



PEER-Bridge Program Request for Proposals (PEER-BRIDGE 20-01)

Proposal Submission Deadline: May 8, 2020

Objective

Develop a new LRFD-based bridge deck design procedure that accounts for modern trucks, dynamic (rolling) loads, shear demands, and concrete fatigue. The procedure should include two design tiers: 1) a rigorous analysis, incorporating the use of a computer code, and 2) a streamlined chart-based procedure suitable for production design.

Background

The current deck design procedure is based on a transverse strip approximation, i.e., a flexural beam analogy, and was initially developed in the 1930's then improved in the 1940's and 1950's. Several assumptions and approximations in this procedure are no longer valid. For example, current design procedures utilize a simple beam approximation instead of more realistic two- or four-sided plate theory. Moreover, current design trucking loads and wheel configurations do not reflect modern trucks. Bridge deck design in the current AASHTO *LRFD Bridge Design Specifications* uses a 32-kip 2-wheel design axle load that has been in use since 1944. Tandem, tridem, and 8-tire axles are now common as are wider tires. Some vehicle configurations mandated or allowed by federal programs such as Special Hauling Vehicles (SHV) and Emergency Vehicles (EV) do not meet the California Vehicle Code (CVC), but must be used in the designs. The current trend of increasing axle loads, and truck volume are projected to continue, and these impacts must be considered using modern concrete fatigue models.

Requirements

The proposed design method should include the use of a more realistic deck model that replaces the current approximate "strip model". The method should also include the effects of rolling loads, shear, and concrete and reinforcing steel fatigue. Development of a new concrete fatigue model, unless an extension of recent work, is beyond the scope of this project. A review of available concrete fatigue models in literature should be included in the final report along with an explanation of why a model was chosen for the design procedure development.

The recommended procedure should include two design tiers: 1) a rigorous analysis, incorporating the use of a computer code, and 2) a streamlined chart-based procedure for production design. The latter should be concise and rely on charts, tables and/or graphs to expedite the work of the bridge designer.

Additional project guidance and summary are listed as follows:

1. Develop methodology for refined deck analysis. Generate (1) computer-based analysis and (2) design chart-based simplified design procedure.
2. Dynamic vehicle suspension models do not need to be incorporated into the analysis. Caltrans Technical Panel will provide rolling/moving loads guidance based on soon-to-be-completed work.
3. Deck flexural, shear, and fatigue behaviors must be investigated.
4. Required vehicle loads: HL-93, California P15, EV, and SHV.
5. Wheel loads must be modeled as patch loads per CVC and approved by the Caltrans Technical Panel.
6. AASHTO with California Amendments Load Combinations and Load Factors apply.
7. Survey and carry out literature search on available concrete fatigue models. Identify appropriate concrete fatigue model for practical use as a design method.
8. AASHTO reinforcing bar fatigue model applies.
9. Perform parametric studies on various deck/support systems and configurations considering system stiffness and rigidity (Support systems and configuration to be provided).

10. Minimum deck thickness of 8 inches applies.

Project Duration: 24 months & **Max. Available Total Budget, Including 30% Overhead:** \$300,000

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. Co-PIs or collaborators may be from public or private institutions.
2. Description of the PEER-Bridge Research Program, forms and other details are available at <https://peer.berkeley.edu/research/PEER-Bridge>.
3. Proposals should reflect the described entire scope of work. It is expected to fund one project. However, depending on the submitted proposals, in addition to this single award, one more project may be partially funded if it adds significant value to the general effort.
4. 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 institution's official sponsored project office.
5. 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>_<PB2020-1>_<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 each year of funding: 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 project completion),
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 guidelines document at <https://peer.berkeley.edu/tools-funded-peer-researchers>),
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 documents of the project.

It is expected that proposing institutions will waive indirect costs, as is the practice for University of California institutions. 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 the preliminary one-page budget.