

**NAU Solar Plane
18F22
“Solis Fur”
Assembly Manual**

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1 General Notes

- **While completing this build, it is a good idea to print off a copy of the bill of materials and keep it as a reference for each step.**
- **This build is meant for experienced craftsman, it is not recommended for novice builders.**
 - A good understanding of basic building techniques and wiring will be required.
- Approximate build time will be 200+ hours.
- Purchased parts (mainly electronics) will not be detailed within the appendices.
- Some parts will be used in multiple sections, labeled as separate parts, but will be the same part.
 - Ultracote (A8, B6, C6, D8, E13).
 - Fuselage Rib (B2, C2)
 - 5mm Carbon Fiber Fuselage Rod (B3, C3)
 - Fuselage Stringer (B4, C4)
 - 3x2mm Magnet (B5, C5)
 - Tail Main Rib End (D3, E6)
 - Tail Main Rib (D4, E7)
 - Tail Rear (D5, E8)
 - Tail Rear with Horn (D6, E9)
 - Control Rod (D7, D12)
- Electronic positioning will not be detailed, it is up to the discretion of the builder where the most appropriate placement is within the fuselage.
- Fastener locations will be detailed within the notes, but a graphic will not be provided.
- The lengths of wire to be used will not be disclosed, enough wire will be provided.
- All Eagle Tree components can be omitted if the builder desires, they are not crucial to the functionality.
- Please ensure that all fastener connections are secure but not overly tight.
- Please ensure that when building the wings, the stick-out of the 13mm Carbon Fiber Wing Spar (A1) is on opposite sides and in the correct orientation so that the wings will fit onto the plane in the correct orientation. Refer to Figure 16.
- In addition to included parts, approximately Qty-5 8' 2x4s will be required to build jigs.
- It is a good idea to have various heat shrink tubing sizes and electrical tape on hand.

2 Assembly Tools

- Sandpaper/Emory cloth
- Toothpick/Cotton swab (Q-tip)
- Soldering Iron
- Wire Strippers
- Wire Cutters
- Lighter
- Monokote Iron
- Heat Gun
- Various Screwdrivers
- Various Allen keys
- ½" Wrench
- Hobby Knife/Utility Knife
- Scissors
- Multi-meter
- Needle Nose Pliers
- Tweezers
- Chop Saw
- Woodworking clamps for jigs

3 Bill of Materials

Item	Part Number	Quantity	Description	Item	Part Number	Quantity	Description	Item	Part Number	Quantity	Description
-	A	2	Wing	-	E	1	Vertical Tail	-	G	-	Connections and Fasteners
1	A1	2	13mm Carbon Fiber Wing Spar	29	E1	1	11mm Carbon Fiber Vertical Short	53	G1	1	Deans Plug (Pairs)
2	A2	4	5mm Carbon Fiber Support Rod	30	E2	2	11mm Carbon Fiber Vertical Long	54	G2	4	XT-60 Plug (Pairs)
3	A3	16	NACA 4412 Airfoil	31	E3	1	11mm Carbon Fiber Angle Rod	55	G3	3	3.5mm Bullet Connectors (Pairs)
4	A4	30	C60 Solar Cell	32	E4	1	5mm Carbon Fiber Trailing Edge	56	G4	2	6mm Clevis Pin
5	A5	45	C60 Solar Cell Dogbone Connector	33	E5	1	5mm Carbon Fiber Trailing Edge Angle	57	G5	8	2mm Cotter Pin
6	A6	1	Double Sided Foam Tape (Roll)	34	E6	5	Tail Main Rib End	58	G6	4	M2x20 Bolt
7	A7	4	20 AWG Wire (Quantity in m)	35	E7	2	Tail Main Rib	59	G7	4	M3x20 Bolt
8	A8	1	Ultracote	36	E8	4	Tail Rear	60	G8	8	M5x40 Bolt
-	B	1	Fuselage, Top	37	E9	2	Tail Rear w. Horn	-	H	-	3D Printed Parts
9	B1	4	Top Fuselage Bracket	38	E10	2	Tail Rear Lower	61	H1	1	Motor Mount
10	B2	3	Fuselage Rib	39	E11	2	Tail Rear Upper	62	H2	1	Fuselage Positioning Bracket
11	B3	5	5mm Carbon Fiber Fuselage Rod	40	E12	1	Control Rod	63	H3	1	Nosecone
12	B4	2	Fuselage Stringer	41	E13	1	Ultracote	64	H4	1	Rearcone
13	B5	18	3x2mm Magnet	-	F	-	Electronics	65	H5	2	Control Horn
14	B6	1	Ultracote	42	F1	1	Hobby Sky 360Kv Motor	-	I	-	Misc Parts
-	C	1	Fuselage, Bottom	43	F2	1	Turnigy 2200mAh Battery	66	I1	1	Carbon Fiber Tail Boom
15	C1	4	Bottom Fuselage Bracket	44	F3	1	Eagle Tree Elogger V4	67	I2	1	Aeronaught 18x6 Folding Propeller
16	C2	3	Fuselage Rib	45	F4	1	Turnigy Plush 60A ESC	68	I3	1	Aeronaught Yolk
17	C3	5	5mm Carbon Fiber Fuselage Rod	46	F6	1	Fr Sky X8R Radio Receiver	69	I4	1	Aeronaught 2-Blade Spinner
18	C4	2	Fuselage Stringer	47	F7	1	Fr Sky Mini LiPo Voltage Reader	70	I5	1	Propeller Adapter
19	C5	18	3x2mm Magnet	48	F8	1	Eagle Tree Pitot Tube Sensor	71	I6	1	Carbon Fiber Wing Shroud Upper
20	C6	1	Ultracote	49	F9	1	Eagle Tree RPM Sensor	72	I7	1	Carbon Fiber Wing Shroud Lower
-	D	1	Horizontal Tail	50	F10	1	Eagle Tree GPS	73	I8	4	Wing Mounting Arms
21	D1	3	11mm Carbon Fiber Tail Spar	51	F11	2	Parkzone DSV-130 Servo				
22	D2	1	5mm Carbon Fiber Trailing Edge	52	F12	1	Switching Relay				
23	D3	8	Tail Main Rib End								
24	D4	10	Tail Main Rib								
25	D5	11	Tail Rear								
26	D6	2	Tail Rear w. Horn								
27	D7	1	Control Rod								
28	D8	1	Ultracote								

4 Wing Construction

1. Obtain Qty-2 13mm Carbon Fiber Wing Spar (A1), Qty-4 5mm Carbon Fiber Support Rod (A2) and Qty-16 NACA 4412 Airfoil (A3).
2. Thread carbon fiber rods through their corresponding holes.
3. Space each NACA 4412 Airfoil approximately 130mm apart, flushing up all rods on a single end.
4. Move each Airfoil about an inch to gain access to the carbon fiber rods.
5. Slightly rough each area that will be housed in an Airfoil with an Emory cloth or sand paper.
6. Place a thin layer of epoxy around each tube with a Q-tip or toothpick.
7. Slide the Airfoil into position.
8. Repeat for remaining Airfoils.
9. Allow the epoxy to set for at least one hour.

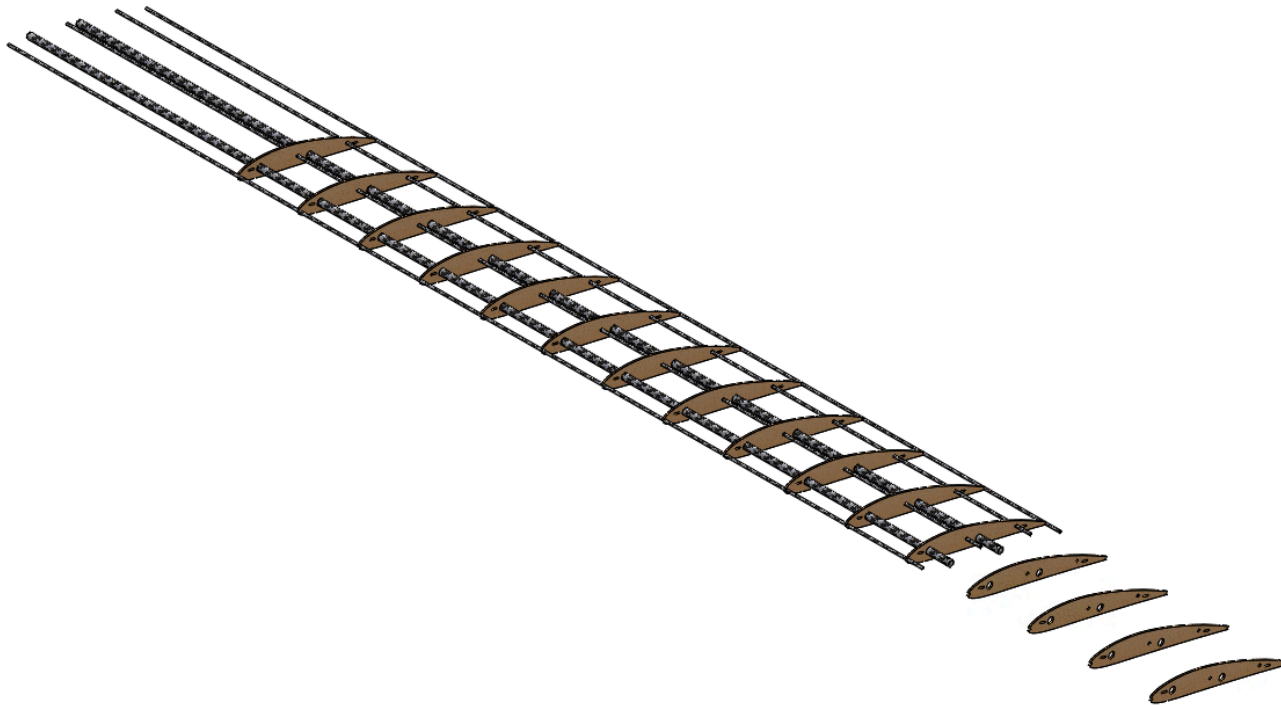


Figure 1 - Wing Construction 1

10. Obtain Qty-3 C60 solar cell dog bone connectors (A5) and pre-tin a drop of solder onto each extremity using a soldering iron.
11. Place Qty-2 C60 solar cells (A4) face down and align connectors to the soldering points identified by gold dots.
12. Ensure solar cells are oriented in series by connecting the positive and negative terminals in the center using the connector.
13. Gently press the Qty-6 pre-tinned locations on each cell with a soldering iron, making sure not to let solder flow over the internal wiring.
14. Repeat until 15 sets have been made.
15. Attach double sided adhesive (A6) to the wing structure by placing Qty-2, 1" strips onto all carbon fiber supports with the exception of the two outside support rods.
16. Remove the adhesive backing and place the soldered pair of solar cells centered in the gap between the airfoils, making sure to alternate positive and negative terminals.

