This manual, entitled *Seismic Retrofitting Guidelines for Complex Steel Truss Highway Bridges* (referred to as *Guidelines* in this document), collects and summarizes the state-of-the-practice, up to 2005, for retrofitting steel truss bridges on the highway system within the United States. These *Guidelines* are based on and are supplementary to the *Seismic Retrofitting Manual for Highway Structures Part 1: Bridges* (referred to in these *Guidelines* as the *Bridge Retrofitting Manual*), developed by the Multidisciplinary Center for Earthquake Engineering Research (MCEER), to be published by the Federal Highway Administration (FHWA) in 2006.

The *AASHTO Standard Specifications for Highway Bridges* generally apply to the design of new “ordinary” highway bridges with spans less than 500 ft and with a design life of 75 years. The *AASHTO Standard Specifications for Highway Bridges* also suggest that supplemental specifications may be required for the design of new highway bridges of “unusual types,” or for the design of “long-span” bridges with spans longer than 500 ft. These two bridge classifications usually have design lives of 100 years or more.

Similarly, the seismic retrofit design of existing bridges can also be separated into “ordinary” highway bridges, “unusual” types of highway bridges, and “long-span” highway bridges with spans greater than 500 ft. These *Guidelines* function as a special supplemental document to the *Bridge Retrofitting Manual* for the seismic retrofit design of “unusual” types of highway steel trusses or for “long span” highway steel trusses, with spans longer than 500 ft.

The *Bridge Retrofitting Manual* focuses on the design of the seismic retrofitting of “ordinary” highway bridges. It is intended to be applicable nationwide for ordinary concrete substructures and for ordinary steel and concrete girder-type highway bridges.

The *Bridge Retrofitting Manual* divides ordinary highway bridges into two classifications, “essential” and “standard,” by their expected performance after a seismic event. Essential bridges are all bridges that are expected to function after a seismic event by continuing to carry traffic. Standard bridges are all other ordinary highway bridges, which may sustain minor to serious damage after a seismic event (but preserve life safety) and may need extensive repair or replacement.

These *Guidelines* also define two classifications of highway steel trusses by their truss configurations: “seismically standard” trusses, which are “ordinary highway bridge” trusses; and “seismically complex” trusses, which are the “unusual” types of highway steel trusses and “long-span” highway steel trusses. All highway truss bridges that meet the classification of “essential bridges” in the *Bridge Retrofitting Manual* are automatically classified as “seismically complex” trusses in these *Guidelines*.

As in the *Bridge Retrofitting Manual*, a performance-based seismic retrofit philosophy is used in these *Guidelines* with performance criteria specified for two earthquake ground motions: a *lower level* earthquake with a mean return period of 100 years, and an *upper level* earthquake with a mean return period of 1,000 years. For the “seismically standard truss” classification, a higher
performance requirement is specified for the lower level earthquake than for the upper level earthquake. For the “seismically complex truss” classification, a higher performance requirement is specified for both lower level and upper level earthquakes, because seismically complex trusses have special structural configurations that behave under seismic excitation in a complex manner; thus they require a higher standard of seismic retrofit.

These Guidelines are written primarily for practicing bridge design engineers who have some familiarity with the seismic retrofitting design of ordinary steel and concrete girder bridges. Experience in the applications of more advanced design techniques such as nonlinear analysis, soil-foundation-structure interaction, and experience with bridge construction methods are helpful in applying these Guidelines. U.S. customary units are used rather than SI units because they were used in the construction of most of the truss bridges that will require seismic retrofitting.

While these Guidelines cover all of the major aspects pertinent to the seismic retrofitting of steel truss bridges, its focus is on superstructure (including steel support towers) retrofit, and it does not include explicit guidelines for foundation retrofit. However, general guidelines on foundation modeling related to bridge structures have been provided in these Guidelines and can also be found in two existing MCEER publications [PoLam et al., 1998; PoLam and Law, 2000]. The latter publication addresses issues related to foundation modeling and soil-structure interaction analyses for large pile groups and caissons often associated with steel truss bridges. A third publication, Bridge Foundations: Modeling Large Pile Groups and Caissons for Seismic Design [Martin] is in preparation.

Theses Guidelines comprise seven chapters on the technical application of the seismic retrofitting of steel truss highway bridges:

1 Introduction
2 Retrofitting Philosophy and Process
3 Screening and Prioritization
4 Structural Analysis
5 Design Parameters
6 Evaluation of Members, Connections and Subsystems
7 Retrofit Measures, Approach and Strategy

Three additional chapters provide supporting information:

8 Case Studies
9 Glossary
10 References and Bibliography