Single Anchor Hammock

THE UNIVERSITY OF UTAH
Department of Mechanical Engineering

Team: Michael Auffenberg, Cole Laulis, Alec Martin, Finn Navidomskis, Connor Phelps, Aaron Tang
Advisor: Prof Ken Monson

Background

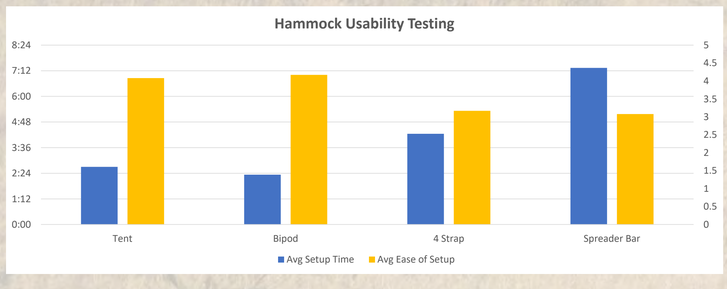
Traditional backpacking hammocks are limited in their use by their dependence on needing two, correctly spaced trees for support. The objective of this project was to create a single point hammock system that allows any standard hammock to be anchored to a single tree for support. These products enable backpackers to use hammocks in far more scenarios and environments than a traditional two-point hammock would allow.

4-Strap Design

The 4-strap design is attached to a tree using a tree strap with a D ring. Two hammock straps are clipped onto this D ring with a carabiner by the single loop at the end of the strap. Two anchor straps made of 1" nylon are looped through the ends (one at each end) of the hammock and secured to the ground with 4 anchors. To choose sufficient ground anchors, the force at each ground anchor was determined by assuming a 250lb load in the hammock and finding the resultant forces at each anchor point. During initial testing, the system was found to sag heavily due to deflection in the ground anchors. To correct this, the two lower straps were replaced with ratchet straps to remove the deflection before loading.

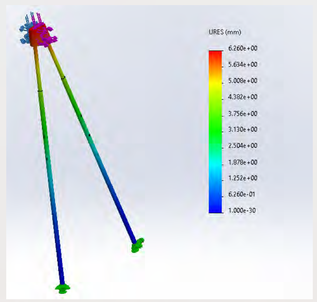
Testing Data

Test	4 Strap Design	Bipod Design	Spreader Bar
Max Load Test (250 lbs)	Pass	Pass	Fail
Packability Test (< 10 L)	Pass (3.8 L)	Pass (5.5L)	Pass (7.3 L)
Weight Test (< 5 lbs)	Pass (2.7 lbs)	Pass (3.4 lbs)	Pass (3.8 lbs)

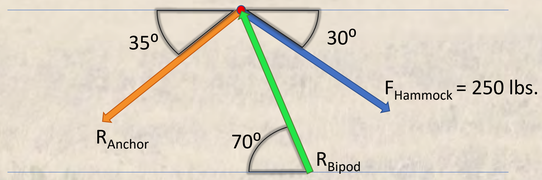


Bipod Design

The single anchor bipod design is 2 sets of nested carbon fiber tubes, secured with 3/16” steel pins for variable set up heights of 36” to 42”. The smaller tubes are then slotted into a steel connection point with eyelets on either side. One eyelet is connected to a webbing strap which is then anchored to the ground using a ground screw. The opposite eyelet is connected to the free side of the hammock.



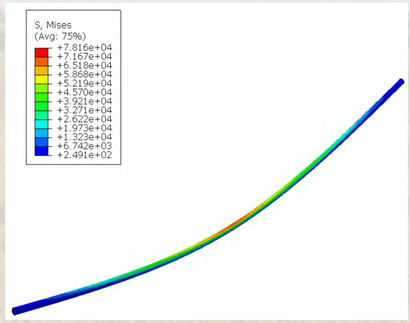
Design specifications for this product were based on preliminary static force calculations drawn below and a finite element analysis of the product under maximum loading conditions. The results of the initial FEA informed a change from 6065 aluminum to carbon fiber, as well as the appropriate diameter and wall thickness of said tubing. The connection point was also changed from 3D printed ABS to a smaller, more robust welded steel piece.



Spreader Bar Design

The spreader bar design is comprised of an 8’ collapsible, 1.1” OD carbon fiber tube, with sections connected by 1” OD T6061 Aluminum connectors. The carbon tube acts as the backbone of the hammock, maintaining its shape while loaded and preventing the ends of the hammock from collapsing in on each other. 1” nylon webbing straps connect the hammock and spreader bar to the single anchor point on the tree, and 3 additional nylon straps help protect the carbon tube against buckling when it is transversely loaded, such as when a user grabs the tube and pulls downward while entering or exiting the hammock. A vinyl fabric inflatable spacer keeps the hammock pushed away from the tree trunk to ensure the user isn’t bumping against the tree all night.

Originally, a 0.75” OD carbon tube was used as our spreader bar due to an early design miscalculation, causing a failure in our Max Load Test. After re-evaluating our loading scenario, we have selected the 1.1” OD tube, and ran an FEA analysis which shows that the larger tube should be able to withstand our combined loading scenario.



Conclusion

All three designs are viable options as effective replacements for backpacking tents. The cost of each design varies widely, with the 4-strap coming in at $95, the spreader bar totaling $195, and the bipod at $340. In addition to being the cheapest, the 4-strap is also the lightest design, weighing under 3 lbs. However, this is one of two designs that require improvements for optimal performance. The 4-strap design would benefit from 1” handle ratchets to reduce sagging. The spreader bar design needs a larger diameter bar to support the maximum load, which could increase the cost substantially. The bipod design is the most successful under maximum loads and during user testing.