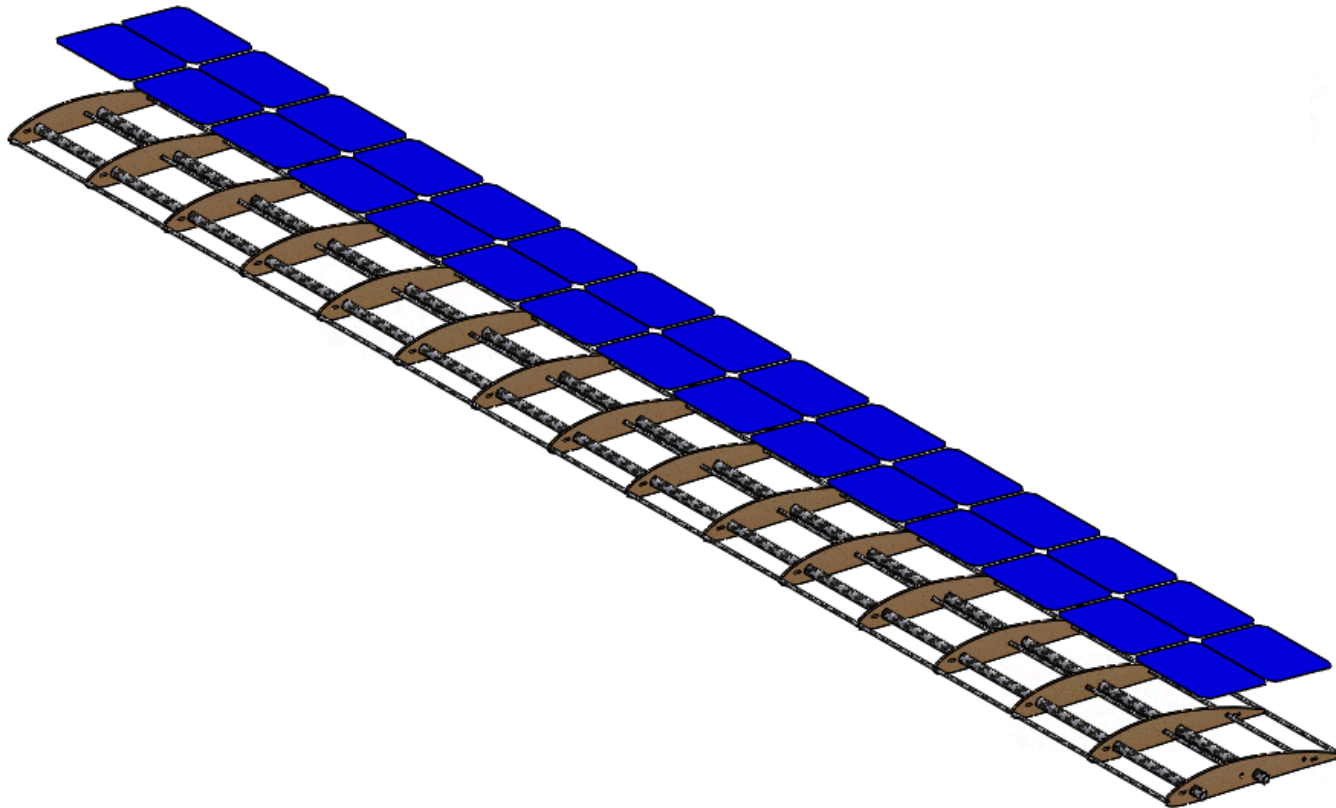


Figure 2 - Wing Construction 2

17. Verify the solar cells alternate polarity along the leading edge (+ - + -).
18. Cut short lengths of 24 AWG wire (A7), long enough to reach from one edge of a connector through the slot in the Airfoil and to the adjacent edge of the next connector of the adjacent solar cells.
 - 18.1. Note: The jumper wire should go from a + to a - to remain in series.
19. Beginning at the outermost set of solar cells, on the negative side, solder and run a length of wire through each slot in the Airfoil and out the end of the wing.
20. Solder a male XT60 plug (G2) onto the wires protruding through the final slot in the Airfoil.
21. Apply Ultracote film (A8) to the exterior of the Airfoil Ribs, trying to avoid wrinkles and securing the ends.

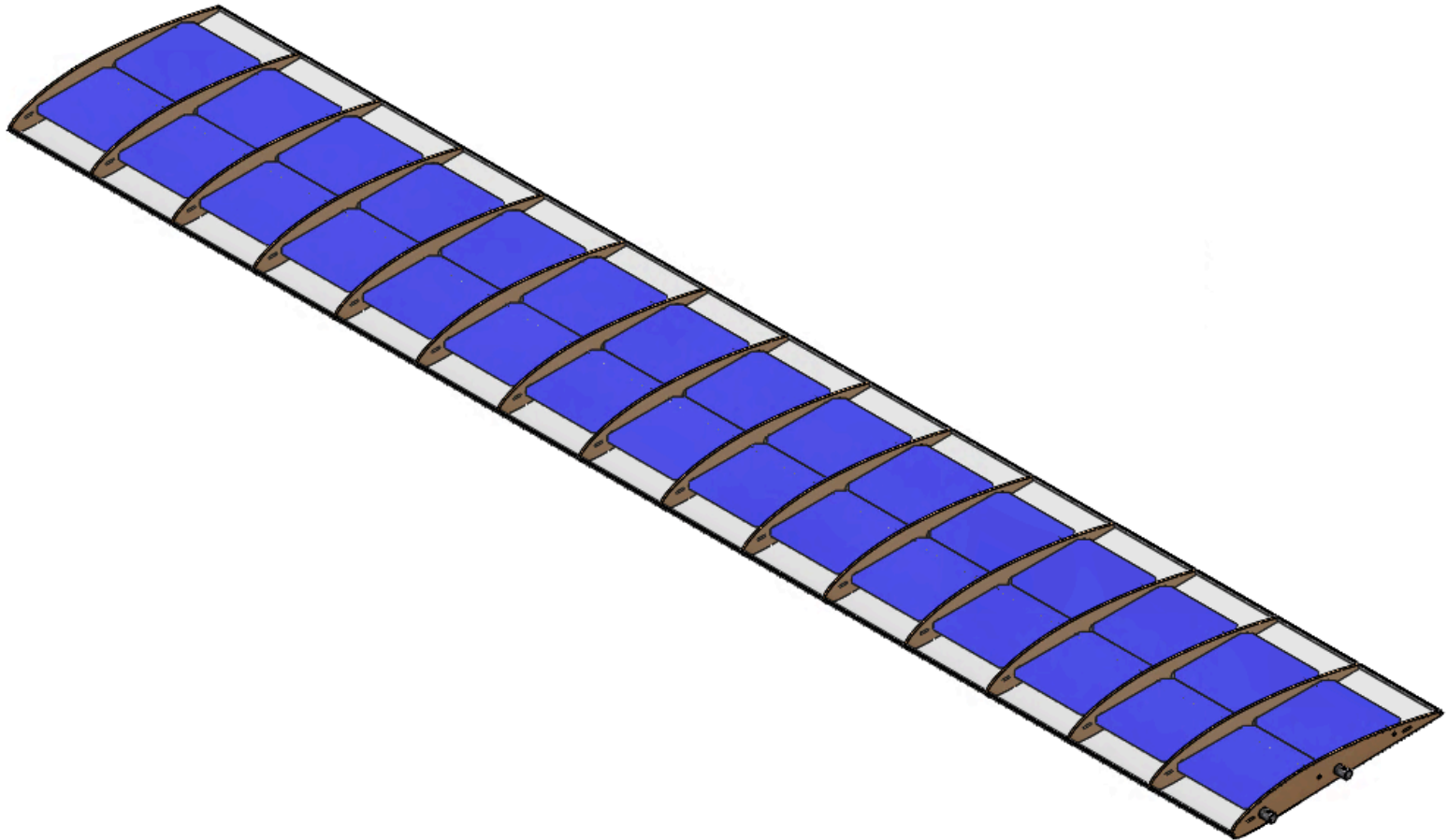


Figure 3 - Wing Construction 3

22. Using a small iron, tack the Ultracote along the outside perimeter of each Airfoil.

23. Cut overlap on each end to approximately 10mm and tack to end Airfoil ribs with the iron.
24. Using a heat gun, shrink Ultracote until taught and free of wrinkles.

