Preliminary numerical and experimental analyses of the thermo-mechanical behaviour of a monitored wind-turbine located in Italy

Felice Carlo Ponzo (1), Rocco Ditommaso (1), Gianluca Auletta (1), Donato Pica (2), and Luca Carosielli (2)

(1) University of Basilicata, School of Engineering, Potenza, Italy, (2) Freelance Engineer, Italy

Renewable energy sources, especially wind power, have become a focus of energy policies in several countries around the world. Wind turbines have to be located on sites with high wind speeds, this leads to high forces acting upon the tower and the blades, causing vibrations throughout the structure. Current technical and scientific literature specifically focusses on vibrations of the wind turbine blades and the effect of earthquakes on the turbines. Additionally, there is considerable research in the field of low frequency noise and infrasound from wind turbines. This study presents the preliminary results retrieved from the analyses performed on real accelerometric time-histories recorded on a cracking wind-turbine located in southern Italy. The permanent accelerometric monitoring system has been installed in 2016, and it is recording data every day under several climatic conditions. Particularly, both weak- and strong-motion synchronized data are available from two three-directional stations: the first one, installed on the foundation and, the second one, installed on the top of the tower. In this phase of the study the recorded motion of the monitored tower has been investigated under several wind conditions correlating the dynamic characteristics of the structural eigenfrequencies with others parameters such as wind speed, air temperature, etc. Accelerometric data have been analysed using both stationary and non-stationary tools, particularly, weak-motion data have been analysed using Fourier Transform and Transfer Functions, while, strong-motion data have been analysed using the Stockwell Transform. In order to analyse the cracking phenomena observed at the base of the tower, also numerical analyses are in progress with the aim to evaluate stresses and strains associated to the complex thermo-mechanical behaviour of materials constituting the monitored tower and any fatigue phenomena.