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PARAMETRIC STUDIES OF GUYED COLUMNS WITH APPLICATION ON WIND TURBINES

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Abstract. From telecommunication towers to energy transmission lines, guyed structures are extensively employed across various engineering applications. In recent years, this structural typology has also been incorporated into the design of wind turbines. The present work investigates the nonlinear dynamic response of guyed wind turbine towers subjected to various cable tension configurations and loading scenarios. Two loading scenarios are considered: high wind velocity loads during non-operational states and lower wind loads during operational states. Wind actions are modeled as stochastic processes. Special attention is given to the modeling of rotational loads transferred from the operating turbine to the tower structure. Additionally, the interaction between the tower base and the supporting soil is modeled through flexible boundary conditions. Numerical methods are implemented to capture the complex nonlinear behavior, including geometric nonlinearities in the cables. A parametric study explores the influence of guy wire tension, rotor-generated load models during operational regimes, and soil characteristics on the dynamic response. Finally, through a stochastic approach, valuable insights into the probability distribution of the structural responses are obtained, which, in this type of analysis, complements the understanding of the dynamics provided by the raw deterministic nonlinear results.

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