5 Fuselage Construction

Note: Construction steps will be the same for both the top and bottom fuselage assemblies (B,C). All elements in this section will be termed (B) components, but the corresponding (C) components can be used when building the (C) assembly.

1. Take Qty-2 Fuselage Stringer (B4) and Qty-18 3x2mm Magnet (B5). Epoxy Qty-2 3x2mm Magnet into each hole in the Fuselage Stringer, ensuring all magnet polarities are facing the same direction.



Figure 4 - Fuselage Construction 1

2. Take Qty-4 Top Fuselage Bracket (B1) and laminate two sets of two together using epoxy.
3. String Qty-3 Fuselage Rib (B2) onto Qty-5 5mm Fuselage Rod (B3) putting a laminated Top Fuselage Bracket on either end.
4. Evenly space the Top Fuselage Brackets and Fuselage Ribs on the 5mm Fuselage Rods.
5. Spread a thin layer of epoxy where each Top Fuselage Bracket or Fuselage Rib will be placed.
6. Slide each Top Fuselage Bracket or Fuselage Rib into position.
7. Secure with wedges pressing the 5mm Fuselage Rods tight.
8. Leave the epoxy to set for at least an hour.

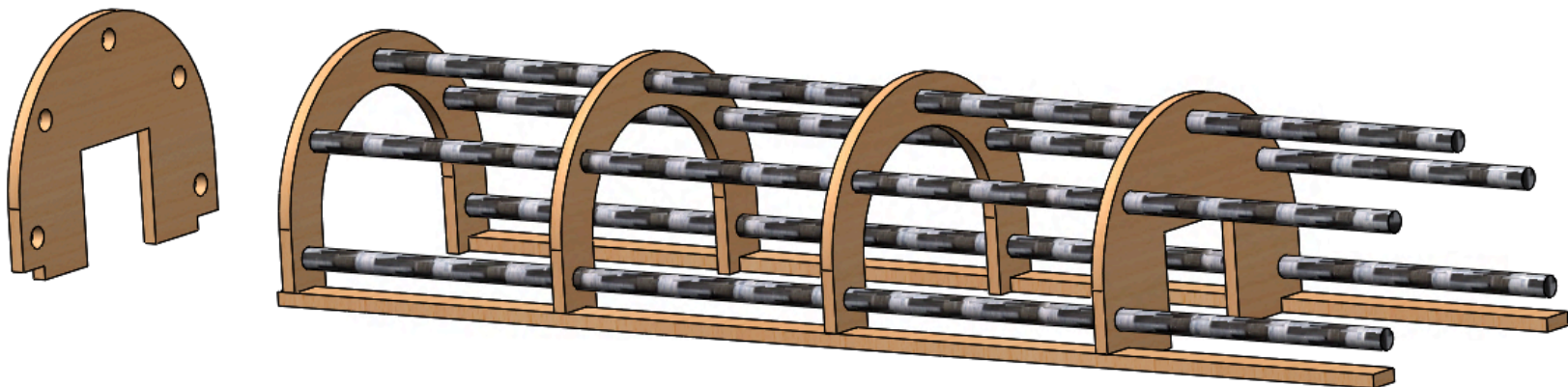


Figure 5 - Fuselage Construction 2

9. Apply the Ultracote (B6) in the same manner as used for the wings

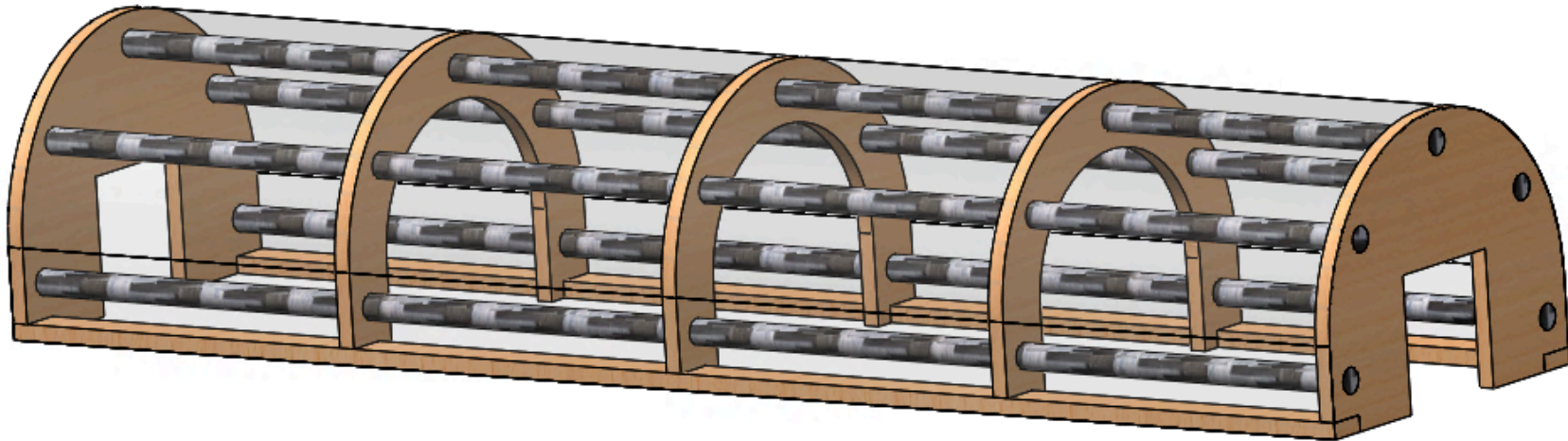


Figure 6 - Fuselage Construction 3

6 Horizontal Tail Construction

Note: Ensure that all pivot members have adequate room such that they do not bind.

1. Take Qty-2 11mm Carbon Fiber Tail Spar (D1) and epoxy into Qty-1 Carbon Fiber Tail Boom (I1) such that an equal length protrudes from each side.

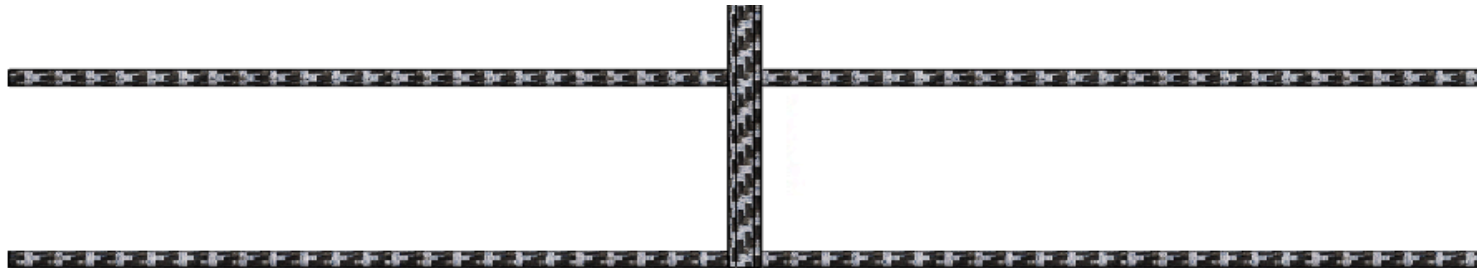


Figure 7 - Horizontal Tail Construction 1

2. Laminate 4 sets of Tail Main Rib Ends (D3) and 1 set of Tail Rear With Horns (D6) together using epoxy
3. Closest to Carbon Fiber Tail Boom, place Qty-1 Tail Main Rib (D4) followed by a laminated Tail Main Rib End then 3 more Tail Main Ribs, finally an additional laminated Tail Main Rib End.
4. Equally space all members
5. Apply epoxy to each mating face, save the protruding end of the Tail Main Rib Ends
6. Repeat for the other side

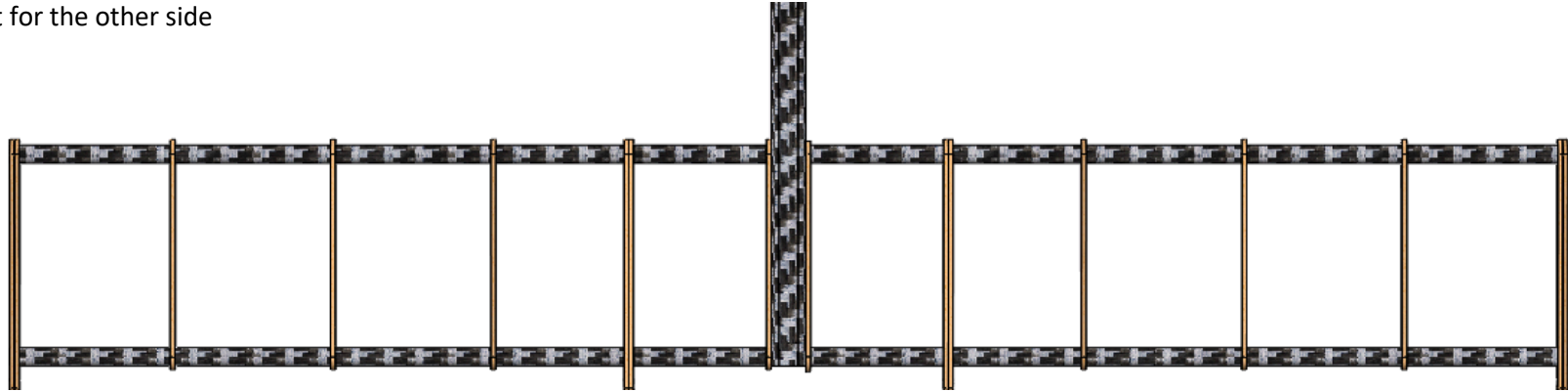


Figure 8 - Horizontal Tail Construction 2

7. Slide the following members onto the remaining 11mm Carbon Fiber Tail Spar, in this order: Tail Main Rib End, Qty-4 Tail Rear (D5), Tail Main Rib End, laminated Tail Rear With Horns, Qty-3 Tail Rear, Tail Main Rib End, Qty-4 Tail Rear, Tail Main Rib End.
8. Equally space all Tail Rears with the exception of the 2 in the middle, to be aligned with their corresponding Tail Main Rib.
9. Epoxy all members into place, ensuring to not fix the pivots.

