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1.13.4 Skewed Flow; 1.13.5 Summary; References; 2 Rotor Aerodynamic Design; 2.1 Optimum Rotors and Solidity; 2.2 Rotor Solidity and Ideal Variable Speed Operation; 2.3 Solidity and Loads; 2.4 Aerofoil Design Development; 2.5 Sensitivity of Aerodynamic Performance to Planform Shape; 2.6 Aerofoil Design Specification; References; 3 Rotor Structural Interactions; 3.1 Blade Design in General; 3.2 Basics of Blade Structure; 3.3 Simplified Cap Spar Analyses; 3.3.1 Design for Minimum Mass with Prescribed Deflection 3.3.2 Design for Fatigue Strength: No Deflection Limits 3.4 The Effective t/c Ratio of Aerofoil Sections; 3.5 Blade Design Studies: Example of a Parametric Analysis; 3.6 Industrial Blade Technology; 3.6.1 Design; 3.6.2 Manufacturing; 3.6.3 Design Development; References; 4 Upscaling of Wind Turbine Systems; 4.1 Introduction: Size and Size Limits; 4.2 The 'Square-Cube' Law; 4.3 Scaling Fundamentals; 4.4 Similarity Rules for Wind Turbine Systems; 4.4.1 Tip Speed; 4.4.2 Aerodynamic Moment Scaling; 4.4.3 Bending Section Modulus Scaling; 4.4.4 Tension Section Scaling; 4.4.5 Aeroelastic Stability 4.4.6 Self Weight Loads Scaling 4.4.7 Blade (Tip) Deflection Scaling; 4.4.8 More Subtle Scaling Effects and Implications; 4.4.9 Gearbox Scaling; 4.4.10 Support Structure Scaling; 4.4.11 Power/Energy Scaling; 4.4.12 Electrical Systems Scaling; 4.4.13 Control Systems Scaling; 4.4.14 Scaling Summary; 4.5 Analysis of Commercial Data; 4.5.1 Blade Mass Scaling; 4.5.2 Shaft Mass Scaling; 4.5.3 Scaling of Nacelle Mass and Tower Top Mass; 4.5.4 Tower Top Mass; 4.5.5 Tower Scaling; 4.5.6 Gearbox Scaling; 4.6 Upscaling of VAWTs; 4.7 Rated Tip Speed; 4.8 Upscaling of Loads; 4.9 Violating Similarity 4.10 Cost Models

Sommario/riassunto

Innovation in Wind Turbine Design addresses the fundamentals of design, the reasons behind design choices, and describes the methodology for evaluating innovative systems and components. Always referencing a state of the art system for comparison, Jamieson discusses the basics of wind turbine theory and design, as well as how to apply existing engineering knowledge to further advance the technology, enabling the reader to gain a thorough understanding of current technology before assessing where it can go in the future. Innovation in Wind Turbine Design is divided into four
