Cable Bend Testing over a Variable Diameter Sheave

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ABSTRACT

Typical cable bending tests involve only a single, relatively small pulley diameter, which provides limited information about the development of strain in cable wires. To provide a wide range of bend diameters to fully evaluate wire strain development, a variable diameter apparatus was employed in a series of constant-tension, variable-diameter tests. These data are plotted and compared to a numerical model. Experimental concerns including strain measurement validation, wire-layer separation, interlayer friction coefficient, and bending method are discussed.

KEY WORDS: Wire; cable; tension; bending; friction; slip.

INTRODUCTION

This research was conducted to develop a new methodology for testing cables in bending over a sheave. A typical approach might be to wrap a cable around two pulleys, tension the unit, and roll the cable around the pulleys while taking readings from a strain gage installed on the outer wires. This certainly reveals something about the behavior of cables around a bend, but the results are difficult to interpret, since little is known about the bend diameter (which drives the wire strain) unless the cable at the strain gage location is fully engaged with the pulley. Alternatively, getting experimental data from a wide range of pulley diameters can reveal the progression of strain at particular bend diameters and help develop an understanding of the development of wire strain, friction, and wire slip within the cable.

The approach in this research was to use a variable-diameter sheave pressed into an instrumented cable held at constant tension. Strain readings were taken after physically verifying that the cable was fully engaged with the sheave. Using this device, a large number of bend diameters were implemented in a small amount of time. Using these data, experimental strain-bend curves were generated and compared to a numerical model (CableCAD, 2009), in part based on the cable bending analysis by Knapp (1988).

The paper is divided into four major sections: a basic explanation of the test equipment; the properties of the test specimen; the experiments and results; and conclusions.