LAYERWINGS · ASSEMBLY MANUAL

Shaheen 1200

3D-printable tail-sitter VTOL drone in the Cheel family
1200 mm span · twin tractor motors · big elevons · 26 printed parts · Bambu Lab ready



Version 1.0 · November 2026
Questions: info@layerwings.com · layerwings.com

Read this first

Dry-fit every step before you glue. The parts only fit one way: spar holes, pin holes and spigots line up only with the right neighbour. The file name of every part is its code in this manual: **`WING-L3`** = Wing, Left, section 3 counted from the body. **`BODY-2R`** = middle body piece, right half. **`FIN-T`** / **`FIN-B`** = top / bottom fin.

Safety. A new design, not yet flight-tested by us: weigh your parts, check the CG and test carefully before the first full flight. Remove the propellers whenever you work on the plane with a battery connected. Fly at your own risk and follow your local drone rules.

Colours in the step pictures: orange = parts you add in this step, grey = already built, black = carbon, blue = PETG parts and screws, green = servo.

Key numbers

	Value
Wingspan	1200 mm (body + 2 plug-in wings)
Standing height	746 mm (nose to feet)
Wing area	34 dm^2 · Cheel reflex airfoil 12 %, 24° sweep
All-up weight	≈ 2.13 kg (4S2P 10 Ah) · ≈ 2.41 kg (4S3P 15 Ah)
CG	**284 mm behind the nose tip** (aft limit 294 mm)
Printed parts	≈ 0.88 kg, 26 parts
Stall / cruise	≈ 38 km/h stall · best L/D 10.5 at ≈ 47 km/h
Flight time	≈ 98 min (10 Ah) / ≈ 130 min (15 Ah), calculated incl. 2 min hover
Hover	2 x 3115 900 KV + 11 x 5.5" tractor props, big elevons in the prop wash
Take-off / landing	Vertical, standing on 2 fin tips + 2 carbon wingtip legs (TPU feet)

What you need

Carbon and hardware

Qty	Part	Length	Where
2	Carbon tube 10 x 8 mm	648 mm	Main spars (they cross inside the body)
2	Carbon tube 6 x 4 mm	356 mm	Rear spars (wing only)
2	Carbon rod 5 mm	104 mm	Rear pins (wing to body, stop twist)
2	Carbon rod 4 mm	243 mm	Wingtip legs
2	Carbon rod 3 mm	173 mm	Fin rods (one per fin)
2	Carbon rod 3 mm	60 mm	Elevon joiners (2 pieces per elevon)
2 + 2	M4 x 25 nylon bolt + M4 heat-set insert		Wing lock
4	M3 x 40 bolt + nyloc nut		Nacelles through the wing
8	M3 motor screws + thread lock		Motors on the nacelles
8	6 x 3 mm magnets		Hatches
~20	1.75 mm filament, 20 mm pieces		Body alignment pins

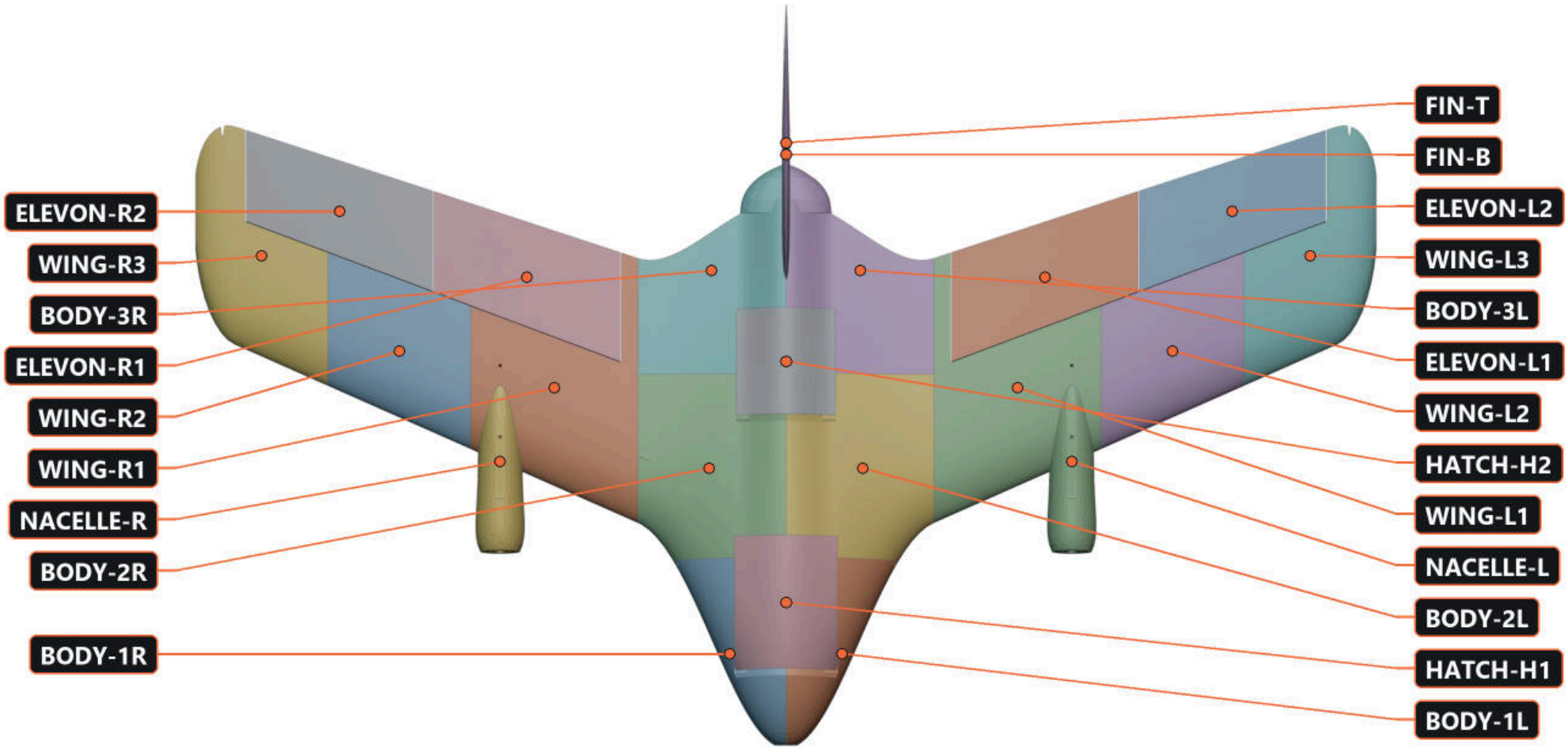
Electronics (suggested)

