

## Feasibility of an Extreme Wind Risk Assessment Software for Industrial Applications

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**Abstract :** The impact of extreme winds on industrial assets and the built environment is gaining increasing attention from stakeholders, including the corporate insurance industry. This has led to a progressively more in-depth study of building vulnerability and fragility to wind. Wind vulnerability models are used in probabilistic risk assessment to relate a loss metric to an intensity measure of the natural event, usually a gust or a mean wind speed. In fact, vulnerability models can be integrated with the wind hazard, which consists of associating a probability to each intensity level in a time interval (e.g., by means of return periods) to provide an assessment of future losses due to extreme wind. This has also given impulse to the world- and regional-scale wind hazard studies. Another approach often adopted for the probabilistic description of building vulnerability to the wind is the use of fragility functions, which provide the conditional probability that selected building components will exceed certain damage states, given wind intensity. In fact, in wind engineering literature, it is more common to find structural system- or component-level fragility functions rather than wind vulnerability models for an entire building. Loss assessment based on component fragilities requires some logical combination rules that define the building's damage state given the damage state of each component and the availability of a consequence model that provides the losses associated with each damage state. When risk calculations are based on numerical simulation of a structure's behavior during extreme wind scenarios, the interaction of component fragilities is intertwined with the computational procedure. However, simulation-based approaches are usually computationally demanding and case-specific. In this context, the present work introduces the ExtReMe wind risk assessment prototype Software, ERMESS, which is being developed at the University of Naples Federico II. ERMESS is a wind risk assessment tool for insurance applications to industrial facilities, collecting a wide assortment of available wind vulnerability models and fragility functions to facilitate their incorporation into risk calculations based on in-built or user-defined wind hazard data. This software implements an alternative method for building-specific risk assessment based on existing component-level fragility functions and on a number of simplifying assumptions for their interactions. The applicability of this alternative procedure is explored by means of an illustrative proof-of-concept example, which considers four main building components, namely: the roof covering, roof structure, envelope wall and envelope openings. The application shows that, despite the simplifying assumptions, the procedure can yield risk evaluations that are comparable to those obtained via more rigorous building-level simulation-based methods, at least in the considered example. The advantage of this approach is shown to lie in the fact that a database of building component fragility curves can be put to use for the development of new wind vulnerability models to cover building typologies not yet adequately covered by existing works and whose rigorous development is usually beyond the budget of portfolio-related industrial applications.

**Keywords :** component wind fragility, probabilistic risk assessment, vulnerability model, wind-induced losses

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