Hybrid Hanger Treestands

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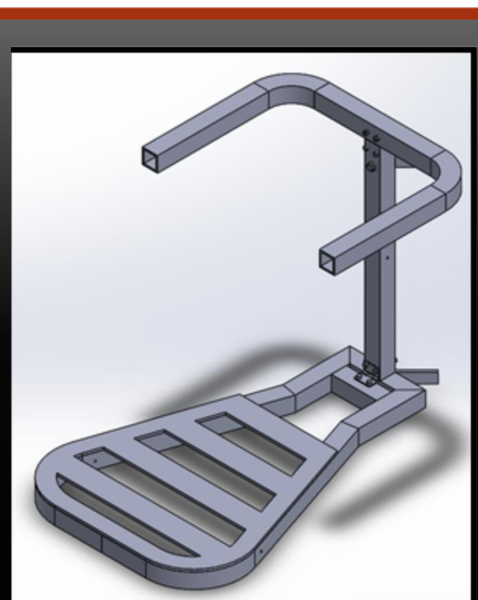
Abstract

The Hybrid Hanger is a fully carbon fiber-epoxy composite hang-on tree stand. This 12-pound tree stand design allows a hunter to carry the stand further without fatiguing, which is perfect for public land hunters. In order to support the weight of a person and the harshness of hunting environments, the Hybrid Hanger will need to be strong and weather resistant. It has been tested to 450 pounds and the carbon fiber is an improvement upon the current metal stands of today's market. Other qualities of the Hybrid Hanger that improve upon current tree stands in the market include: noise reduction, corrosion resistance, and the compact and sleek design. The Hybrid Hanger will also be foldable with backpack straps to easily carry on a hunter's back as they walk to their hunting location.

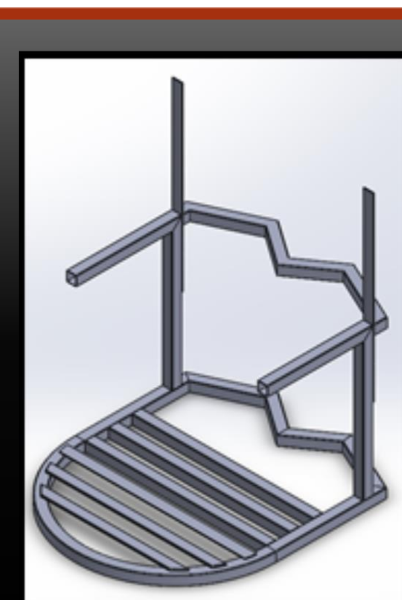
Design Alternatives

Design 1



- Compact
- Single Vertical Bar
- No Back Rest
- Collapsible
- 9 Parts

Design 2



- Bulky
- Double Vertical Bar
- Back Rest
- Foldable
- 12 Parts

Design Concerns

DESIGN CONCERNS CATEGORIES	DESIGN CONCERNS	DEFINITION (Unit of Measurement)	REQUIRED VALUE	GOAL
Physical	Lightweight	Weight of stand (lb)	12	8
	Comfort	Deflection of seat with 450lbs applied in center of seat (in)	1.0	1
Structural	Adequate Strength	Failure load applied to front of seat according to ASTM F2531 standards (psi)	450	450
	Impact	Drop test without structural damage (ft) [Impact test substituted (lbf)]	10 [111.6]	10 [189]
Environmental	Weather Exposure	Flexural strength (ASTM D 790) retained following exposure to water for 24 hr (%)	95	95
	UV	42 cycles of 8 hours at 70 C (ASTM D 4329) [Retaining percentage of strength] (%)	95	95
Human Engineering	Ease of Use	Quick take down time to fold and transport (min)	Low	-
	Quiet	Cannot hear from distance (ft)	100	100
Life cycle	Ease of Service	Number of parts total (#)	Low	12
Cost	Affordable Price	Cost plus profit margin of 36% ($)	300	185.15 (38%)