	Suggestion
Motors	2 x 3115 class 900 KV, ≥ 2.1 kg thrust each on 4S with 11 x 5.5 props (1 CW + 1 CCW)
ESC	2 x 40 A (AM32 / BLHeli_32), one inside each nacelle
Servos	2 x 12 g metal-gear, ≥ 4 kg·cm (the big elevons work hard in hover)
Battery	4S2P 21700 Li-ion 10 Ah brick 71 x 85 x 43 mm (8 x P50B) · or 4S3P 15 Ah 142 x 64 x 43 mm
Autopilot	ArduPilot tail-sitter: Matek H743-WING / Pixhawk 6C mini + M10 GPS + compass
Radio	ELRS receiver + telemetry, airspeed sensor (pitot in the nose)
Hover	≈ 375 W / ≈ 25 A with 10 Ah, peaks ≈ 70 A: XT60 + 14 AWG

Tools and glue

- Soldering iron with a heat-set insert tip
- Thin + medium CA glue, CA activator
- 30-min epoxy + microballoons (spars)
- 5-min epoxy (pins, small parts)
- Hobby knife, sandpaper 120 / 240
- Hacksaw or Dremel cutting disc for carbon (wear a mask)
- Ruler, marker, masking tape, small spirit level
- CA hinges or hinge tape
- Velcro straps, double-sided foam tape, zip ties

Parts map



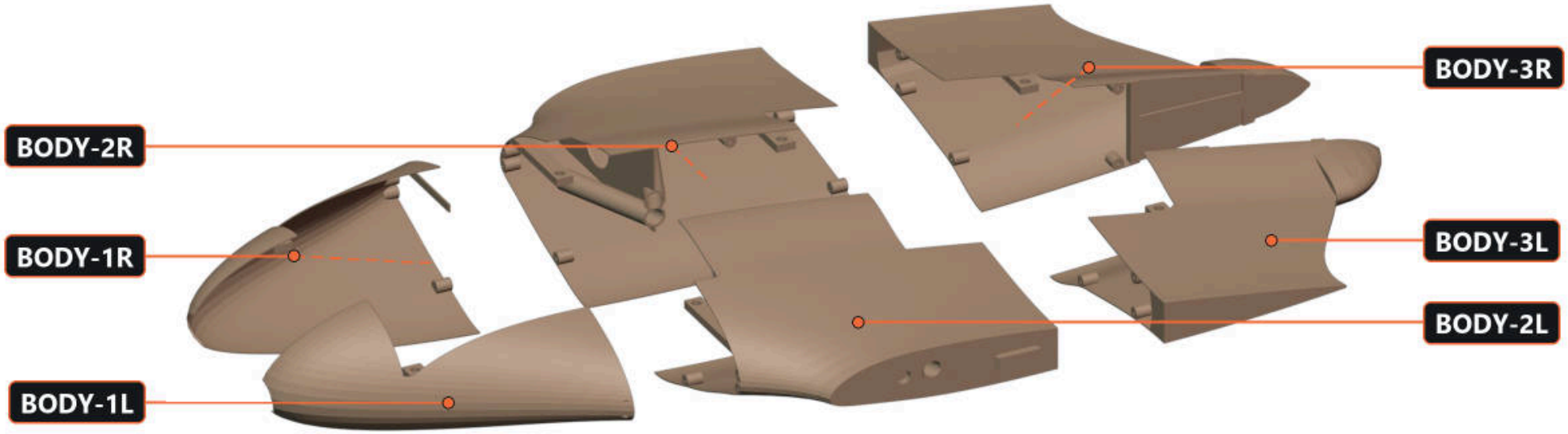
Seen from above, nose at the bottom. Each colour is one print; the code is its file name. Hatches are drawn lifted. Fins, feet and the carbon parts are shown in their steps.

26 printed parts

File	Filament	Settings	Size on bed (mm)	≈ mass
BODY-1L	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, standing on the rear joint face, nose up	94x114x188	15 g
BODY-1R	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, standing on the rear joint face, nose up	94x114x188	15 g
BODY-2L	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, lying on the flat centre split face	188x187x155	42 g
BODY-2R	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, lying on the flat centre split face	187x188x155	43 g
BODY-3L	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, lying on the flat centre split face	176x176x150	28 g
BODY-3R	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, lying on the flat centre split face	176x176x150	28 g
ELEVON-L1	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	132x133x190	28 g
ELEVON-L2	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	124x124x190	25 g
ELEVON-R1	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	133x132x190	28 g
ELEVON-R2	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	124x124x190	25 g
FIN-B	PETG	3 walls, 10 % gyroid, lying flat on its side	223x222x7	60 g
FIN-T	PETG	3 walls, 10 % gyroid, lying flat on its side	228x228x7	66 g
FOOT-FIN-B	TPU 95A	3 walls, 30 % infill	16x16x8	1 g
FOOT-FIN-T	TPU 95A	3 walls, 30 % infill	16x16x8	1 g
FOOT-TIP-L	TPU 95A	3 walls, 30 % infill	16x14x14	2 g
FOOT-TIP-R	TPU 95A	3 walls, 30 % infill	16x14x14	2 g
HATCH-H1	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, standing on its front edge	87x87x135	9 g
HATCH-H2	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, standing on its front edge	83x83x110	7 g
NACELLE-L	PETG	3 walls, 15 % gyroid, motor face down	50x50x183	72 g
NACELLE-R	PETG	3 walls, 15 % gyroid, motor face down	50x50x183	72 g
WING-L1	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	198x196x170	69 g
WING-L2	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	149x148x145	45 g
WING-L3	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	189x188x134	43 g
WING-R1	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	196x198x170	69 g
WING-R2	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	148x149x145	45 g
WING-R3	LW-PLA / Bambu PLA Aero	2 walls, 0 % infill, 0.6 mm skin, standing on the inboard face	188x189x134	43 g

The files in 1_PRINT_ready_for_Bambu are already turned and centred for a 256 mm bed: open, pick the filament, slice. Wings, elevons and body in LW-PLA / PLA Aero (2 walls, 0 % infill: the thin slots inside become printed ribs and spar webs). Nacelles and fins in PETG (they carry motor and landing loads), feet in TPU.

