CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

J0330

Project Title

Fall Factor: Testing the Forces Resulting from Lead Climbing Falls

Abstract

Objectives/Goals

To find the forces resulting from lead climbing falls and to find an effective way to reduce these forces.

Methods/Materials

Materials: #50 meter long, 10.8 mm diameter climbing rope; #Two 25 lb weights; #Weston 320 lb scale with slider to record maximum weight; #Two slings (for anchor and to attach scale to tree); #Two carabiners for anchor point; #Kong Impact Shock Absorber (KISA); #Tape measure.

For Standard Test:

1. Assemble anchor point using sling and carabiner attached to railing. 2. Pass rope through anchor point and tie rope to weight(s). 3. Set distance of fall by measuring length of rope between weight and anchor point. 4. Tie other end of rope to scale attached to tree. 5. Drop weight from anchor point. 6. Record force of fall. 7. Repeat steps 2-5 three times for each distance.

For Friction Device Test:

Repeat steps in standard test while using the friction shock absorber device.

For Belayer Test:

Repeat steps for standard and friction device tests, tying rope and scale to a human belayer rather than a tree.

Results

For the 25 lb weight, the forces recorded ranged from 49 lbs at 5 ft up to 111 lbs for a 12-ft fall. For the 50 lb weight for a 5 ft fall, 185 lbs was the minimum. The maximum for an 11 foot fall was 285 lbs. For both weights, at 9 ft the forces started to increase less with distance. We believe this happened because a damping material in the rope started to activate at this distance or force. The friction device tests showed that the device reduced the impact forces, especially on longer falls; for an 11 ft fall the force was reduced by ~40 %. In the belayer tests, we found that a human belayer acts as a shock absorber and dampens the impact forces. Some of the forces with a real belayer and friction shock absorber were less than 50% of those without a friction device and no belayer.

Conclusions/Discussion

From our tests, we observe that long lead-climbing falls generate forces that can injure people. We also found that forces generated by these falls were not linear, and varied with fall height, most likely due to the stretch of the rope. The inexpensive, easy-to-use, reusable friction shock absorber greatly reduced the impact force during falls. This device could potentially save lives and prevent injuries if climbers used it. We also found that a human belayer acts as a shock absorber. The friction device and belayer together

Summary Statement

To find the forces resulting from lead climbing falls and to find an effective way to reduce these forces.

Help Received

Julie Foquet helped check our board, Kirt Williams let us use his 60M dinamic rope and two 25 lb weights. Mother edited writeup.