Seismic Evaluation of Long Span Bridge Tower Components

Ahmad M. Itani, Ph.D., P.E.
Associate Professor of Civil Engineering
Department of Civil Engineering
University of Nevada, Reno, NV 89557, USA

Abstract

Recent earthquakes exposed the vulnerability of bridge towers in transferring the loads during earthquakes. This paper discusses the seismic evaluation of tower components for three California long span bridges. Large-scale experiments were conducted on the components of these towers to evaluate their performance, ultimate strength and failure mode under large cyclic deformations. One-half scale riveted laced members with end restrained were tested under cyclic axial deformations. These members are similar to the tower members of the San Francisco-Oakland Bay Bridge and the Richmond San Rafael Bridge in the California Bay Area. Experimental results showed that the lacings play an important role in connecting the components of the built-up laced member. However, due to the flexibility of the lacings, the built-up member did not act as a one unit, causing it to buckle under less than expected buckling load.

The cyclic evaluation of shear links that are being used to retrofit the Richmond San Rafael towers will be discussed. Full-scale experiments were conducted on built-shear links to determine their response and ultimate capacity under cyclic deformations. The results of these tests showed that the ultimate capacity of built-up link exceeded the code specified values by almost fifty percent. This finding had a detrimental effect on the design of eccentric braces and their connections.

This paper will also discuss the results of the experimental testing of dual one-half scale built-up bolted links that will be used in the new San Francisco-Oakland Bay Bridge towers. The proposed new tower consists of built-up shear links that connect its four legs. These shear links will act as a fuse to dissipate the input energy during seismic events. The details of these shear links utilized High Performance Steel (HPS) in their connections to ensure that these connections will stay in the elastic range.