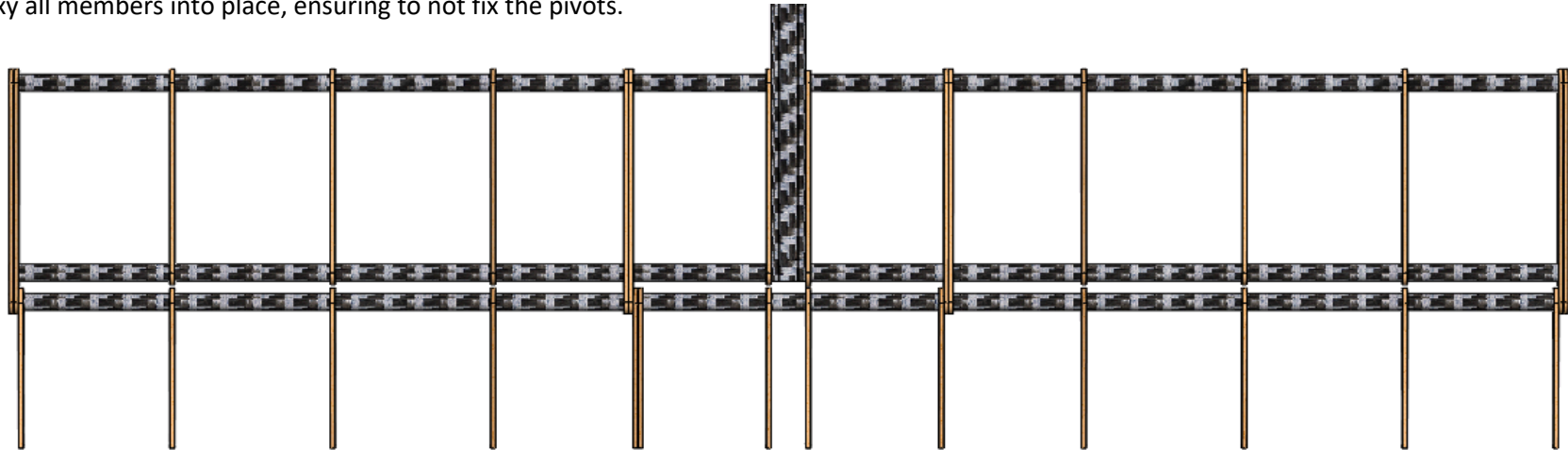


Figure 9 - Horizontal Tail Construction 3

10. Epoxy Qty-1 11mm Carbon Fiber Tail Spar onto the slot placed at the end of the Tail Rears and secure until dry.
11. Install Qty-1 Parkzone DSV-130 Servo (F11), Qty-1 Control Rod (D7), Qty-1 Control Horn (H5) and Eagle Tree Pitot Tube Sensor (F8) in their corresponding locations, securing all connections.
12. Apply the Ultracote (D8) as previously completed.

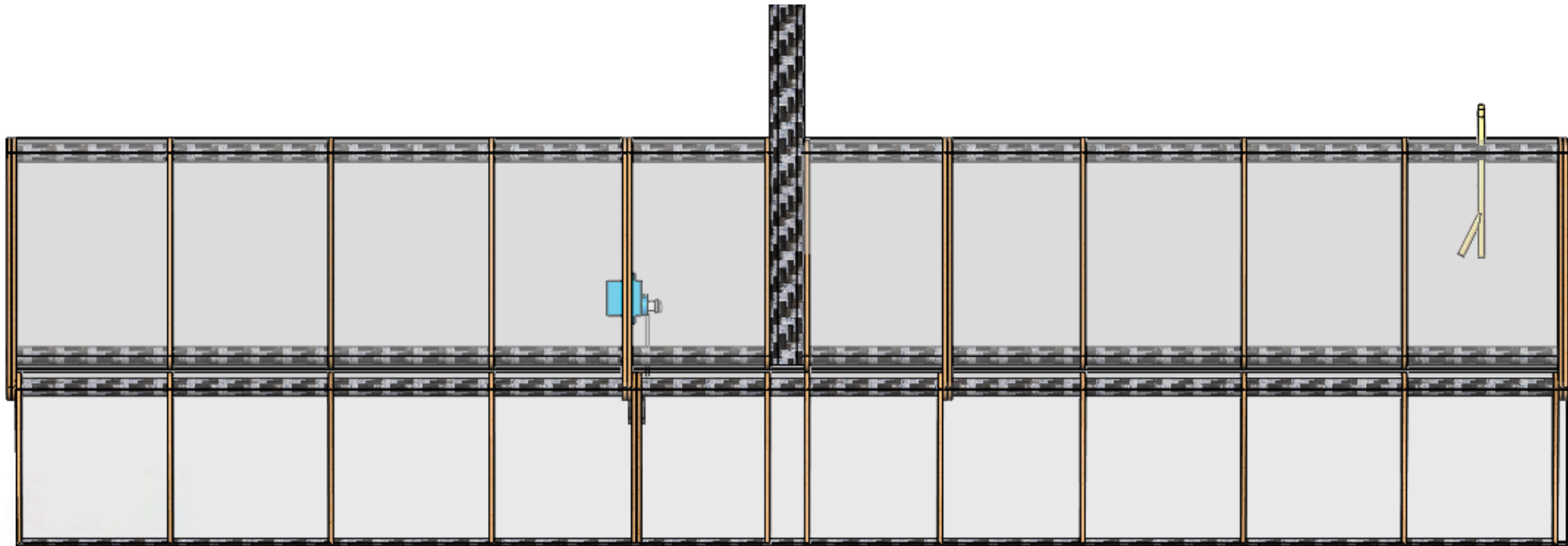


Figure 10 - Horizontal Tail Construction 4

7 Vertical Tail Construction

1. Take Qty-1 11mm Carbon Fiber Vertical Short (E1) and 1xCarbon Fiber Vertical Long (E2) and epoxy into Carbon Fiber Tail Boom (I1) leaving a 3mm stick out at the bottom.

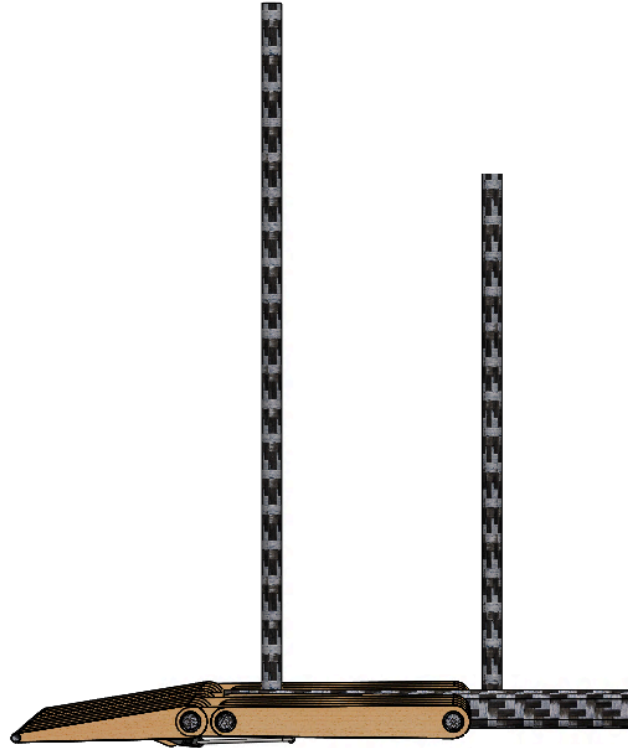


Figure 11 - Vertical Tail Construction 1

2. Epoxy Qty-2 Tail Main Rib (E7) to either side of Carbon Fiber Tail Boom.
3. Take Qty-4 Tail Main Rib End (E6) and laminate 2 pairs with epoxy.
4. Place over the existing tubes the following members, in this order: laminated Tail Main Rib End, Tail Main Rib, laminated Tail Main Rib End, Tail Rear Upper (E11).
5. Equally space and epoxy.

