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Reliability Analysis of Wind Turbines

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Reliability analysis of wind turbines

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Abstract: (239 words)
For minimising the total expected life-cycle costs of a wind turbine it is important to be able to estimate the reliability level for all components in the wind turbine. This paper deals with reliability analysis for different structural components in a wind turbine under different limit states.

For the wind turbine tower and blades representative limit state functions are formulated for typical structural failure modes. From these limit state equations the reliability level for the tower and blades can be estimated under both extreme and operational conditions. For wind turbines, where the magnitude of the loads is influenced by the control system, the ultimate limit state can occur under both extreme and operational loading.

The representative structural failure modes include both fatigue and ultimate limit states. Especially for the fatigue limit state the loading is dependent on weather the wind turbine is placed alone or in a wind farm, where wake effects from the neighbouring wind turbines must be taken into account.

The limit state equations are dependent on a number of parameters which must be modelled by stochastic variables. The distribution and distribution parameters for these stochastic variables are, when possible, based on the "Probabilistic Model Code" by Joint Committee on Structural Safety.

Illustrative examples show the reliability level for the wind turbine towers and blades obtained for different failure modes where the design is determined according to the wind turbine standard IEC 61400-1 "Wind turbines – Design requirements".