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As the size of wind turbine rotors continuously grows, the need for innovative solutions that would yield to lighter rotor configurations becomes more urgent. Traditional wind turbine designs have favored the classic three-bladed upwind rotor configuration. This work presents instead a concept study on an alternative downwind two-bladed rotor configuration. The study is based on a model representative of next generation multi-MW wind turbines: the DTU 10-MW Reference Wind Turbine (RWT). As a first design iteration, the aerodynamic characteristics of the original rotor are maintained, and the rotor solidity is kept constant by increasing the blade chord by 50%. The configuration allows saving 30% of the rotor weight and material, corresponding to one blade, but implies several complications: lower power output due to increased tip losses effects, and increased load variations. The increase in load variations, and hence in fatigue damage, affects the turbine blades, shaft and tower, and originates from the aerodynamic unbalance on the rotor, as well as from aeroelastic interaction with the tower frequency.

To mitigate the load amplification caused by the interaction between the tower frequency and the rotational forcing, the tower mode frequency is lowered with a modified tower stiffness distributions. The loads caused by the aerodynamic unbalance are instead addressed by introducing a teetering hub configuration. The load alleviation potential of the teetering hub, and the required teeter angle range are evaluated for different stiffness values of the teeter bearing.

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