tasks and findings in a comprehensive final report. This report is intended to include:
    - A list of acceptable deck systems that have been tested and found to meet the defined serviceability, strength, and fatigue requirements, which could serve as a basis for the Caltrans Approved Materials List (AML).
    - Recommended revisions for Caltrans Design Specification for highway bridges.
    - A proposed methodology or design aid to help Caltrans engineers in the preliminary sizing and selection of grid deck systems.
    - Compare manufacturer's deck sizing systems to the Caltrans deck sizing methodology.
    - Recommendations on how to engage with vendors regarding their design criteria and fatigue analyses.

Special consideration will be given to teams with extensive experience and expertise in steel fatigue, concrete and steel mechanics/material testing, and mechanical engineering.

Project Duration: 36 months (**RFP decision: July 15, 2025, with an Expected Project start date: April 1, 2026**)

Project Budget: $1,000,000 (including 35% overhead and indirect costs)

Proposal Submission Instructions

1. According to the Master Agreement between the funding agency and the University of California, Berkeley, **for this RFP**, only public universities are eligible to submit proposals. That is, the Principal Investigator (PI) must be affiliated with one of the following universities: UC Berkeley, UC Davis, UC Irvine, UC Los Angeles, UC San Diego, Oregon State University, University of Nevada – Reno, and University of Washington. The Co-PI's or collaborators may be from any public or private institution.
2. Description of the PEER-Bridge Research Program and other PEER-related programs including active projects are available at https://peer.berkeley.edu/research/PEER-Bridge.
3. Proposals should be prepared using the form in the above site and should include five-page project description, two-page biographical sketch of each key person and a one-page budget (linked to an Excel Spreadsheet). A one-page budget justification can be included. At this stage, the proposal need not be submitted via the institution's official sponsored project office.
4. Proposals should be uploaded at the above site before the submission deadline indicated in the title of this document. A single PDF document may be uploaded with the filename in this format: **<PI's last name>_<PB25-01>_<optional title less than 20 characters>.pdf**.

Other Requirements

Investigators must commit to the following:

1. Working as part of the overall PEER-Bridge team, and sharing information, data, models, outcomes and ideas needed for other projects,
2. Attending at least three meetings per year for the funding duration: the PEER Annual Meeting (usually held in January), the PEER Researchers' Workshop (usually held in August), and a PEER-Bridge specific meeting in April or May,
3. Submitting a research highlight at the beginning of the project for distribution to the PEER and Caltrans community,
4. Writing a PEER report at the end of the project (no later than 3 months after the completion of the project),
5. Along with the PEER report, submitting a two-page high-level summary of the project ("research nuggets"), that summarizes 'Why', 'How' and 'What' of the project along with 'Who benefits' (please refer to the research nuggets template in the above website),
6. In the case of two-year projects, submitting a detailed progress report at the end of the first year, along with a plan for the second year, for review by PEER and Caltrans,
7. Making data available to Caltrans and PEER community in an open-source format at the end of the project (allowing for reasonable journal publication requirements by the research team), and
8. Acknowledging PEER and Caltrans in all oral presentations and written papers/articles/reports on the project.

It is expected that the proposing institution will include indirect costs, as determined by the institution and Caltrans. Final budgets with campus sponsored projects office approval can be prepared after the initial selection of successful proposals and any negotiated agreement on the scope and preliminary one-page budget.