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SANDWICH METAL FOAM RINGS FOR WIND TURBINE TOWER BUCKLING ENHANCMENT

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ABSTRACT

In this paper, modal analysis of wind energy towers is performed. A reduced order mathematical model based on the continuous beam approach is performed, avoiding time-consuming large finite element models. Ignoring shear deformations Euler Bernoulli continuous beams are suitable for this analysis. Stiffening rings are used in various heights to enhance the dynamic behaviour of wind energy structures, making the tower stiffer and reducing the susceptibility of the structure to local buckling under external loads. The augmenting stiffening rings may be steel solid or composite, the latter being a sandwich steel ring filled by metal foam. The aim of this design approach is to take advantage of low density of metal foam combined with its high values of modulus of elasticity to achieve stiffening with a reduced bill of materials, whilst the porosity of the foam presents additional opportunities to control structural damping. Three different design configurations are taken into account to assess the vibrational characteristics of the proposed approach: one unstiffened tower, one stiffened tower through solid steel rings and a stiffened tower with metal foam composite ring. Furthermore, theoretical estimation of mode shapes and eigenfrequencies is carried out for each design approach. Finally, the proposed theoretical model is applied to a wind turbine tower with specific height and mass in order to verify the accuracy of the aforementioned mathematical model.