Table 1: Design Concerns Table

Final Design

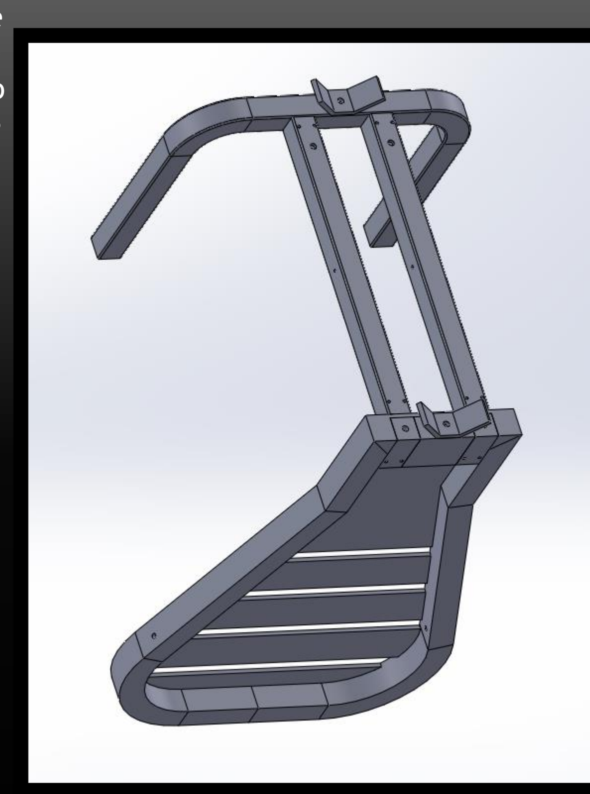
The final design of the Hybrid Hanger is a combination of the two design alternatives. Most of the ideas chosen were from Design 1 shown above but a few design changes were necessary for a quality part. The first design change was to include two vertical bars. This added extra strength to the seat connection without adding too much weight. The second change was to simplify and strengthen the base of the stand. This provided more stiffness and strength in critical areas.

Features

- Lightweight (About 10 lbs)
- Minimal Total Parts (6)
- Collapsible (Two Hinged Joints)
- Quiet (Fully Carbon Parts)
- Easy To Use

Additional parts included (not shown in Figures)

- Backpack Straps
- Tree Straps
- Mesh Seat
- Cables
- Hardware



Fabrication of Prototype

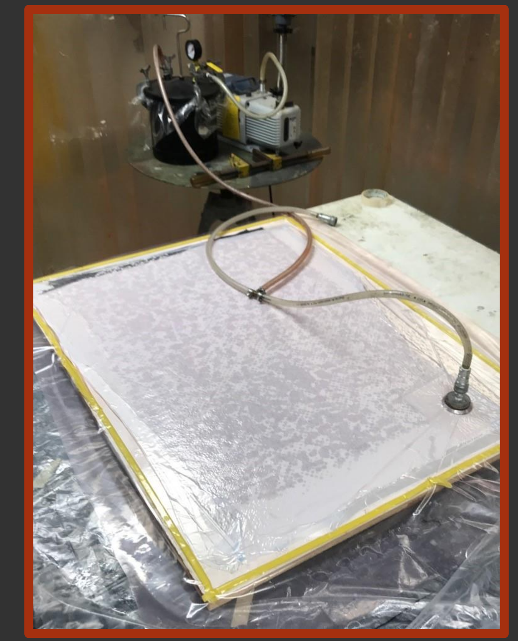


Figure 1: Vacuum Bagged Base Plate

Figure 2: Cutting the Base Plate

1. **Base Plate and Frame**

The process started with laying up a flat sheet of carbon fiber fabric and letting it cure under vacuum (Figure 1). Once cured, the sheet was then cut to size using a bandsaw (Figure 2). A foam core was placed on the trimmed plate to gain the thickness needed in the frame of the base (Figure 3). A lay-up draping method was then used to entrap the foam core and bond to the flat plate on bottom shown in Figure 8 below. After draping the plies the part was then cured under vacuum again to achieve the correct dimensions. After it was cured the slats were then cut out to produce the finished base part.

