

Elongation of Static Rope Resulting From a Sudden Dynamic Force Loading

Presented by:
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and
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Virtually every rescue team in the United States and Canada use low stretch ('static') rope in their mainline and belay systems to reduce the amount of work on the litter haul team and to have better and more predictable control of the operation.

Low stretch rope, by its design, has less stretch both in a static slow-pull and a dynamic sudden impact configurations than high stretch ropes. But all rope, including low stretch, elongates. This elongation under normal rescue raising or lowering operations has a minimal impact on performance or safety. Under sudden dynamic loading, such as when a mainline fails or when there is slack in the system as the litter tender negotiates the cliff or building edge this elongation may have considerable impact on safety. Just how much elongation occurs? Is this elongation consistent and predictable? And, more specifically, will this elongation differ between manufacturers and between new and in-service (used) ropes made by the same manufacturers?

Study Objective:

- 1) In the event of a mainline failure in a rescue system resulting in a factor 0.3 fall of the rescue load, what is the expected percent of elongation of the belay rope supporting that load?
- 2) Is there a difference in the resultant elongation based on rope age and use history?

Null Hypothesis:

The elongation of static rope with a dynamic impact is approximately the same as the factory stated percent derived from static testing with a mass one tenth of the rope's breaking strength, and, age and use do not affect rope elongation.

Additional factors which may affect the results:

- 1) Manufacturer and model of rope
- 2) Atmospheric conditions (temperature, humidity, barometric pressure)
- 3) More or less rigid test rig
- 4) Substantially different drop distances
- 5) Variances in knot type and knot tying.
- 6) Other changes in test methods or materials.

Co-Investigators:

Scott Fischer - Joshua Tree National Park

Kim Aufhauser - West Valley College

Phil Spinelli and Dave Pylman - Joshua Tree Search and Rescue

Suppliers of equipment:

Joshua Tree National Park – Joshua Tree Search and Rescue
West Valley College
Pigeon Mountain Industries
Sterling Ropes

Research

Test Procedure:

Drop testing will be performed on a rigid tower sixteen feet tall. A mass weighing 200Kg, will be attached to three meters of 11mm static rope, and dropped a distance of one meter. Constants include length of rope, load, height of drop, individual tying the knots, type of knot and all rigging. Variables will include manufacturer of rope and models of new rope, and various brands and models of used ropes with known manufacturing dates.

Equipment for testing:

30 each, 5 meter lengths of new 11mm “static” nylon kernmantle rope
manufactured by PMI and Sterling,
15 each, 5 meter lengths of used static rope.
200Kg mass (an assemblage of concrete)
Quick release device
Three stationary video cameras
One digital still camera
Visual height indicator
Load retrieval system

Location: Joshua Tree, California

| <u>Project timeline</u> | | <u>Begin</u> | <u>End</u> |
|-----------------------------|----------|--------------|------------|
| Site/Equipment Construction | 16 hours | 5/09/05 | 5/30/05 |
| Test Preparation | 8 hours | 6/02/05 | 7/30/05 |
| Drop Tests, new rope | 10 hours | 8/06/05 | 8/07/05 |
| Drop Tests, aged rope | 5 hours | 8/07/05 | 8/07/05 |
| Site breakdown | 4 hours | 8/14/05 | 8/14/05 |
| Data compilation | 16 hours | 8/08/05 | 8/14/05 |
| Video post-production | 18 hours | 8/08/05 | 9/23/05 |
| Power Point production | 32 hours | 8/08/05 | 10/01/05 |
| Presentation, ITRS | 1 hour | 10/2-6/2005 | |

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About the Presenters

Kim Aufhäuser:

Kim Aufhäuser is a faculty member in the Park Management Department at West Valley College in Saratoga, CA. After 16 years as a National Park Service ranger in six parks (including over five years in Yosemite), he now teaches students the skills to become rangers. Subjects include mountaineering, technical rescue, and wilderness first responder. Kim provides first aid training to two local SAR teams. He is also the Emergency Services Coordinator for his college.

Aufhäuser holds an undergraduate degree in Wildlife Management from Humboldt State University and a graduate degree in Experienced Based Leadership Training and Program Development from Prescott College.

Scott Fischer:

Scott Fischer is a U.S. Park Ranger at Joshua Tree National Park. He currently manages the search and rescue program for the Park, which includes supervising the Joshua Tree Search and Rescue team (JOSAR.) Scott has over 13 years of SAR experience, with both the National Park Service and with volunteer teams.

Scott has been at Denali, Sequoia and Kings Canyon, Grand Teton and Rocky Mountain National Parks. In addition, Scott has been a Park Medic for 6 years, and is the Climbing Resource Ranger at Joshua Tree, overseeing programs for climbing safety and education.

