Name(s)

Lydia J. Bates

Project Number

S0203

Project Title

How Strong Is That Knot? A Study of the Knot Efficiency of the Double Fisherman's Knot

Abstract

Objectives/Goals

The purpose of this experiment was to determine if the tying of a typical fireman's rescue knot using a static kernmantle rescue rope would cause a tensile strength reduction compared to the rope's rated average breaking strength. This is known as knot efficiency. Two sizes of rope, 7/16" and 1/2", and the double fisherman's knot were tested. Due to testing apparatus limitations, this experiment was limited to testing single looped ropes. The hypothesis was that the tying of a double fisherman's knot in the static rope will cause a measureable reduction in the rope's tensile strength.

Methods/Materials

Tests were performed using various methods of securing the rope to eliminate the clamping method as a variable. This led to the use of a looped rope over guide pulleys for testing. Looping the rope distributes the force over two lengths of rope, doubling the rated strength of the rope. Therefore, knot efficiency was compared to 200% of the rated strength of a single unknotted rope. The testing equipment used was a 450K lb tensile testing machine. The rope sample was secured and pulled at a constant rate until the rope failure point was reached. Five samples each of the two sizes of rope were tested using this method. The results were compared to the rope's average breaking strength supplied by Underwriter's Laboratories (UL). These UL values were used as a control, as limitations of the equipment prevented separate control testing on single rope strands.

Results

Tensile strength of the rope was reduced by the addition of the double fisherman's knot. The knot in the 7/16" rope failed at an average of 77.4% and the 1/2" rope at an average of 74.8% of the UL breaking strength of the unknotted rope. The knot efficiency for the double fisherman's knot is listed from 21% to 30%. The knot efficiency ratings obtained by this experiment were within the published ratings for the double fisherman's knot.

Conclusions/Discussion

The data indicated that the hypothesis was correct. The hypothesis was based on the theory that the knot would create a stress concentration in the rope, crushing the rope's core and causing the rope to fail before a non-pinched rope. Inspections of the broken rope samples showed in every case that the rope failed at the stress concentration of the knot. In conclusion, the tying of a double fisherman's knot in the static rope will cause a measureable reduction in the tensile strength of the rope.

Summary Statement

The purpose of this experiment was to determine if the tying of a typical fireman's rescue knot using a static kernmantle rescue rope would cause a tensile strength reduction compared to the rope's rated average breaking strength.

Help Received

Bruce Miller, Terry Tilton, & Gary Peddecord - Training and assistance in operating the tensile testing equipment.