.The word “to” (or “in order to”) lets the reader know what problem is being solved.

Proposal

To Estimate the Load Rate Imparted to a Climbing Anchor During Fall Arrest

Dave Custer

Specific topic info is available in stress positions, both in the title and at the start of the introduction

Summary: Because the strength of ice anchors is, in part, a function of the load rate, increasing the load rate of the decelerating climber reduces anchor strength in brittle ice. To provide a rule of thumb estimate of the load rate imparted to a climbing anchor during fall arrest, a simple, algebraic formula for load rate will be derived by modeling the rope as a spring. Further refinements of the model will take other energy losses into account, including the damping of the rope, friction losses at the top carabiner, and lifting of the belayer. The model will be compared to data taken from the literature. The resulting estimate of load rate will allow ice climbers to better evaluate which equipment to use and how to arrange anchoring systems.

A little sketchy telling the reader what is in fact not important. The “usually no one cares, so no one has checked this out” logic is decidedly unclear. Further, in the digression, I’ve strayed from

1 Introduction

An estimate of load rate, the time derivative of force, is important in ice climbing because high load rates reduce the strength of anchors in brittle ice. Load rate is rarely addressed in non ice climbing situations because the components of the safety system are not affected by changes in load rate over the range of values that can occur during fall arrest. For example, metal equipment is expected to be slightly stronger at higher loading rates (Newby, 1985). Further, the strength of granite, a rock favored by climbers, also exhibits little change over several orders of magnitude changes in strain rate, and some rock types increase in strength with increased strain rate (Lockner, 1995). In contrast, the strength of ice anchors decreases with increasing load rate. While the metal ice screw itself is unaffected, a two order of magnitude increase in strain rate roughly halves the ice strength (Gold, 1977). Tests on ice anchors show a similar halving of strength with a two order of magnitude increase in loading rate (Blair, 2004). This phenomenon is complicated by the fact that ductile ice exhibits an increase in strength with increased strain rates. Further complications are the paucity of data and conflict in existing data that pinpoints the brittle/ductile transition at temperatures above -40°C, temperatures at which most ice climbing occurs. Nonetheless, the documented decrease in ice and ice anchor strength at higher load rates suggests that climbers need to understand and control the loading rate of ice anchors. To this end, a (very) simple model of a climbing fall is used to derive an algebraic formula to estimate the load rate imparted to a climbing anchor during fall arrest, and this simple model is compared to more realistic models and to existing experimental data.

This paragraph tells the story of “load rate.” The noun occupies many subject positions. The alternate “strain rate” is probably just confusing.

The end of the introduction provides an overview of the solution.

In general, transitions between sentences are OK. The “further” and “nonetheless” transition words are vague.