

The Department of Civil and Environmental Engineering at the University of Houston presents...

CIVE 6111 Graduate Seminar

Rocking Isolation: An effective strategy for limiting forces, permanent displacements, damage and cost



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Southern Methodist University, Dallas, Texas

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2:45pm-3:45pm

Classroom Business Building (CBB) - Room 122

Zoom: <https://uh-edu-cougarnet.zoom.us/j/97662524208>

Abstract

The uplifting and rocking of slender, free-standing structures when subjected to ground shaking may limit appreciably the seismic moments and shears that develop at their base. While the unparalleled seismic performance of rocking isolation has been documented with the through-the-centuries survival of several free-standing ancient temples; and careful post-earthquake observations in Japan during the 1940's suggested that the increasing size of slender free-standing tombstones enhances their seismic stability; it was Housner (1963) who elucidated a size-frequency scale effect and explained that there is a safety margin between uplifting and overturning; and as the size of the column or the frequency of the excitation increases, this safety margin increases appreciably to the extent that tall, free-standing columns enjoy ample seismic stability. This talk revisits the important implications of this post-uplift dynamic stability and explains that the enhanced seismic stability originates from the difficulty to mobilize the rotational inertia of the free-standing column. As the size of the column increases, the seismic resistance (rotational inertia) increases with the square of the column size; whereas, the seismic demand (overturning moment) increases linearly with size. The same result applies to the articulated rocking frame given that its dynamic rocking response is identical to the rocking response of a solitary free-standing column with the same slenderness; yet, larger size. The talk concludes that the concept of rocking isolation is a unique seismic protection strategy for large, slender structures such as tall valley bridges—not just at the limit-state but also at the operational state.

Bio

Professor Nicos Makris, an internationally recognized expert in structural-earthquake engineering and structural mechanics-dynamics, is the Addy Family Centennial Professor in Civil Engineering at Southern Methodist University, Dallas, Texas. Makris received his Ph.D (1992) and Master of Science (1990) from the State University of New York at Buffalo, USA; while he holds a Diploma in Civil Engineering from the National Technical University, Athens, Greece (1988). He has previously served on the faculty of the University of Notre Dame, Indiana (1992-1996); the University of California, Berkeley (1996-2005); the University of Patras, Greece (2003-2019) and the University of Central Florida (2014-2018). He has published more than 123 papers in archival journals with an H-index=59 (Spring 2022); while he has supervised 14 Ph.D. thesis and more than 40 MSc and 5th year Diploma thesis. He has served as the Editor of the Journal *Earthquakes and Structures*; the Associate Editor for the *Journal of Engineering Mechanics, ASCE*, and the Chair of the Dynamics Committee on the same Journal. He is a member of Academia Europaea “The Academy of Europe”, a Fellow of the American Society of Civil Engineers (ASCE), distinguished Visiting Fellow of the Royal Academy of Engineering, UK, a member of the Congress Committee and General Assembly of the International Association of Theoretical and Applied Mechanics (IUTAM); while, he has been honored with several international prizes and awards including the *J. James R. Croes Medal* from the ASCE, the *Walter L. Huber Civil Engineering Research Prize* from ASCE, the *T. K. Hsieh Award* from the Institution of Civil Engineers, U.K., the *Shah Family Innovation Prize* from the Earthquake Engineering Research Institute (EERI), USA and the *CAREER Award* from the National Science Foundation, USA.

During the years 2003-2009, Professor Makris has served as the Director of Reconstruction of the Temple of Zeus in Ancient Nemea, Greece: <https://www.youtube.com/watch?v=LsxPSeWS52Q>