01 Body: 6 pieces



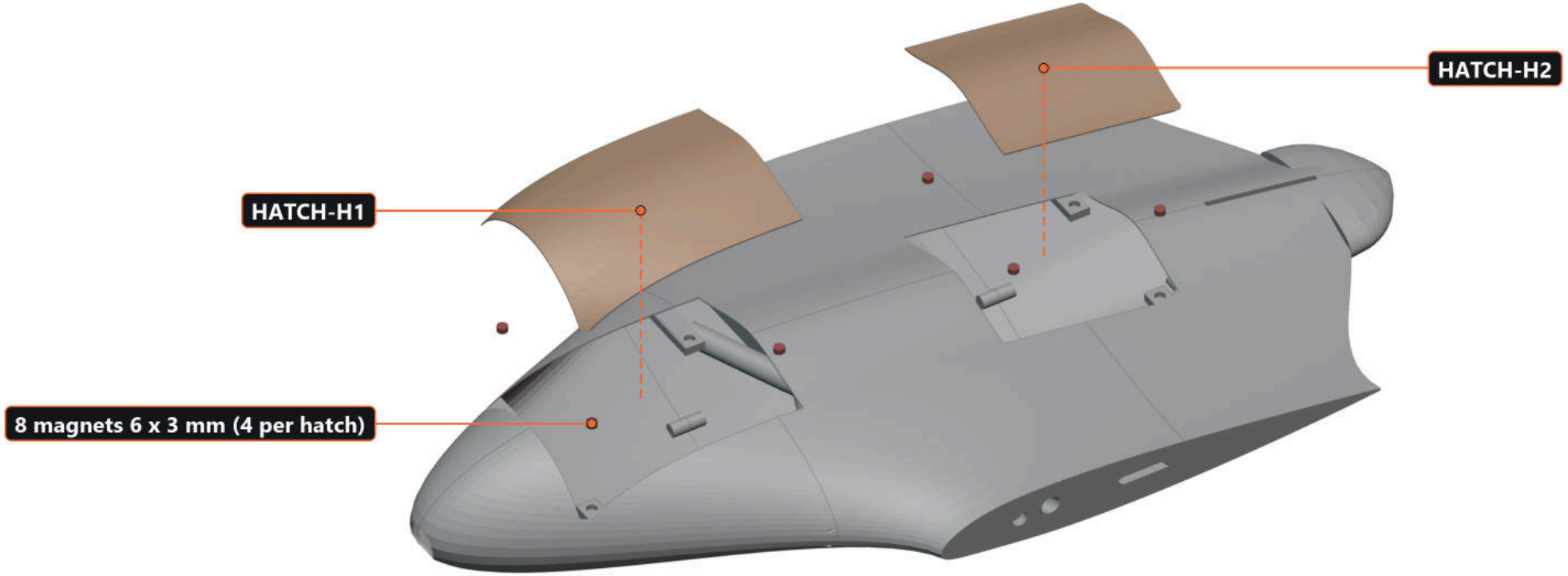
CA / thin epoxy | ~20 filament pins

1. Sand the joint faces flat. Every seam has round bosses with a 1.9 mm hole: push in 20 mm pieces of **1.75 mm filament** as alignment pins.
2. Glue **BODY-1L + 1R**, **2L + 2R**, **3L + 3R** first (left + right halves), then join the three rings with CA or thin epoxy.
3. Check from above that the centre line is straight before the glue cures.
4. **BODY-3** has the rounded tail cone and the two **fin slots** (top and bottom): keep them clean of glue.

Tip: Tape the halves together, then wick thin CA into the seam.

New in this step | Already built | Carbon | Hardware | PETG

02 Hatches and magnets



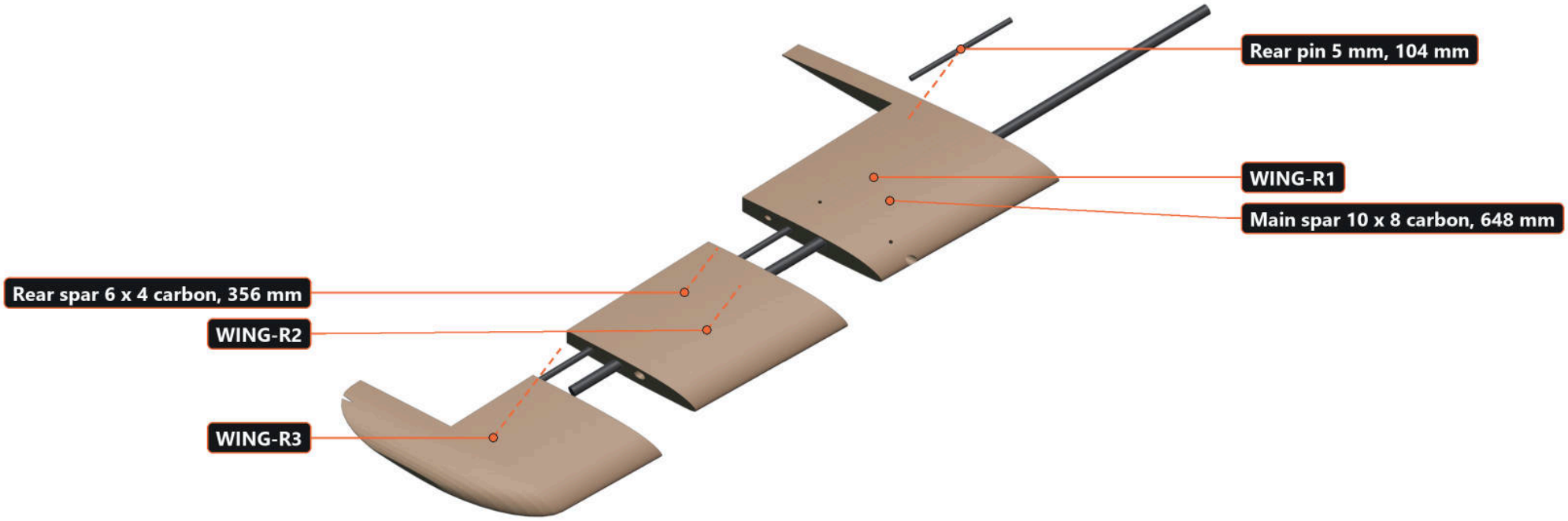
8 magnets · CA

1. Glue **4 magnets 6 x 3 mm** in each hatch frame and 4 in each hatch (mind the polarity).
2. **HATCH-H1** (front) is the battery bay, **HATCH-H2** (middle) the autopilot + GPS bay.
3. Both hatches must close flush; the hover airflow goes over them.

