I – Research Problem Title (04-EQ089)

Guidelines for the Seismic Design of Steel Girder Bridge Superstructures

II – Research Problem Statement

Question: How can we improve the seismic design and construction of steel girder bridges?

Develop guidelines for seismic design of straight and skewed steel plate girder bridge superstructures and their bearings based on analytical study and experimental verification.

III – Objective

The research objective is to develop seismic design guidelines for the following components of straight and skew steel plate girder bridge superstructures: deck, cross frames, shear connectors, bearings and their attachments to bent caps.

IV – Background

Although the first edition of "Guide Specifications for Seismic Design of Steel Bridges" was published in December 2001, there are many seismic issues for steel bridges remaining to be solved.

Recent experimental investigations funded by Caltrans and FHWA exposed the vulnerabilities of steel plate girder bridges during seismic events. The experimental investigation was carried on a single span two-girder bridge. Although the results of this investigation shed some light on the behavior of steel bridges, questions remain about the adequacy of this model in representing the framing action of steel bridges.

The proposed investigation will include experimental and numerical studies on a model with several girders and a bent cap. This model will be subjected to bi-axial excitations on the shake tables to establish the design guidelines of the superstructure and bearing components. The proposed design guidelines will be developed in close cooperation with Caltrans design engineers so it can be incorporated in Caltrans Seismic Design Criteria.

V – Statement of Urgency and Benefits

A. Support of the Department's Mission/Goals:
(Improving Mobility: Safety and Reliability) There are about 3000 steel highway bridges in California. However, there is no detailed design provision in the current Caltrans Seismic Design Criteria. Development of practical guidelines for the seismic design of straight and skew steel plate girder bridge superstructures and their bearings is urgent.

B. Return on Investment:

It is expected that the results of this research will be incorporated in the Caltrans Seismic Design Criteria for steel superstructures, several Memo-to Designers and design examples. Seismic design specifications for steel girder bridges are required for California bridges. Addressing this problem will result in improved design and construction details for steel girder bridges, resulting in improved safety, and potentially reducing long term life cycle costs by up to $X through a reduction in construction claims and/or reduced maintenance costs resulting from improved structural performance.

VI – Related Research

- *"Cyclic Behavior of Cross Frames in Steel Bridge Superstructures"*, UNR, Funded By Caltrans, 2000-2002
- *"Seismic Load Path and Dynamic Behavior of Steel Bridge Superstructures"*, UNR, Funded by FHWA

VII – Deployment Potential

Caltrans SDC will benefit from this research:

- More detailed design guidelines for steel girder bridge components
- Further understanding of cyclic behavior of steel girder bridges and several bearing systems that are used by Caltrans.