Seismic Instrumentation of the Hernando- Desoto I-40 Bridge in Memphis, Tennessee

Shahram Pezeshk, The University of Memphis
Department of Civil Engineering
The University of Memphis, Memphis, TN 38152

Mitch Withers, The University of Memphis
Center for Earthquake Research and Information
The University of Memphis, Memphis, TN 38152

Mehmet Celebi, U.S. Geological Survey
USGS (MS977), 345 Middlefield Road, Menlo Park, Ca. 94025

ABSTRACT

The Hernando-Desoto I-40 bridge is located about 54 km to the southwestern segment of the New Madrid seismic zone (NMSZ), which is regarded by seismologists, engineers, and public officials as the most hazardous seismic zone in the Eastern United States. Thus, Memphis and Shelby County are potentially exposed to significant seismic hazards. A large earthquake occurring anywhere within the NMSZ could cause widespread loss of life with damage to buildings, bridges, and lifelines due to ground shaking and ground failure induced by the earthquake.

The purpose of this paper is to describe the development and installation of a seismic instrumentation system that has been proposed to be deployed on and in the vicinity of the I-40 Hernando DeSoto Mississippi River Bridge in Memphis, Tennessee. This bridge has been retrofitted to withstand a magnitude (m_b) 7 event at 65 km distance from the site with a depth of 20 km. The goal of the retrofit is to have this bridge fully operational following the maximum probable earthquake (2500 year return period). As part of the I-40 bridge retrofit, Friction Pendulum™ Isolation Bearings are used to insure the integrity of the main spans of the bridge.

The bridge motion is measured by sensors in transverse, longitudinal, and vertical directions. These sensors record the motion at bridge piers above and below their isolation bearings and at the mid-spans of the main span. Using data recorded by these sensors, we can establish the dynamic characteristics of the bridge, such as vibrational mode shapes, structural periods, and main span deflections in the longitudinal, the transverse, and the vertical direction. The torsional response is estimated from the motion recorded by pairs of sensors placed on opposite sides of the bridge deck and measured by rotational sensors installed along the principal axis of the structure. The effect of base-isolation will be estimated by comparing the motion recorded above and below the isolation bearings.