6. Install 11mm Carbon Fiber Angle Rod (E3) in its position and epoxy.

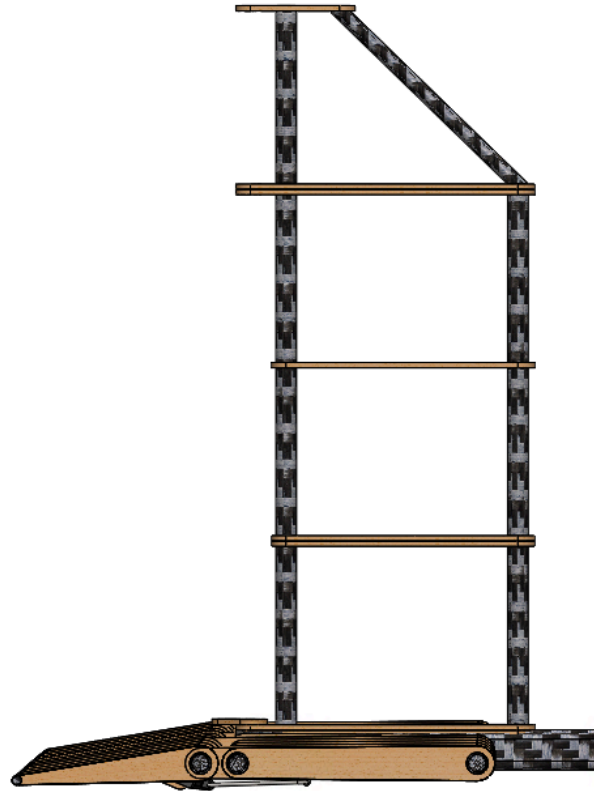


Figure 12 - Vertical Tail Construction 2

7. Making sure it passes through the following order, slide the remaining Carbon Fiber Vertical Long into position: Tail Rear (E8), Tail Rear Upper, Tail Main Rib End, Tail Rear, Tail Rear, Tail Rear with Horn (E9), Tail Rear Lower (E10).
8. Epoxy all members in place, again insuring to leave pivots alone.
9. Install and epoxy 5mm Carbon Fiber Trailing Edge (E4) and Carbon Fiber Trailing Edge Angle (E5) in the slots provided.

10. Install Qty-1 Parkzone DSV-130 Servo (F11), Qty-1 Control Rod (E12), and Qty-1 Control Horn (H5) in their corresponding locations, securing all connections.
11. Apply the Ultracote (E13) as previously completed.

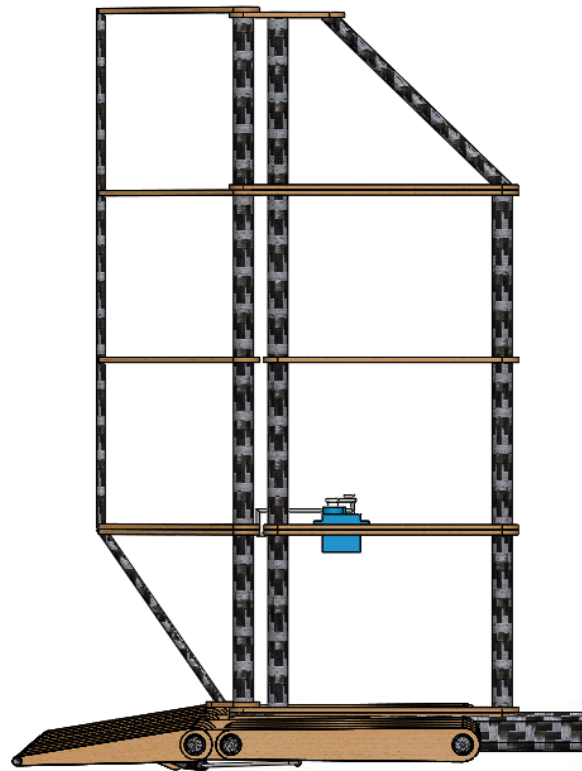


Figure 13 - Vertical Construction 3

8 Electronics Setup

1. Epoxy Rear cone (H4) to Fuselage Positioning Bracket (H2) and Motor Mount (H1) to Nosecone (H3) in the configuration shown.

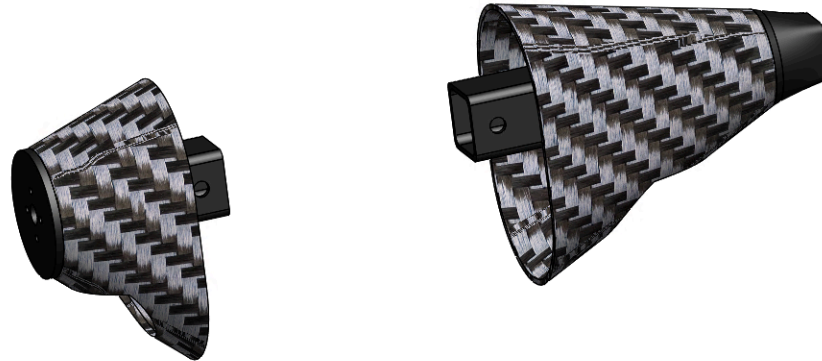


Figure 14 – Electronics Setup 1

2. Attach Hobby Sky 360Kv Motor (F1) to Motor Mount using Qty-4 M2x20 Bolt (G6)
3. Insert Qty-2 6mm Clevis Pin (G4) into the corresponding holes on the Fuselage Positioning Bracket and Motor Mount.
4. Secure with Qty-2 2mm Clevis Pin (G5)
5. Connect all wiring connections as shown in Figure 15. More detailed views will be added in Appendix G.

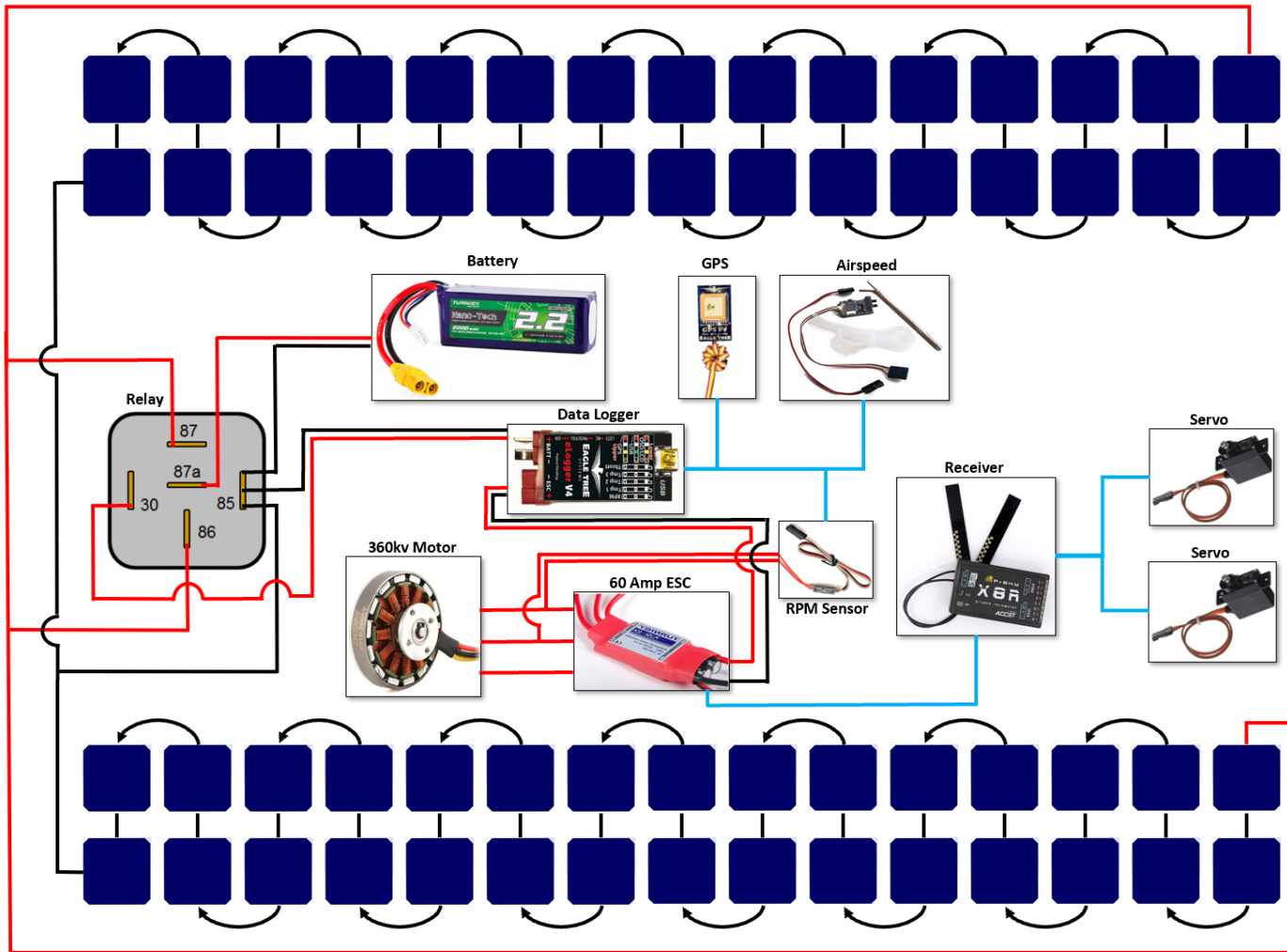


Figure 15 Electronics Setup 2

6. Attach Turnigy 2200mAh Battery (F2) to Carbon Fiber Tail Boom (I1) as the front most component.
7. Attach all other components to tail boom where they will fit using Double Sided Foam Tape (A6), zip ties or electrical tape.

9 Final Assembly

1. Attach Propeller Adapter (I5) to Hobby Sky 360Kv Motor using Qty-4 M3x20 Bolt (G7)
2. Attach Aernaught Yolk (I3) to Propeller Adapter using the supplied hardware.
3. Attach Aernaught 2-Blade Spinner (I4) to Aernaught Yolk using the supplied bolt.
4. Attach Aernaught 18x6 Folding Propeller (I2) to Aernaught Yolk using the supplied hardware.
5. Using short strips of Double Sided Foam Tape (A6) secure the antennae of Fr Sky X8R Radio Receiver (F6) to Rear cone (H4) so that they are 90° from each other.
6. Attach Qty-4 Wing Mounting Arms (I8) to Carbon Fiber Tail Boom (I1) using Qty-8 M5x40 Bolt (G8).
7. Slide each wing onto the Wing Mounting Arms as seen in Figure 16.

