Description of Research Accomplishments of Professor Nicos Makris

a) Nicos Makris has conducted pioneering work on the application of fractional calculus to develop viscoelastic models that approximate the strong frequency dependence of seismic protection devices (A4, A7, A11) and he extended the concept of fractional differentiation to complex-order time derivatives (A7, A10). Although the concept of complex differentiation was well established in the mathematical literature since the beginning of the 20th century, Professor Makris' contribution appears to be the first application of complex derivatives in viscoelasticity. He has also conducted ground braking work on the representation of non-integer derivative constitutive models in three dimensions (A33). Professor Makris' research on the implementation of modern technologies for the seismic protection of civil structures also includes the design, analysis and development of an electrorheological (ER) fluid damper (A25, A26, A27, A28). Most of the ER-dampers proposed in the past involve shear flow. The contribution of Nicos Makris is an innovative damper design that generates plastic flow through concentric cylinders (Hagen-Poisseuille flow). This innovative design, which was supported by the industry, was presented in a paper (co-authored with D. P. Taylor, B23) that was awarded the Henry C. Pusey Award by the Program Committee of the 67th Shock and Vibration Symposium. Professor Makris proceeded with theoretical and experimental studies on damping devises by investigating problems related to the viscous heating of fluid dampers (A36, A37, A59) and the causality of phenomenological constitutive models with emphasis on nearly frequency independent dissipative models (structural damping, A34, A35, A66). In recognition of this work he received the 1999 Shah Family Innovation Prize from the Earthquake Engineering Research Institute, USA and the 2001 Walter L. Huber Civil Engineering Research Prize from the American Society of Civil Engineers.

b) Professor Makris has conducted fundamental work on the rocking response and stability of free-standing and anchored slender structures and explained several "counterintuitive" results which derive from their strong nonlinear behavior (A42, A43, A47), while he developed the concept of the rocking and overturning spectrum (A48). This work received wide acceptance and is now recommended to the design professionals by the FEMA 356 (2001) Guidelines issued from the Federal Emergency Management Agency, USA. His interest on this subject was further fostered during his tenure as the Director of Reconstruction of the Temple of Zeus at Nemea, Greece (2004-2009) and he extended his studies on the seismic response of multidrum classical columns (A56). He has also investigated the response of related structures such as: (a) a rigid block rocking on a viscoelastic foundation (A60, A61), and (b) a rigid block standing free on a seismically isolated base (A77). At present, Professor Makris is investigating the static and dynamic stability of masonry arches.

c) Professor Makris has conducted important work on the seismic response analysis and monitoring of bridges (both conventional and seismic isolated) accounting for soil-structure-interaction. His work shows a logical continuation from the prediction of recorded bridge response with soil-structure-interaction (A16, A20) and the investigation of the role of approaching embankments (A45, A46, E11) to the investigation of the effectiveness of modern seismic protection technologies (A44, A51, A52, E24). In recognition of his early work on understanding and modeling the seismic response of bridges (A20) he received (with G. Gazetas and T. Delis) the T. K. Hsieh Award from the Institution of Civil Engineers, UK. Recent studies of the applicant focus on: (a) the earthquake induced pounding between adjacent bridge decks (A64, A65, A68, A76); (b) the modal identification of seismic isolated bridges (A67, A75, A78) and (c) the health monitoring of fluid dampers installed in bridges (A80). He has also investigated in depth the through-soil coupling of the motion of neighboring piles when excited by seismic waves (A1, A5, A12, A17, A21).

d) While the behavior of rocking, sliding and pounding structures is strongly nonlinear, Professor Makris conducted important work to show the remarkable order that emerges in the response of nonlinear systems after uncovering via dimensional analysis the self-similarities that prevail in their dynamic response (A53, A54, A57, A69, A74).

e) Professor Makris served for six (6) consecutive years as the Director of Reconstruction of the Temple of Zeus in ancient Nemea. During his tenure as Director (Jan 2004—Dec 2009), He was responsible for all the technical, administrative and financial issues associated with the reconstruction project and the end-result of his effort was the reconstruction of four entire columns and their capitals atop. During the reconstruction effort several important findings regarding the reconstruction practices and techniques of ancient builders were documented and evaluated.

References

The references are listed in the list of publications.