Tip: Stack each hatch magnet on its frame magnet before gluing: polarity is then always right.

New in this step · Already built · Carbon · Hardware · PETG

03 Wing: three sections on two spars



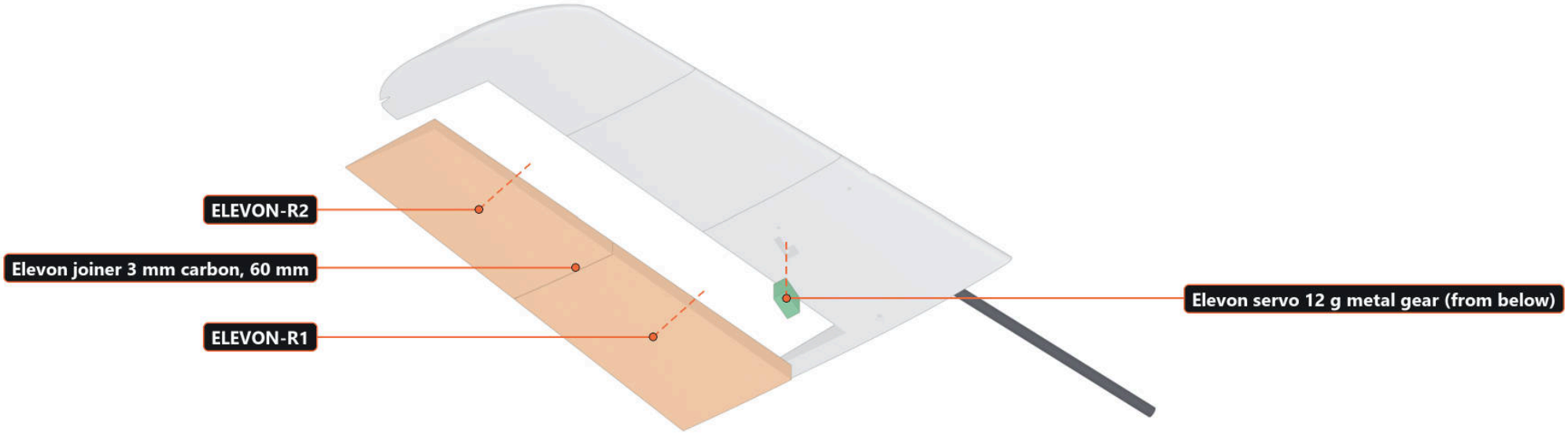
30-min epoxy | CA | Main spar 648 mm | Rear spar 356 mm

1. Cut the carbon: main spar 10 x 8 to **648 mm**, rear spar 6 x 4 to **356 mm**.
2. Dry-fit **WING-R1** → **R3** on both spars (R3 has the rounded tip and the leg socket).
3. Fill the channels with 30-min epoxy + microballoons and slide the sections home; glue the section faces with CA.
4. The main spar sticks out of the root: it goes into the body later. Glue the **5 mm rear pin (104 mm)** into the root. Build the left wing the same way.

Tip: Keep the protruding main spar clean: no epoxy on the part that slides into the body.

New in this step | Already built | Carbon | Hardware | PETG

04 Big elevons and servo



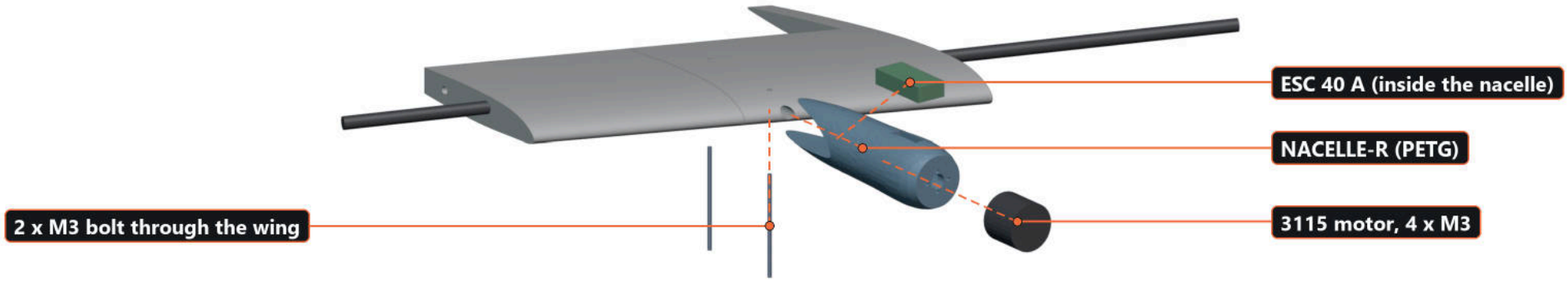
5-min epoxy | Servo ≥ 4 kg·cm | Hinge tape

1. Join **ELEVON-R1 + R2** with the **3 mm carbon joiner (60 mm)** and 5-min epoxy: one stiff elevon of 380 mm.
2. Fit the servo (12 g metal gear, ≥ 4 kg·cm) in the pocket **under** the wing at 270 mm from the centre; centre it with your radio first.
3. Hinge the elevon on the top surface with hinge tape (top and bottom) or 5 CA hinges. It must move **± 30°** freely.
4. Short stiff pushrod (M2) with a ball-link; no slop: in hover the elevons do all the control.

Tip: Big elevons + prop wash = strong hover control. Any slop shows up as wobble.