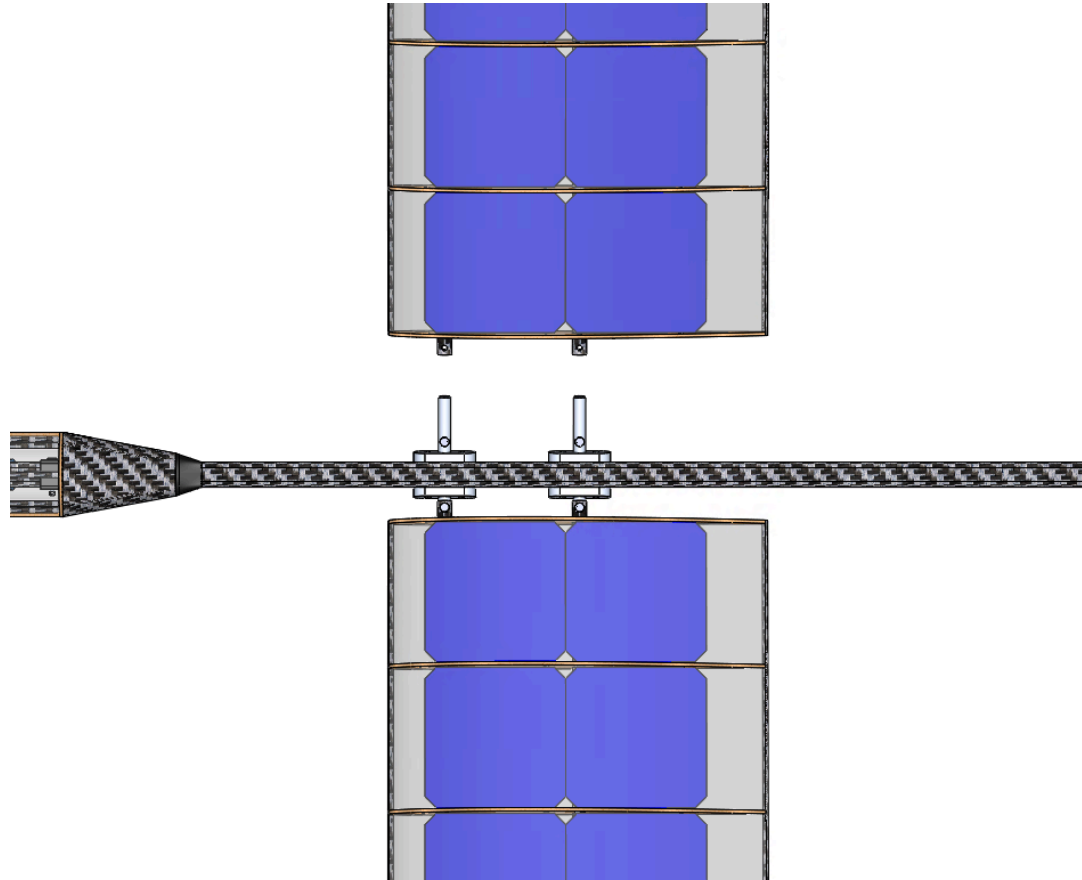


Figure 16 -Final Assembly 1

8. Insert Qty-4 2mm Clevis Pin (G5) into the holes for each Wing Mounting Arm and secure by bending the ends.
9. Connect Qty-2 XT-60 Plug (G2) to connect the solar cells to the power system.
10. Cover the Wing Mounting Arms with Qty-1 Carbon Fiber Wing Shroud Upper (I6) and Qty-1 Carbon Fiber Wing Shroud Lower (I7), securing the lower portion with Double-Sided Foam Tape and the top to the bottom using Qty-2 2mm Clevis Pin.
11. Ensure that the configuration resembles Figure 17, final product.

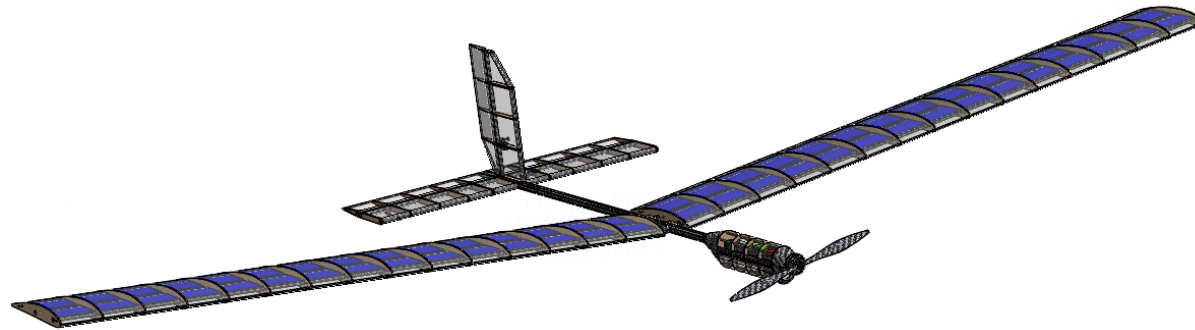


Figure 17 - Final Assembly 2

10 Getting Ready to Fly/Operation

1. Attach the XT-60 Plug (G2) to Turnigy 2200mAh Battery (F2) to power the system.
2. Ensure that all lights present in the fuselage are solid and not blinking, ensuring that the data logging system is operational.
3. Turn on the radio transmitter and ensure that it has paired with the Fr Sky X8R Radio Receiver (F6) by trying all controls (Motor, Elevator, Rudder).
4. Cover all the electronics with Fuselage, Top (Part B) and Fuselage, Bottom (Part C) that secure via the installed magnets.
5. Once you have confirmed that everything is working as intended, you are ready to fly.
6. This airplane will fly using only three controls: throttle, elevator and rudder. Fly the airplane as any other three channel airplane.

11 Maintenance

While the build process for this airplane is quite daunting, the maintenance should be rather care free. Below is a list of general maintenance and possible situations that may occur and how to remedy them.

- Be sure to keep the wing Ultracote covering material free from blemishes, dirt and debris or anything else that would reduce the efficiency that light passes through the material. Use a water and mild soap solution in a spray bottle with a microfiber cloth to keep the material clean.
- If Ultracote covering material begins to sag over time, use the heat gun to re-tighten.
- If dog bone connectors on the solar cells become de-soldered, the Ultracote will need to be removed from that wing, re-solder the solar cell and re-apply

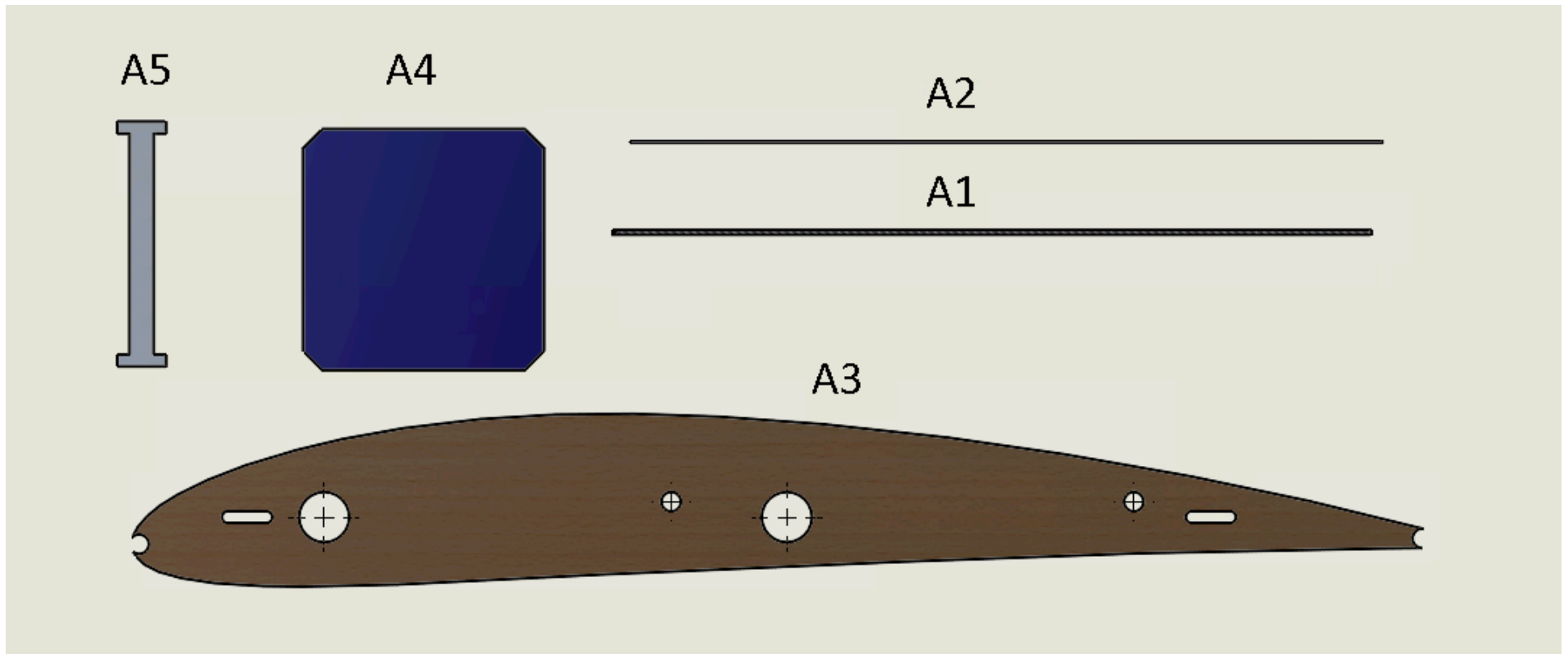
new Ultracote.

