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Solutions for Galloping and Vibration Control

Field Studies

Abstract

Predicting Galloping Amplitudes I & II

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The use of wind tunnel data, lift and drag together with a method of analysis leads to estimates of galloping amplitudes. The application of wind tunnel data, to the calculation of vibration amplitudes includes the effect of structural damping. The critical wind speed no matter which theory is used, linear or non-linear.

These companion papers are based on the Describing Function Method used by control system designers to predict behavior of dynamic systems. The method is based on the assumption that the system is lightly damped and when it vibrates it takes on the response of one mode at a time, which simplifies the analysis. In the case of galloping conductor motion the assumption may be applied to the first mode or second mode. In part I of the paper the analysis assumes zero mechanical damping. The predicted amplitude of gallop is a limit reached by energy balance between wind input and aerodynamic drag. The amplitude of gallop in this case is found from the dynamic angle of attack, which in this case is constant, and depends upon the ice shape. The gallop amplitude increases with wind speed and is inversely proportional to the gallop natural frequency. In part II of the paper the role of mechanical damping is introduced. The dynamic angle of attack is found to build up from zero to the same angle of attack found in Part I for the given ice shape. Again, the gallop amplitude may be calculated as in Part I along this build-up curve. The mechanical damping is what establishes a "critical wind speed" at which galloping is initiated. Above the critical wind speed the dynamic angle of attack increases rapidly, reaching more than 60% of its final value at two times the critical wind speed.

Predicting Galloping Amplitudes
Predicting Galloping Amplitudes II

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