New in this step | Already built | Carbon | Hardware | PETG

05 Nacelle, ESC and motor



2 x M3 x 40 + nyloc | 4 x M3 + thread lock

1. Solder the motor and ESC; slide the **40 A ESC** into the nacelle bay from the front, wires through the hole into the wing channel.
2. Fit **NACELLE-R** over the wing leading edge at 290 mm from the centre and bolt it with **2 x M3 x 40** through the wing (nyloc nuts below).
3. Fix the **3115 motor** on the nacelle face with 4 x M3 + thread lock (16 / 19 mm pattern).
4. Run the ESC power + signal wires through the wing channel to the root. Same on the left (opposite prop direction).

Tip: Check that the motor shaft is parallel to the body centre line.

Important: Never fit the propellers while you build or test on the bench.

New in this step | Already built | Carbon | Hardware | PETG

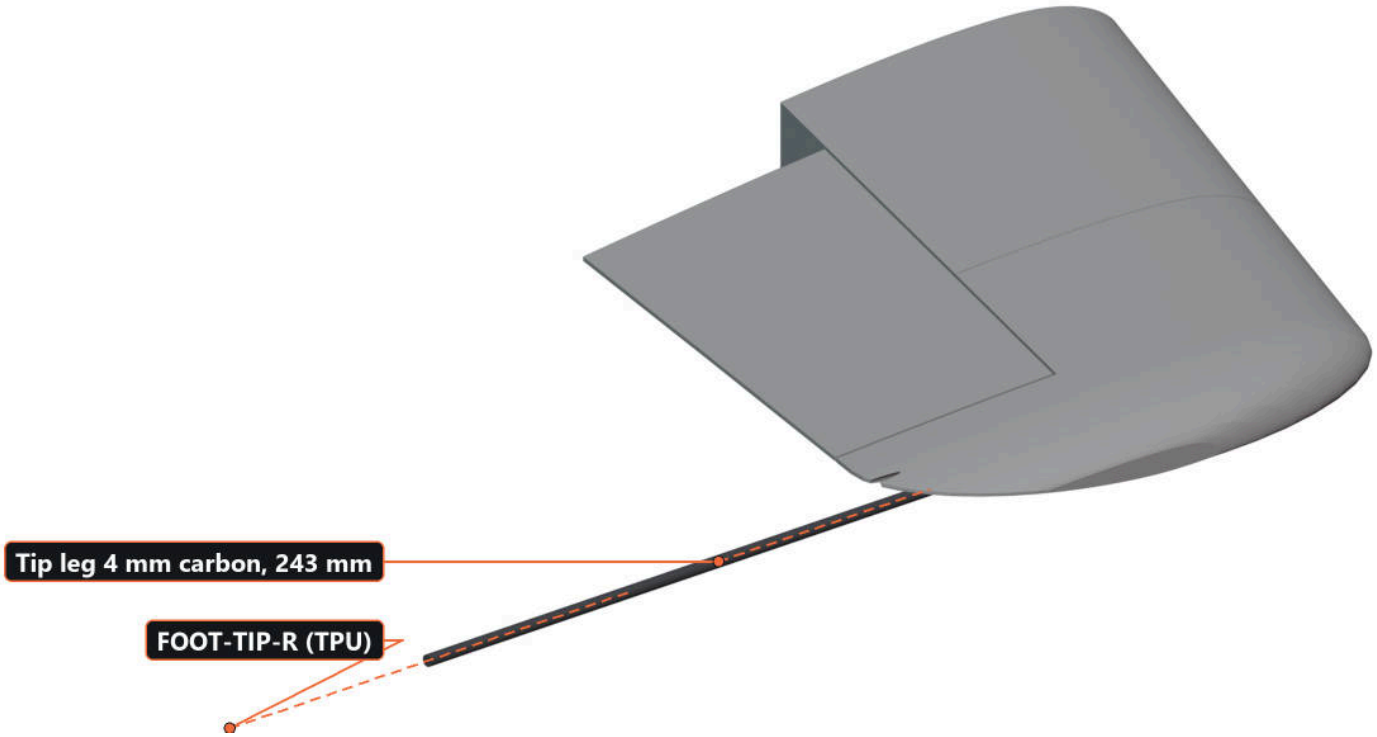
06

Wingtip leg and foot

5-min epoxy | Leg 4 mm, 243 mm | TPU foot

1. Cut a **4 mm carbon rod to 243 mm** and glue it into the socket in the wing tip with 5-min epoxy (it points backwards).
2. Push the **TPU FOOT-TIP** onto the end. The four feet (2 legs + 2 fins) all end in the same plane, 746 mm behind the nose.
3. Same on the left wing.

Tip: Glue the legs with the drone standing on a flat table so all feet touch.



