Are Ultralight Tents Sufficiently Engineered To Withstand a Real Storm?

Sponsor: Backpacking Light (backpackinglight.com)

Introduction

In 2012 we began investigating the storm resistance of ultralight shelters (cf. http://backpackinglight.com/storm_resistance_ultralight_shelters_part_1_intro/). During our research, we have discovered that the primary mode of “failure” of an ultralight shelter during a storm is the disruption of the ground-shelter connection (e.g., a “tent” stake). A number of factors influence the ability of this connection to withstand a storm, including tent stake holding power (http://backpackinglight.com/tent_stakes/) and the forces transferred by wind to the shelter panels to the stake-out point.

Background

The following graph illustrates what tension forces are placed on a stakeout point of an ultralight shelter in response to only a very light breeze (1-2 mph):
Our revised and current experimental system uses aluminum load cells that monitor both force and acceleration (the combination of which can give us information about dynamic loading) at the stake-out point with a resolution as low as 0.1 millisecond (time) and a sensitivity of 0.01N (0.002 lbf). Both force sensors and weather meters then deliver data in real time to a laptop via Bluetooth. This will allow for very precise correlation between measured wind speed, measured deflection (determined via real time videography), and forces transferred to stake-out points. The example graph above shows tension measured in a tarp guyline that was originally staked to a force of about 5.6 pounds (2.5 kg). During this test, a light breeze was blowing (1-2 mph / 1.6-3.2 kph), and you can see the impacts of that breeze on guyline tension by the positive peaks in the graph, that show even a very light breeze can increase guyline tension by 1-3 lbf in this case. (Aside: we are adapting our sensor and data logging system to other projects in 2012 as well, including studies of backpack load stability and the impacts of trekking poles on impact forces transferred by the body during walking).

In order to extend the utility of this project, we must source/develop load cells that are as light and as small as possible. Up to a dozen load cells may be attached to a single shelter during any given test.

**Project Scope**

The purpose of this project is to:

- Develop/source the methodology, instrumentation, and monitoring systems required to collect the data above (e.g., using force accelerometers/load cells, anemometers, and video capture to measure guy line tension, wind speed, and shelter panel deflection accordingly);

- Use this data to create a “rating” system that allows one shelter to be rated against another for the purpose of comparing their wind resistance.

- Apply the methodology and rating system to a series of a dozen ultralight shelters have various engineering designs and storm resistance properties.

- Publish results in a series of articles that will appear at backpackinglight.com.

**About Backpacking Light**

Backpacking Light (backpackinglight.com), a Bozeman-based media publishing company founded in 2001 by MSU Engineering Graduate (Ph.D. 2003) Ryan Jordan, has a research and testing division targeted primarily at conducting field performance evaluations of wilderness expedition equipment including cooking and hydration systems, shelter and sleeping systems, and clothing systems. Investigations focus on determining relationships between the environment and equipment and the impact of equipment on human physiology.