Usually the bulk of the wind turbulent energy is at frequencies below the first out-of-plane mode of the blade. The resonant blade oscillations will result additional inertial loadings over the quasi-static loads that would be experienced by a rigid blade. The response of blade root bending moment might be augmented due to dynamic effects and should be evaluated. Assume the first mode as the most important one, and the standard deviation of the fluctuating root bending moment due to wind excitation can be written as

 



Where ω1 is the first mode natural frequency, σx1 is the stand deviation of resonant tip response, φ1 is the mode shape for the first mode. The variance of the root bending moment is equal to the sum of the background and resonant responses[[1](#_ENREF_1), [2](#_ENREF_2)], that is,



Where σMB is the standard deviation of the background response and is related to wind speed only:



Since the peak response, the expected extreme root bending moment Mmax can be written as



For a Gaussian process, g the peak factor was shown by Davenport[[3](#_ENREF_3)] as



Where T is the mean zero-upcrossing frequency of the root moment fluctuations and T is the mean wind speed averging period, 3600s.

 should be a good indicator of the root moment fluctuation.

The response spectrum will generally reflect the resonant contributions.

Sea state 2 wavedir=0

Blade azimuth 30Response of blade1 Mx





[1] Holmes JD. Wind loading of structures: Taylor & Francis Group; 2007.

[2] Burton T, Jenkins N, Sharpe D, Bossanyi E. Wind Energy Handbook. Wiley Online Library; 2011.

[3] Davenport AG. Note on the distribution of the largest value of a random function with application to gust loading. Proceedings of the Institution of Civil Engineers. 1964;28:187-96.