New in this step · Already built · Carbon · Hardware · PETG

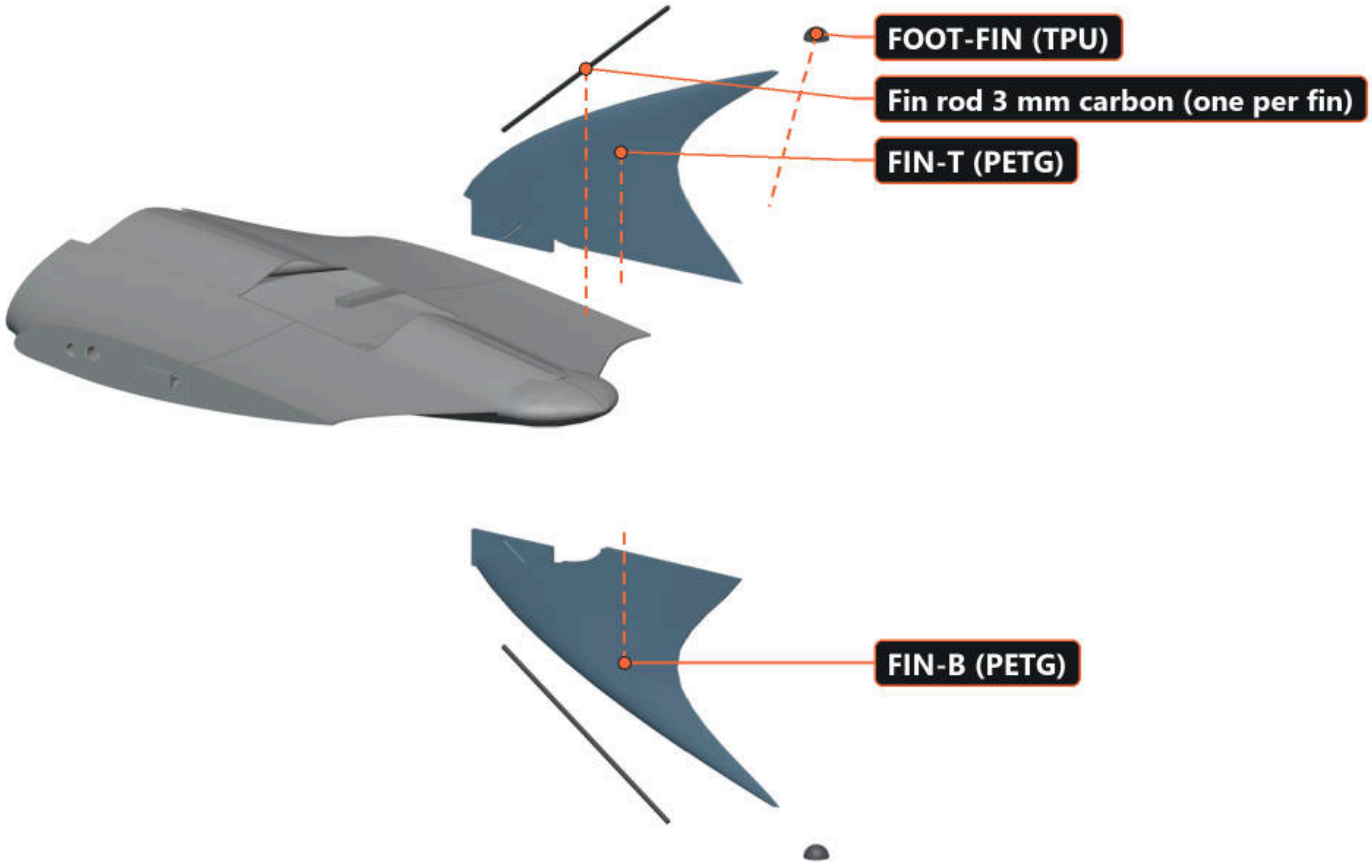
07

Fins into the body

5-min epoxy | 2 x fin rod 3 mm | 2 TPU caps

1. Glue a **3 mm carbon rod (173 mm)** into the channel of each fin.
2. Push **FIN-T** into the top slot and **FIN-B** into the bottom slot of BODY-3; glue the tongue with 5-min epoxy.
3. Glue the **TPU FOOT-FIN** caps on the fin tips.
4. The fins carry the drone on the ground (with the wingtip legs) and keep it straight in forward flight.

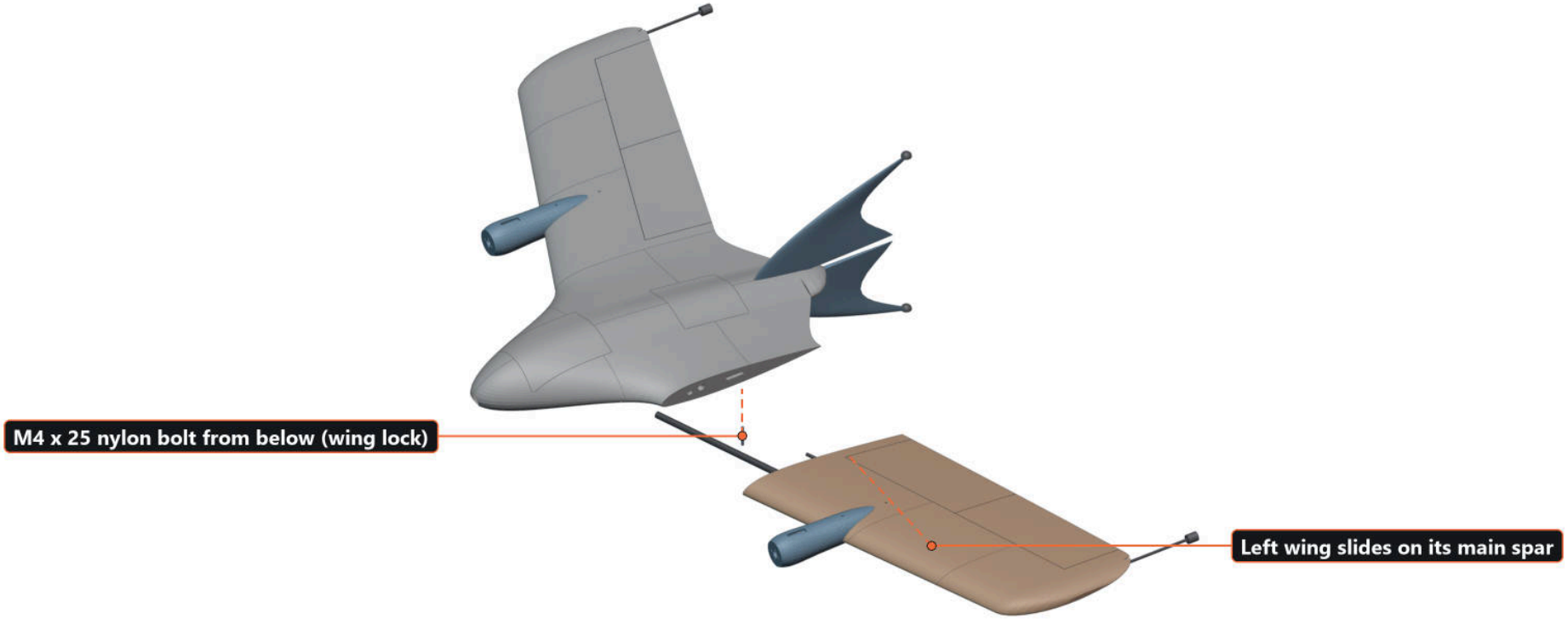
Tip: Check the fins are at 90° to the wing before the epoxy cures.



New in this step | Already built | Carbon

Hardware | PETG

08 Wings on



2 x M4 x 25 nylon | 2 x M4 insert

1. Push the main spar of each wing into the body: the two spars cross one above the other inside the body.
2. The 5 mm rear pin goes into its socket and the body lug into the wing-root pocket.
3. Lock each wing with one **M4 x 25 nylon bolt from below** into the heat-set insert in the lug.
4. Connect the wing wires (motor power + ESC signal + servo) to the body loom.

