Structural Engineering Seminar Series

CEE 595 S

A Novel Technique for Self-Centering Shear Keys in Highway Bridges

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Abstract:

Shear keys are critical bridge components designed to limit transverse unseating, rotation, and collapse of the superstructure during strong earthquakes, as well as to absorb braking forces and other self-equilibrating loads. However, during the 2010 Maule earthquake in Chile, widespread shear key failures highlighted their limitations, leading to partial or complete bridge collapses. Even where shear keys appeared effective, significant superstructure offsets required costly repairs, and retrofits of undamaged bridges were necessary to address the inadequate seismic performance of the infrastructure. This study examines the shortcomings of conventional shear key designs and introduces an innovative self-centering shear key concept aimed at eliminating residual displacements in the superstructure. The proposed design leverages the bridge's self-weight as a restoring force and utilizes its inherent kinematics to ensure self-centering after seismic events. This concept was validated through nonlinear time history analyses for a representative Chilean bridge. Results demonstrate that the self-centering shear key minimizes residual displacements while maintaining the substructure's elastic response, with a manageable increase in seismic demand.

Bio:

José Wilches is a professional faculty and assistant professor of Physics, Engineering, and Astronomy at Augustana College in Rock Island, Illinois. He has expertise in the seismic performance of bridges, numerical modeling of steel-concrete composite connections, and seismic assessment of storage tanks. His professional experience spans consulting and construction, where he has worked across various sectors, including industrial, buildings, and infrastructure. He earned his Bachelor of Science in Civil Engineering from Rafael Núñez University Corporation in Cartagena, Colombia. José went on to receive a Master of Engineering and his first PhD from the Pontifical Catholic University of Chile, followed by a second PhD from Virginia Tech, USA. Afterwards he spent two years as President's Postdoctoral Fellowship Program at UC San Diego. José is the Founder and current President's of the Building the Future of All Foundation (https://www.construyendoelfuturotodos.org)

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1310 Yeh Student Center