The Study of Knot Performance

Exploring the Secrets of Knotted Cordage to Understand How Knots Work

Influences on Knot Performance

Four Factors that Determine the Performance of Practical Knots

The Factors that Affect Knot Performance

By “knot performance,” we mean how a knot works and how well it works. How secure, stable, and strong is it? Where will it break? The performance of a practical knot is determined by four factors: 1) the physical laws of mechanics, 2) the knot’s structure, 3) the material it is tied in, and 4) its environment and conditions of its use.

1. The Invariable Laws of Mechanics

Like all the other objects in the universe, a knot operates according to the physical laws of mechanics. Mechanical forces that affect the performance of a knot include friction, blockage, tension stresses, compression stresses, and shear stresses.

The exact ways these invariable physical forces affect a knot depend on three variable factors: its structure, the material it is tied in, and its environment and conditions of use.

2. Structure

Structure is the first of the three variable determinants of knot performance.

How well a knot performs depends largely on the way it is configured. The most characteristic aspects of knots, the convolutions of the segments they are made up of, include tucks, wraps, bights, hitches, parallel strands, and curves. But as far as structure is concerned, a knot’s performance depends first of all on whether it is properly tied, dressed, and loaded.

3. Materials

A knotted rope performs more or less well depending on the type of cordage it is tied in, whether it is twisted manila hawser, braided cotton twine, kernmantle nylon rope, a handkerchief, leather thong, or the arms of a sweater. Performance is also affected by the thickness of the cordage and its physical condition. Each material has different characteristics of stretch and elasticity, as well as different surface characteristics and coefficient of friction, all of which affect its holding power. As experienced knot users know, nylon rope is more likely to slip than manila or cotton rope, hollow braid polypropylene is slick and kinky but holds well after it is set in place, and thin ropes breaks more easily than thick ropes.

4. Environment and Conditions of Use

The performance of a knot is affected by way it is used in rope systems, by variable atmospheric influences, including temperature, humidity, and moisture, and by lubricants or foreign bodies on the surfaces where the rope comes into contact with itself or with other objects. The performance of a hitch is affected by the object it is tied around. The load that falls on a knot may be applied steadily, by alternating loading and un-loading, or from an unusual direction such as would be caused by snags or sideways pulls on the tail of the knot.

How These Factors Interact

These factors come to bear whether the knot was tied by a jungle ape, a Boy Scout, or the President of the International Guild of Knot Tyers. And they have always applied, from the remote time when a knot was first tied and used to the present.

These factors come into play and interact in complex ways to create a usable knot and make it perform the way it does. In the papers that follow, analysis shows how mechanical forces interact with the structure of a knot to determine how it performs.