Tip: For transport: two bolts out and both wings slide off.

New in this step | Already built | Carbon | Hardware | PETG

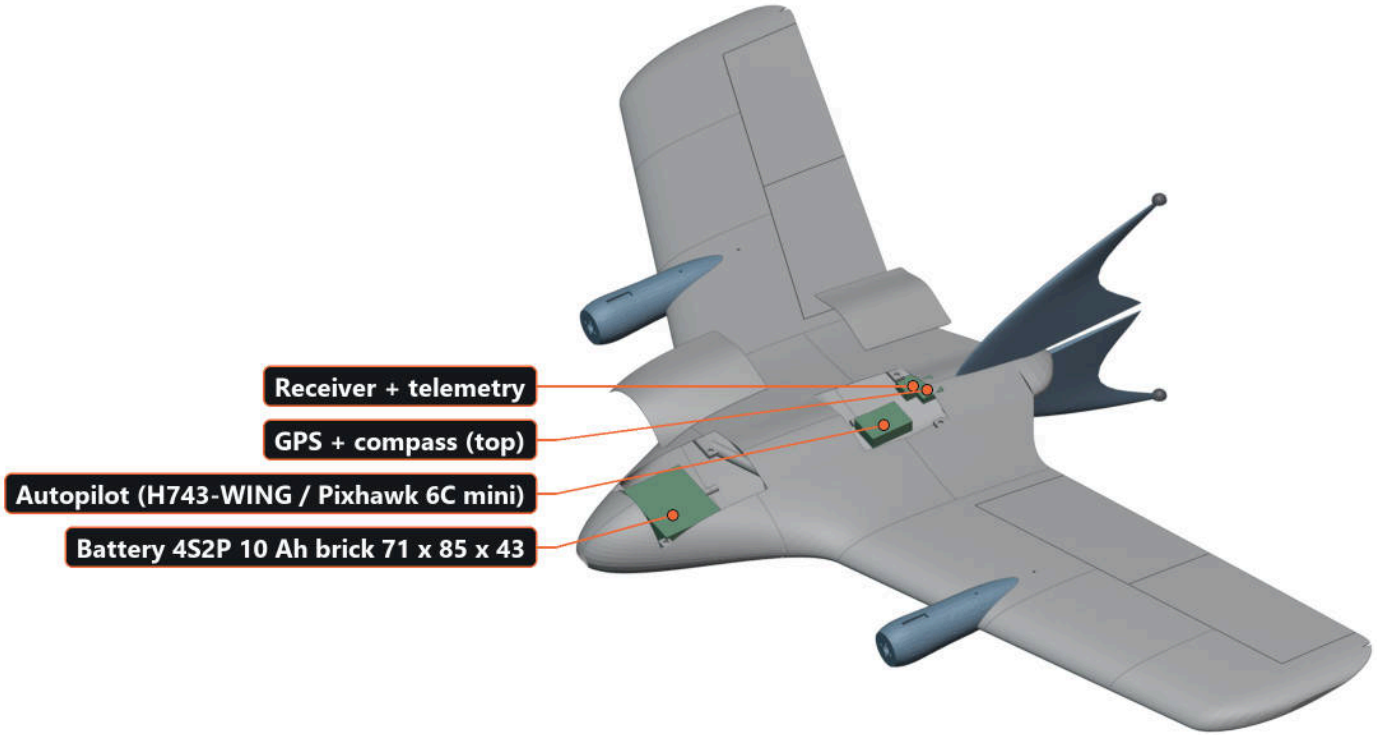
09

Electronics

Velcro strap | XT60 + 14 AWG

1. Battery bay (HATCH-H1): **4S2P 10 Ah brick 71 x 85 x 43** centred at **≈ 117 mm** from the nose, strapped down. 4S3P 15 Ah (142 x 64 x 43) centred at ≈ 171 mm.
2. Autopilot (HATCH-H2) at 360–410 mm, flat, arrow to the nose; GPS + compass on top at ≈ 440 mm, away from the motor wires.
3. Receiver + telemetry beside the autopilot; airspeed pitot through the nose.
4. Power: XT60 + 14 AWG to both ESCs; a power module for voltage and current.

Tip: Move the battery to set the CG, never add lead.