- If you find that the controls set up on your transmitter are controlling the elevator instead of rudder, or vice versa, switch the location of the plugs in the receiver.
- If you find that the motor is spinning the incorrect direction, switch any two of the wires connecting the electronic speed controller to the motor.

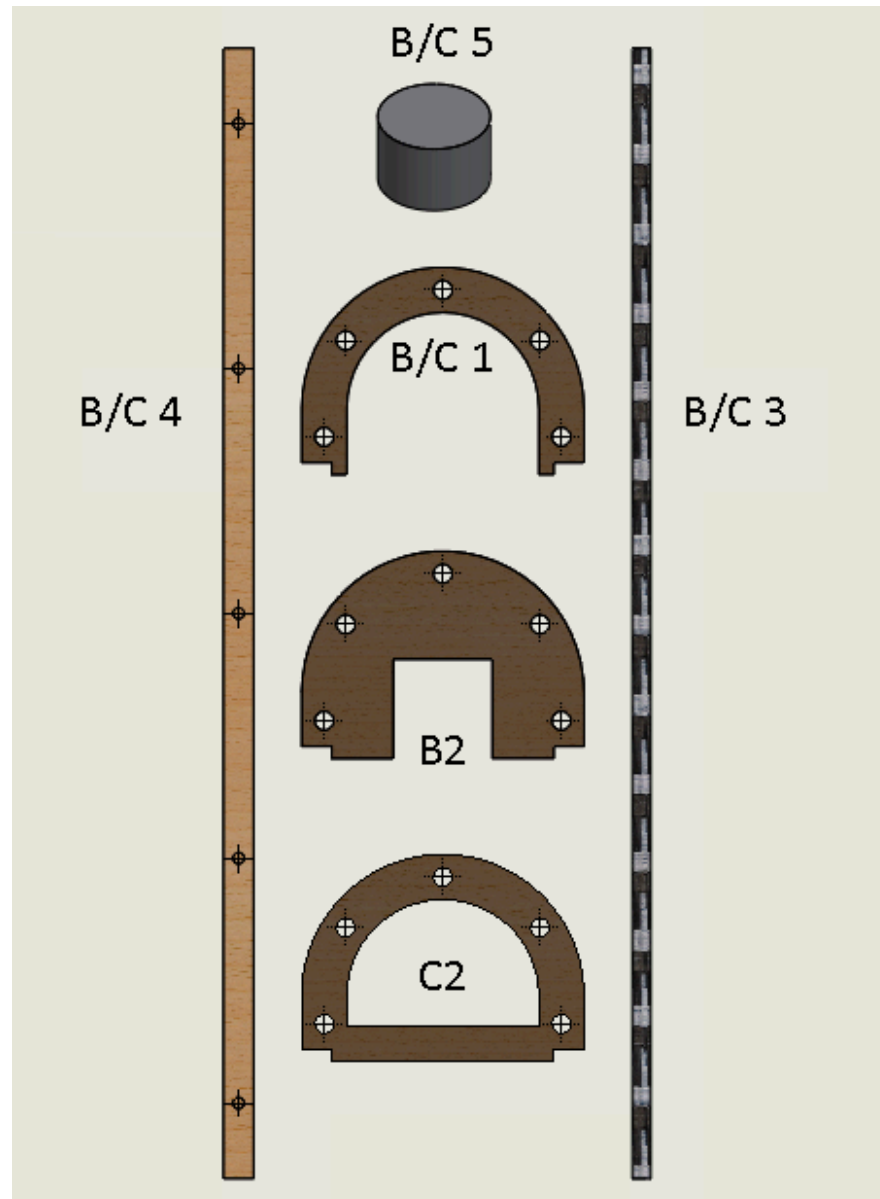
12 Storage

- Store with all power connections un-plugged (XT-60 plugs at wings and battery).
- Store the plane with the wings off between uses to reduce the stress within the wing members, re-install upon the next use.
- Store in a clean, dry area out of direct sunlight.
- Ensure that the battery is stored in its fully charged state, 4.2V/cell (4 cell battery included: 16.8V).

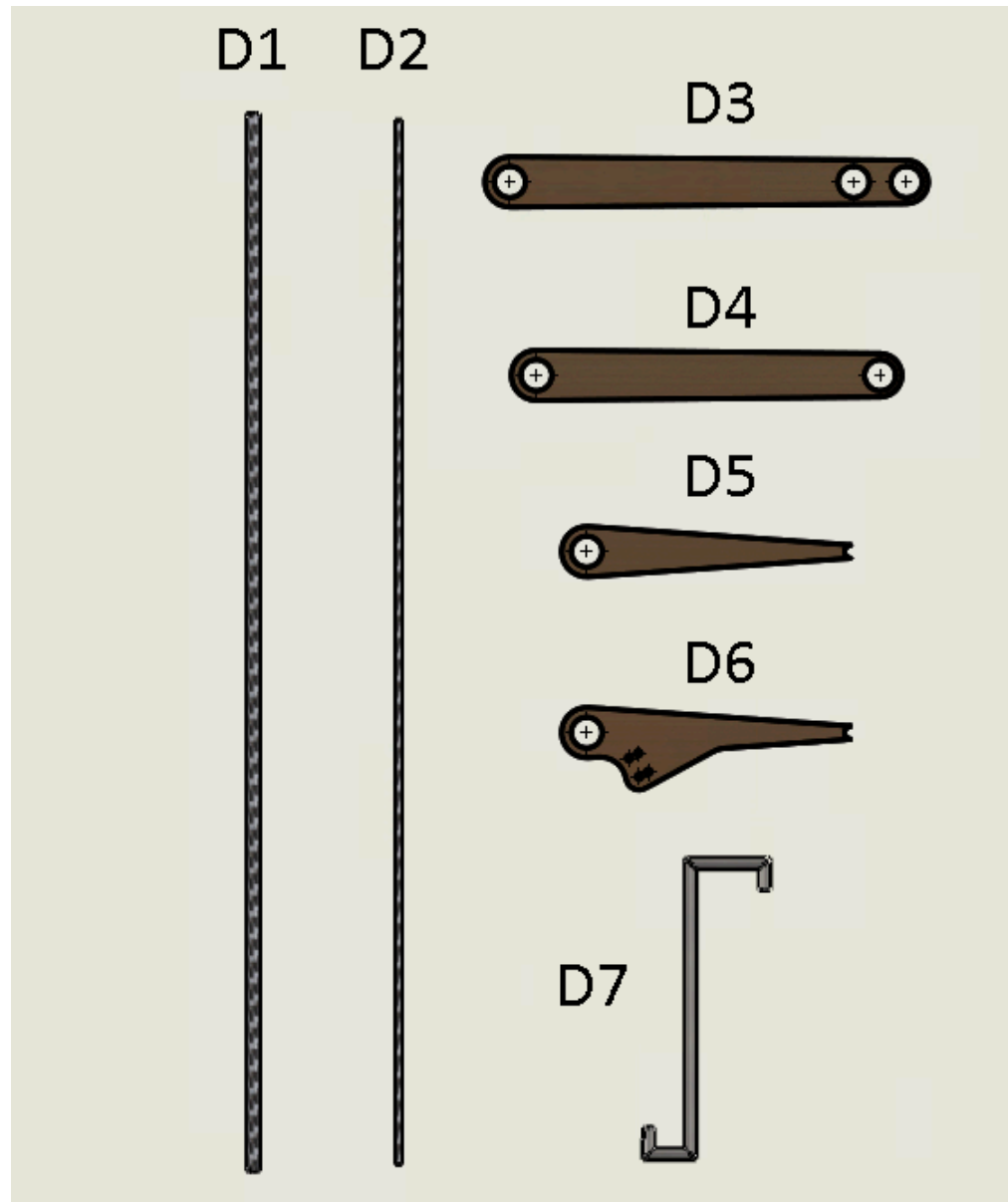
13 Appendix A – Wing Parts (Parts A)



