

Keynote Paper

## **Does Structural Performance against Non-synoptic Wind Loads Matter? Recent Experiences in Life-cycle Cost Analysis against Wind Hazards**

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**Abstract:** This presentation will review recent study activities examining the response of slender structures under the effects of wind hazards. Large-period, low-damping structures are susceptible to damage induced by wind loads. The common feature of the research is the quantification of direct and indirect effects on structures due to uncertain wind loads, measurement errors and load modeling assumptions. Both stationary synoptic winds and localized, nonstationary windstorms are considered. The former include large extra-tropical depressions and tropical cyclonic phenomena, at a scale of several hundred kilometers. The latter include thunderstorm downbursts and tornadoes, less than one kilometer in diameter. Research activity has focused on the prediction of the structural response, mainly tall buildings but also long-span bridges. The investigated methods are both analytical (stochastic calculus) and numerical (Monte-Carlo sampling). The research goal is the evaluation of wind-related damage over structural lifetime in the context of quantitative risk analysis.

The presentation will discuss characterization of the structural response through multi-variable probability density functions and examination of wind-related damage through intervention cost analysis. Examples will consider effects on the envelope and nonstructural elements of tall buildings under various wind load scenarios and aeroelastic vibrations. It will be demonstrated that it is possible to predict structural response and its consequences, even in the presence of large modeling and experimental load variability. Furthermore, it is imperative that uncertainty propagation is extended to all the stages of the structural analysis: turbulent wind field simulation, wind-pressure load assessment and dynamic response.

**Bio-sketch:** Luca Caracoglia is an Associate Professor in the Department of Civil and Environmental Engineering of Northeastern University, Boston, Massachusetts, USA. He joined Northeastern University in 2005. Prior to this appointment, he was a post-doctoral fellow in the Department of Civil Engineering at Johns Hopkins University, Baltimore, Maryland (USA) in 2001-2002 and a post-doctoral research associate in the Department of Civil and Environmental Engineering at the University of Illinois (Urbana-Champaign, USA) in 2002-2004. He received his

*The 2022 World Congress on  
Advances in Civil, Environmental, & Materials Research (ACEM22)  
16-19, August, 2022, GECE, Seoul, Korea*

Ph.D. in Structural Engineering from the University of Trieste, Italy in 2001. His interests are in structural dynamics, random vibration, wind engineering, fluid-structure interaction of civil engineering structures, nonlinear cable network dynamics, energy harvesting systems in wind energy.

Luca Caracoglia received the NSF-CAREER Award for young investigators in 2009. He co-chaired the 3rd Workshop of the American Association for Wind Engineering in 2012 (AAWE2012), and co-chaired the 8th International Colloquium on Bluff Body Aerodynamics and Applications (BBAA VIII) in 2016. Luca Caracoglia is currently a member of the Board of Directors of the American Association for Wind Engineering (AAWE, member of IAWE), and a member of the Executive Board of the ANIV – Italian National Association for Wind Engineering (member of IAWE). He served as a member of the International Executive Board of the International Association for Wind Engineering in 2012 – 2017. Luca Caracoglia is an Associate Editor for the ASCE Journal of Bridge Engineering and the Journal of Fluids and Structures and a member of several editorial boards, among which we note Wind and Structures (Techno-Press). Luca Caracoglia was elected Fellow of the American Society of Civil Engineers in 2020