2. **Seat**

The seat was fabricated using the same process as the Base Plate and Frame. The foam core was placed on a flat carbon sheet and a similar draping method was used to entrap the foam core. The mesh seat was then slid onto the seat part to produce the finished seat shown in Figure 5.

3. **Vertical Bar**

Filament winding was used to create the two vertical bars shown in Figure 7. A square PVC tool with rope wrapped around was used to obtain a square contour while still achieving the correct 1.5in dimension of the bar (Figure 4). The filament wound path chosen included alternating circumferential and a helical wind (20° fiber angle) totaling 4 layers with about 0.2in thickness.

4. **Back Braces**

The back braces were laid up over the tool shown in Figure 6 using carbon fiber fabric material. The part was then cured under vacuum and cut to create both of the back braces. Then they were trimmed and sanded to the correct dimensions.

5. **Assembly**

Holes were drilled in each of the parts where they were needed. Then the tree stand was assembled using stainless steel hinges and hardware. The Assembled base and vertical bars are shown in Figure 7.

Figure 3: Cutting Base Frame Core

Figure 4: Filament Winding of Vertical Bar

Figure 5: Assembly of Seat

Figure 6: Back Brace Tool

Figure 7: Assembly of Base and Vertical Bars

Figure 8: Draping Method Used in Making the Base

Team Members

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Testing

Dimensional Testing	Measurement (in)	Tolerance ± (in)
Seat Beam Height Consistency	1.5	0.25
Seat Beam Width Consistency	1.5	0.25
Base Frame Height Consistency	1.5	0.25
Base Frame Width Consistency	1.5	0.25
Platform Slat Thickness Consistency	0.25	0.10
Platform Slat Width Consistency	3.0	0.25
Back Brace Width	1.5	0.10
Back Brace Thickness	0.25	0.10
Vertical Beam Outer	1.5	0.10

Table 2: Dimensional Testing

Visual Testing			
Test	**Definition**	**Min or Max**	**Required Values**
Blisters	Blisters per 1.5inx1.5in section of the beam	Max	1
	Total blisters along vertical beam	Max	10
Voids	Largest Area of Void (in^2)	Max	0.5
Wrinkles	Deepest Depth of wrinkle (in)	Max	0.1

Table 3: Visual Testing

Mechanical Testing			
Test	**Definition**	**Min or Max**	**Required Values**
Seat Flex Test	Flex Test Load (lbs)	Min	450
	Flex Test Deflection (in)	Max	1
Base Frame Flex Test	Flex Test Load (lbs)	Min	450
	Flex Test Deflection (in)	Max	1
Base Platform Flex Test	Side 1 Flex Test Load (lbs)	Min	225
	Side 1 Flex Test Deflection (in)	Max	0.75
	Side 2 Flex Test Load (lbs)	Min	225
	Side 2 Flex Test Deflection (in)	Max	0.75

Table 4: Mechanical Testing

Qualification testing on the Hybrid Hanger was done using three different Methods: Dimensional Testing, Visual Testing, and Mechanical Testing. For the dimensional inspection 9 different positions of the tree stand were inspected. The measurements and tolerances used are shown in Table 2. The visual inspection; looked for blisters, voids, and wrinkles. Table 3 shows the maximum amounts and sizes the tree stand was to meet in order to pass inspection. The mechanical testing portion consisted of three separate tests. The first test performed was on the base platform and frame shown in Figure 9. The base was fastened into position and tested according to ASTM standard F2126 using Instron testing equipment until failure. The second test was on the seat, shown in Figure 10, which was fastened in the same way and tested according to ASTM standard F2531. The third test done was on one of the slats in the base platform. A three point bend test according to ASTM standard D790 was performed to check the stiffness of the slat. All of the required values the tree stand had to meet in order to pass the mechanical qualifications are found in Table 4 above.

Figure 9: Test Setup for Base

Figure 10: Test Setup for Seat