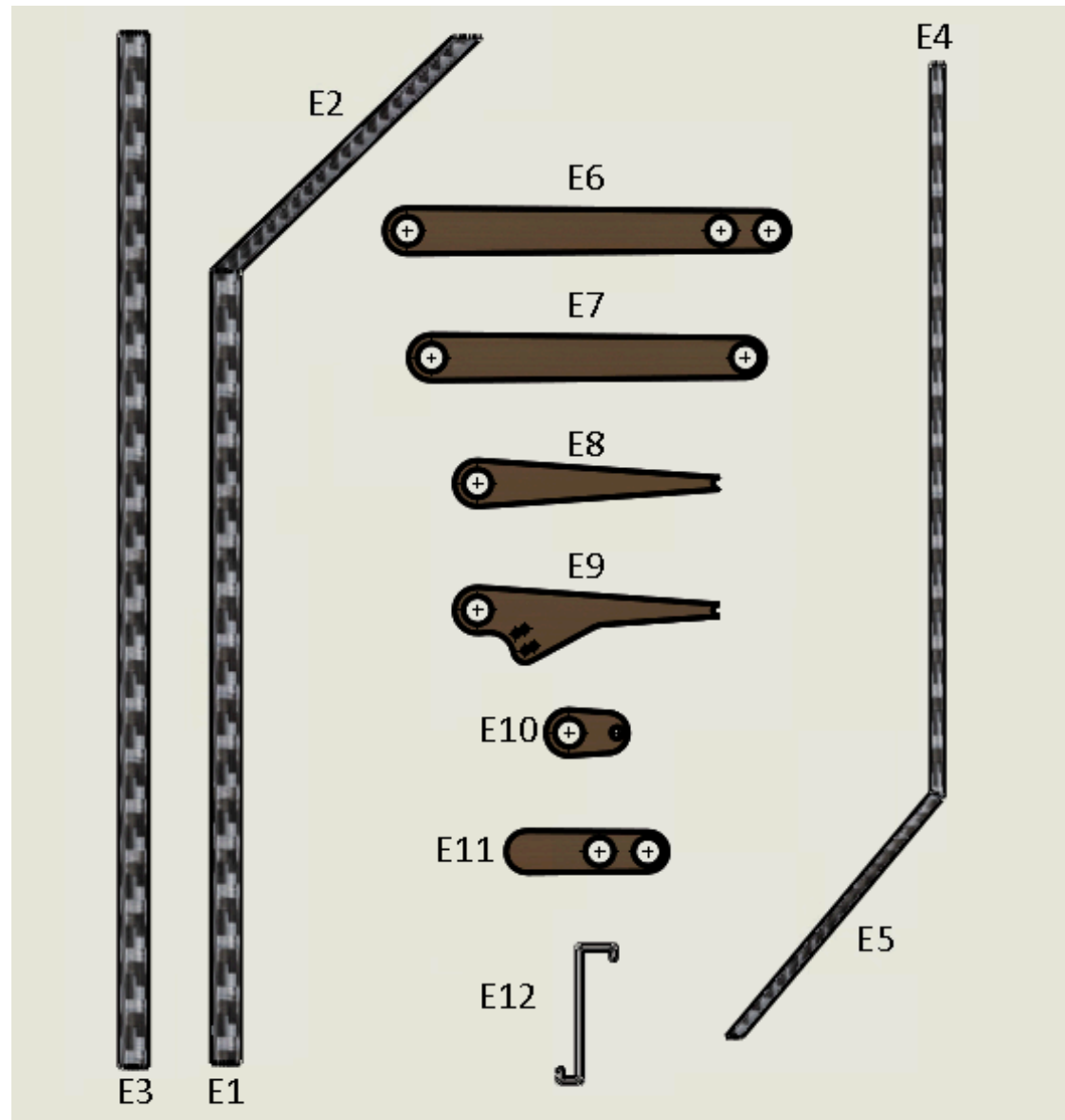
14 Appendix B – Fuselage Parts (Parts B/C)



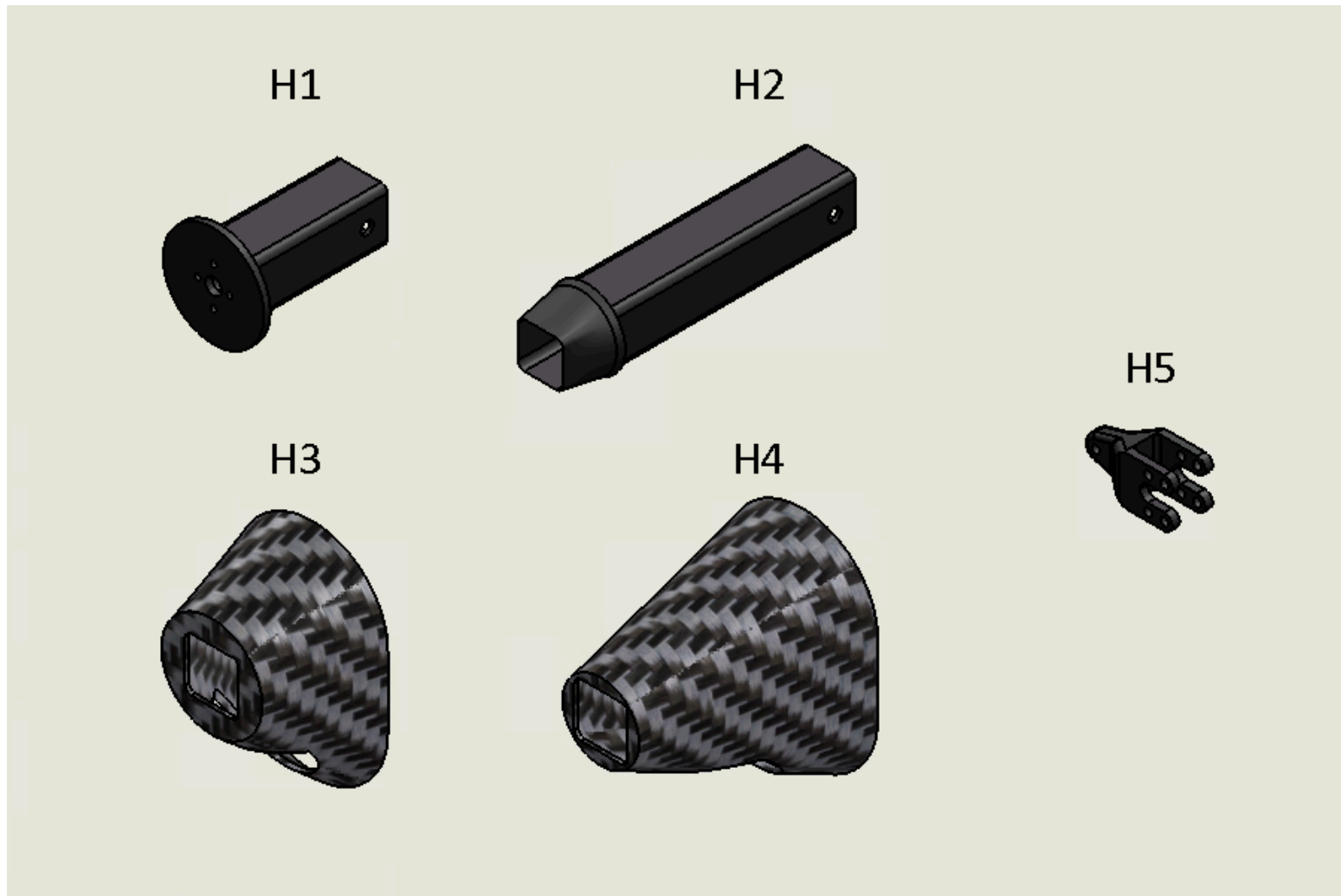
15 Appendix C – Horizontal Tail Parts (Parts D)



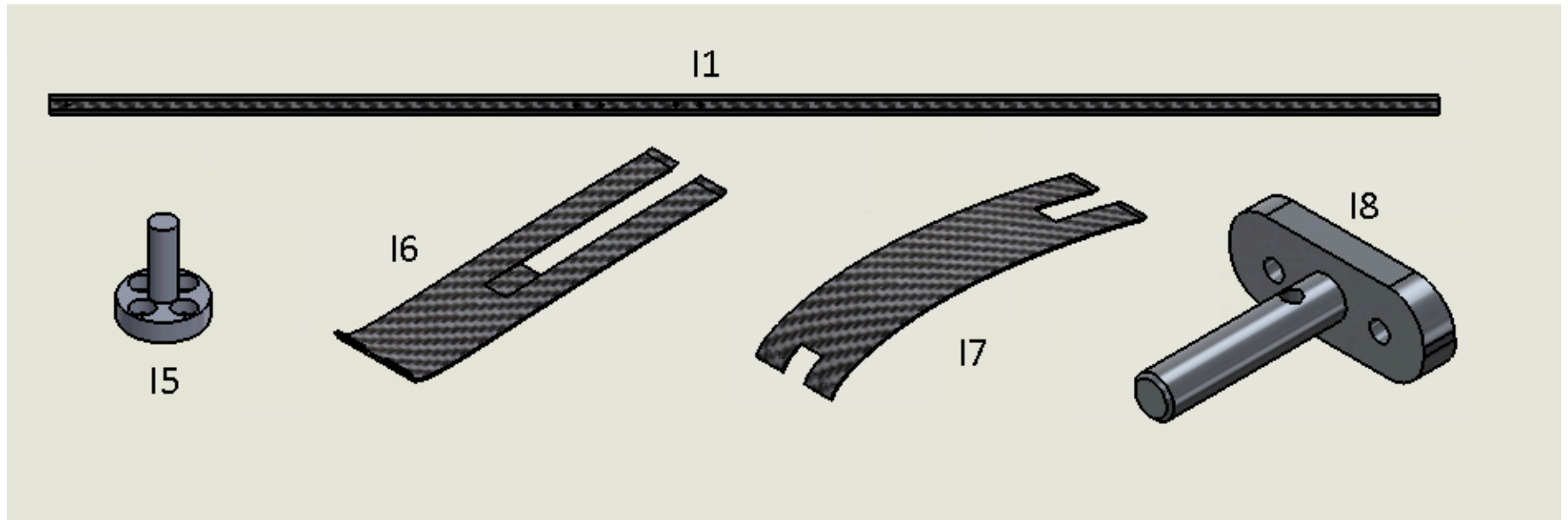
16 Appendix D – Vertical Tail Parts (Parts E)



17 Appendix E – 3D Printed Parts (Parts H)



18 Appendix F – Miscellaneous Parts (Parts I)



19 Appendix G – Electronics/Wiring Diagrams

