

Keynote Paper

Coupled mechanics-probability multiscale approach to computations, testing and uncertainty propagation for massive composite structures safety

*Adnan Ibrahimbegovic¹⁾

¹⁾ *Mechanical Engineering, UTC-Sorbonne Universites, France*

¹⁾ adnan.ibrahimbegovic@utc.fr

ABSTRACT

In this work we address the challenge pertinent to guaranties of safety for massive engineering structures, both in terms of integrity to failure under extreme conditions and durability within their environment. Of particular interest are industrial domains of excellence in France, such as energy-production, and air- or land- transportation (see Fig. 1). The main obstacle to overcome pertains to our inability to certify the structural safety by performing with real-size and real-time experiments, either due to excessive structure size, to excessive cost due to irreplaceable structure component.

We seek to propose the state-of-the-art advances in computational methods that can be brought to bear upon this class of problems, providing the full understanding of the potential failure modes of the given system, along with the very detailed simulation of extreme conditions brought by man-made and natural hazards. We seek further developments in recently proposed approach to coupled mechanics-probability computations that can be successfully used to provide a detailed interpretation of structure tests under heterogeneous stress field and to identify both model parameters and their probability distribution. Finally, we propose to use such a combined approach with probability computations for uncertainty propagation, which can offer a clear explanation of the size effect influence on dominant failure modes of massive composite structures.



(a)



(b)



(c)

Fig. 1 Durability composite structures: (a) nuclear power plant - stringent requirement on waterproof containment structure; (b) Boeing 787 Dreamliner - requirement on no-return-to-hub for crack reparation; (c) large offshore wind-turbine – requirement of operation capabilities for extreme weather conditions

¹⁾ Professor, Chair for Computational Mechanics UTC, IUF Senior Member