

Abstract

Neal Saiki, a Cal Poly alumnus, donated a human powered helicopter to the Cal Poly Aircraft Design and Construction Club in Fall Quarter 2012. To achieve the requirements of the Igor Sikorsky Human Powered Helicopter Competition, this senior project was tasked with reducing the weight of the load-bearing spars without changing geometry.

The aluminum spars were replaced with carbon fiber. The spars were designed to maintain the bending and torsional stiffnesses. Twelve sections of carbon fiber tubes ranging from 8 to 12 ft in length and 2" to 3" in inner diameter were made using pre-preg carbon fiber wrapped on aluminum male mandrels. Sleeves joining spars of dissimilar diameters were made with carbon fiber using a male polypropylene mandrel. Sleeves joining spars of equal diameter were purchased to save production time.

A test was conducted on a section of 2.5" diameter tube to verify that the bending stiffness requirements were met. Although multiple tests were conducted, a conclusive bending stiffness was not determined. Although the spar did not fail under twice the flight load, the weight of the spars was only reduced by 2%.

This report explains the design and manufacturing processes that led to the first completed iteration of the helicopter spars.