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2023 - May Seminar

SOLID-STATE DAMPERS FOR ENHANCED WIND, SEISMIC & VIBRATION PERFORMANCE OF STRUCTURES

Date:	**Thursday - May 25, 2023**
Venue:	**HSBC Hall at UBC Robson Square, 800 Robson Street, Vancouver**
Time:	**Refreshments 6:00pm, Presentation 6:30pm**
Presenter:	**Constantin Christopoulos, P.Eng., Ph.D.; Professor and Director, University of Toronto**
Cost:	**Free for SEABC Members; $85 for Guests and Non-Members**
	Pre-Registration is required: https://seabc.ca/event/solid-state-dampers/

Dr. Christopoulos will present high-performance solid-state damping systems, for improved wind, seismic and overall vibration response of buildings and civil structures. Solid-state viscoelastic damping materials are layered as solid bodies in-between steel plates which are then anchored to building structures in a multitude of configurations. As the structure undergoes vibrations, the steel plates shear the viscoelastic material causing polymer chains to deform. As the polymer chains deform they exhibit both elastic deformation dependent and viscous velocity-dependent forces. They offer advantages over other damping systems as the solid nature of the damping eliminates device compliance issues found in fluid dampers, allowing them to be effective over a larger range of deformations without having to be tuned to a specific displacement range. Because they provide damping as well as an elastic restoring force they can be used to couple the response of structural members increasing their overall global lateral load-resisting effectiveness. Solid-state damping materials (generally viscoelastic in nature), were the first damping systems used in civil applications, as early as 1969 in the World Trade Center towers. After initial development in the U.S. in the 1980s and 1990s, 3M Japan developed new generations of these materials with enhanced energy dissipation, stiffness, bonding and temperature properties with implementation in 300+ buildings for earthquake and wind damping. After more recent uses in the areas of automotive and aerospace damping, the layering of the polymers to achieve larger forces and stiffness as well as novel ways to position them in common structural systems have greatly enhanced their effectiveness in buildings.

Professor Christopoulos will first discuss the fundamentals of advanced viscoelastic materials that have the most desirable properties for structural engineering applications. He will then discuss layering techniques developed to achieve large damping forces and stiffness properties that can be used to couple structural elements and enhance the overall performance of the damped structures. Sample structural configurations ranging from high-rise buildings to lower-rise frame structures where these systems can be implemented for both wind and earthquake damping will be presented. The presentation will include results and insights from more than twenty years of solid-state damping system development and testing at the University of Toronto. Finally, practical aspects on the implementation of these systems in real structures, including design strategies, modelling, specifications and quality control will also be discussed.

Constantin Christopoulos, P.Eng., Ph.D. is the Director of Structures Testing Facility at the University of Toronto and the Chief Technical Advisor at Kinetica. He has been working in the area of high-performing damping and isolation systems for over 25 years. He has authored over 200 technical papers, reports and articles and co-authored two textbooks used in graduate courses around the world: “Principles of Supplemental Damping and Seismic Isolation” and “Elements of Earthquake Engineering and Structural Dynamics”.
He has been a key member of several international high-profile consulting projects involving the implementation and testing of isolation and damping systems.