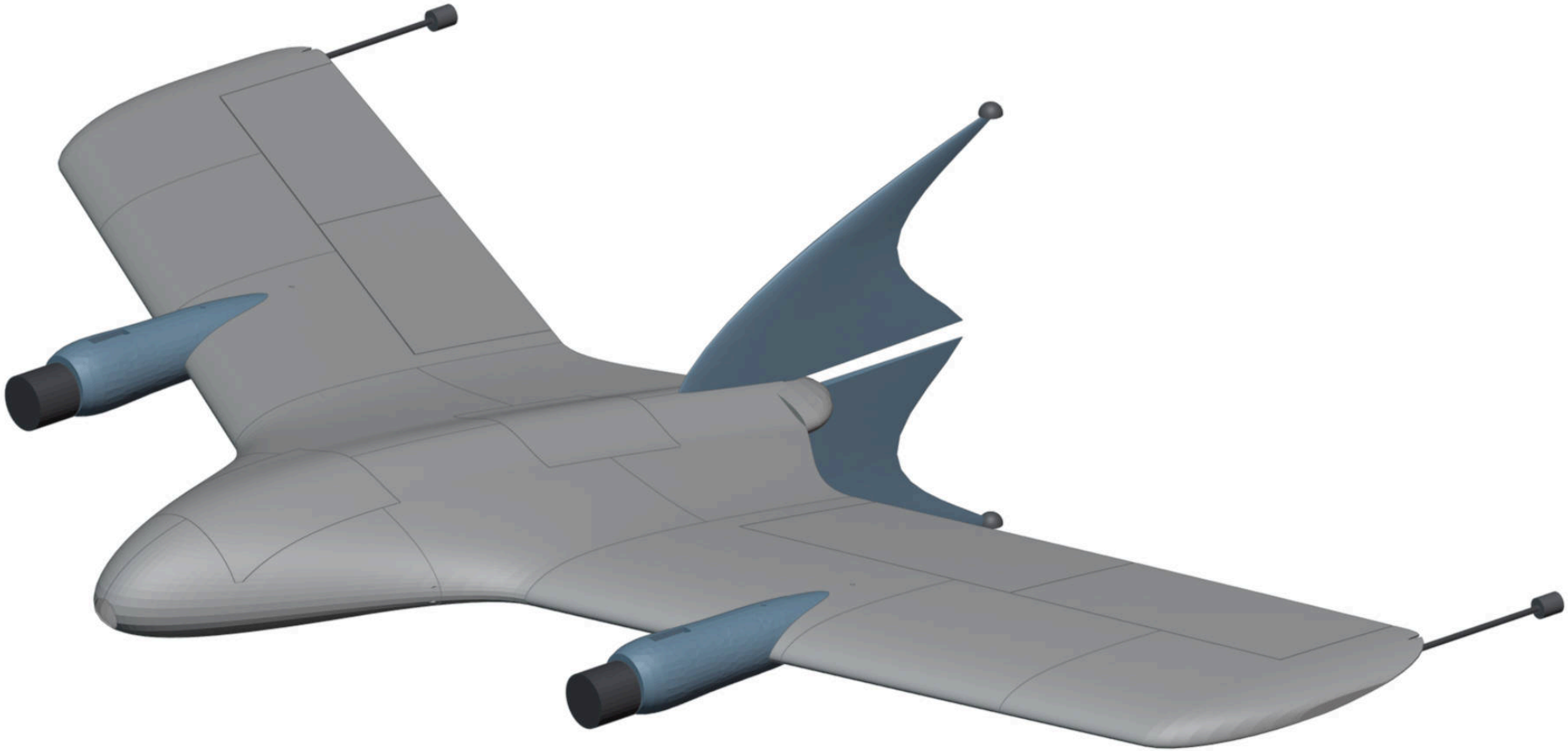


New in this step | Already built | Carbon

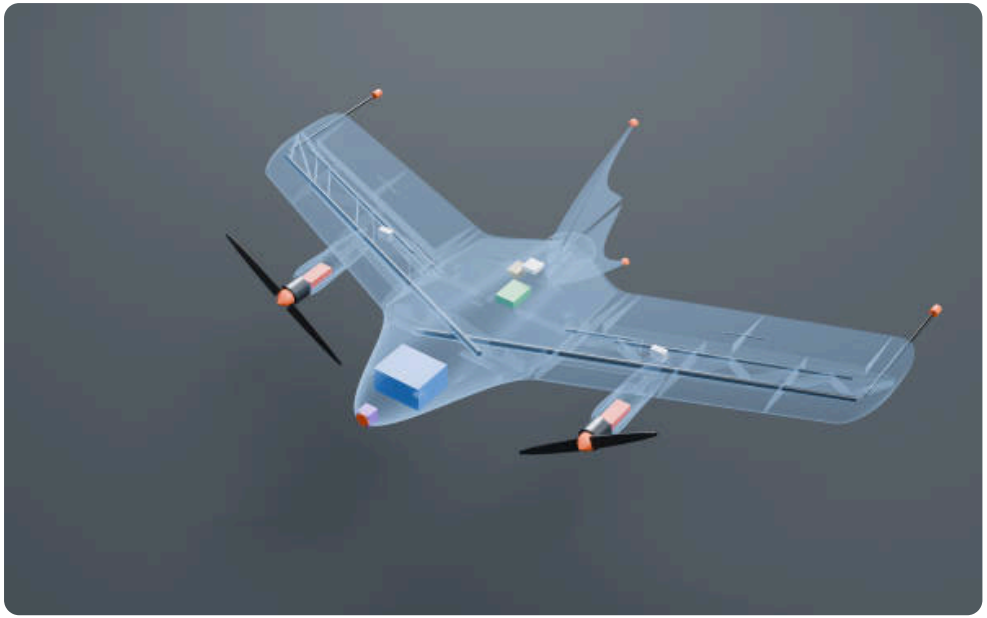
Hardware | PETG

AIRFRAME FINISHED

Shaheen 1200 ready for setup



Where everything goes



Part	Where
Battery	Front bay, centred at ≈ 117 mm (10 Ah) / 171 mm (15 Ah).
Autopilot + GPS	Middle bay, 360–410 mm; GPS on top at ≈ 440 mm. Set GPS_POS / INS_POS offsets.
ESCs	Inside the nacelles, cooled by the prop wash.
Servos	Under the wing at 270 mm, short pushrods to the elevons.

Autopilot outputs (ArduPilot tail-sitter)

Output	Function
SERVO1	77 – Elevon left
SERVO2	78 – Elevon right
SERVO3	73 – Throttle left
SERVO4	74 – Throttle right

Setup, CG and first flight

	Setting
CG	**284 mm behind the nose tip** for the first flights (static margin 11 %). Aft limit 294 mm. Balance it in flight attitude, on two fingers under the wings.
Tail-sitter	Q_ENABLE 1 · Q_FRAME_CLASS 10 (tail-sitter) · Q_TAILSIT_ENABLE 1 · Q_TAILSIT_MOTMX for the two motors · mount the autopilot flat in the plane frame.
Hover control	Pitch + yaw in hover = big elevons in the prop wash, roll in hover = differential thrust. Elevon throws ± 30° in hover.
Prop directions	Left and right props turn opposite. Follow the ArduPilot tail-sitter motor diagram; motor test with the props OFF first.
Thrust check	On a stand: each motor + prop ≥ 2.0 kg at full throttle (T/W ≥ 1.9 for gusts and transitions).
Airspeed	ARSPD_FBW_MIN 13 m/s, cruise ≈ 13 m/s. Q_ASSIST_SPEED 12 m/s. Flight elevon throws ± 15° with expo.

First-flight checklist

1. Weigh the drone and check the CG at 284 mm with the battery you will fly.
2. Elevons move the right way in QSTABILIZE (nose-up) and in FBWA.
3. Failsafe (QLAND / QRTL) set and tested with the radio off.
4. GPS lock, home set, compass calibrated away from the motor wires.
5. QHOVER test 1 m high in calm wind; it must stand still on the elevons before any transition.
6. First transition high, into the wind, with plenty of space. Then a back-transition and QLAND.

New design: numbers are calculated from the CAD, not yet flight-proven. Start with gentle flights and adjust the CG in 5 mm steps.

Need help? Email info@layerwings.com with a photo of your build. Free tools: layerwings.com/tools/

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