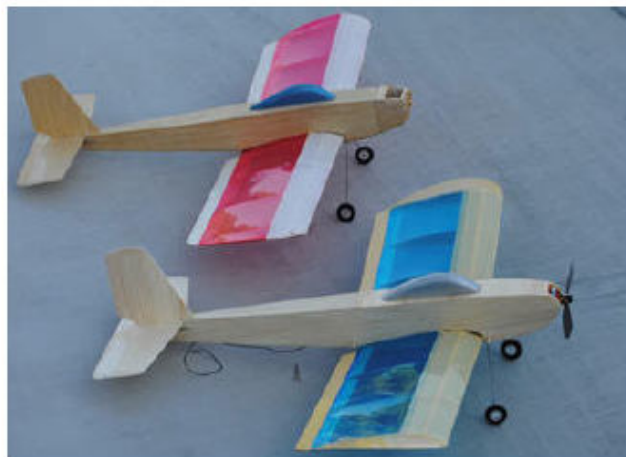


SMALL-E OR small-e by Tom Binkley

SPECIFICATIONS -

Wingspan	25 1/2"
Wing Area	160 sq. in.
Weight RTF	133g
Wing Loading	4.1 oz./sq. ft.
Length	22"
Radio	Hitech Eclipse 7, Bluebird rec'r
Servo	Blue Arrow 4.3g
Motor	SA Sport 2204-14
Power	4.1A 6.8V 28W
Prop	GWS 6050 sf
ESC	Castle Creations Thunderbird
9	
Battery	Turnigy Nano-tech 370 2S



Everyone likes a model that is quick and easy to build. But I also want an attractive looking, compact size, low wing model that flies with

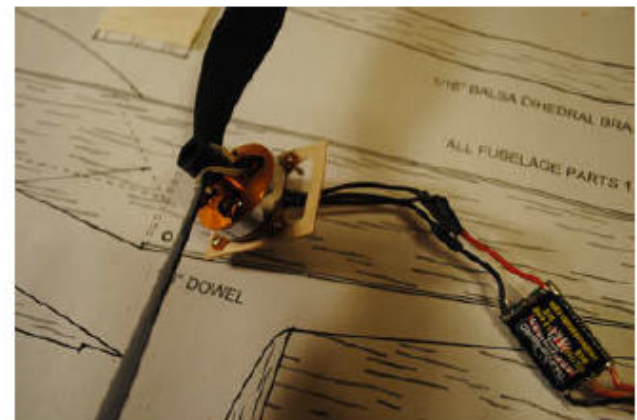
the smoothness of a bigger pattern ship, but that has the self-righting qualities and stability of a trainer. The first small-e, completed in 2004, was powered by an anemic brushed motor, and while it was stable and smooth, it lacked the power needed to enjoy aerobatics. When my generous Sidekick, Enabler and Wife bought me one of the first CD ROM motors, I adapted it to my small-e and it really came to life!



For simplicity and lightness, I chose aileron and elevator for control. For those who prefer full-house control, a friend built a small-e with rudder control added. It worked very well.

You will need a small, light, brushless motor and matching ESC. The 2204-14T weighs only 19g and has a built-in mount and prop-saver. It is light, smooth and rugged. A light 300-370 mAh 2S battery weighing 25g or less, a micro receiver and two 4 gram servos complete the flight pack.

Test servos to see that they center well before using them. Servos that do not center accurately should not be used.



Each gram you save in choosing light components adds up to one of small-e's most delightful virtues, its wide speed range, from slow to fast. The more weight you add, the less of the slow flight sweetness you'll get, so keep it light.



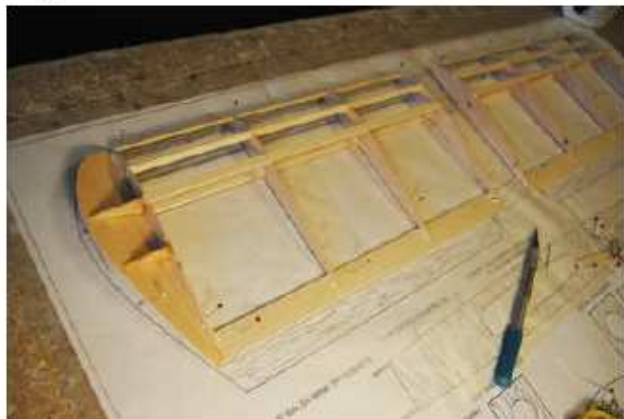
I start construction by cutting out the parts to make a wing "kit". Cut the spars and trailing edge out of 1/16" balsa using a straight edge or balsa stripper.

Glue a photo copy of the wing rib to 1/16" ply and cut slightly oversize for a rib template. Use the template to cut the ribs out of 1/16" balsa. Stack ribs together and sand them to final shape with a sanding stick made from a paint stir stick and 120 grit sandpaper.

With a razor saw, notch the stack of ribs for spars and trailing edge. Then using a rat tail file, shape the leading edge notch. The whole process only takes a few minutes.

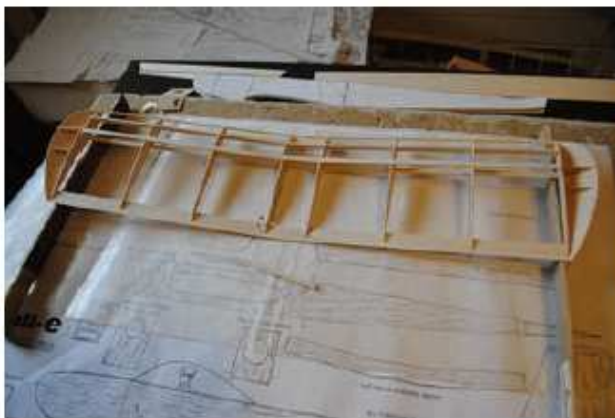
Cover the plans with wax paper and pin the trailing edge to plans and lay the lower spar in place. Then add ribs, then upper spar and turbulator spar, gluing as you go if using white glue.

Remember to cant the center rib at the dihedral angle. Cut 1/8" dowel leading edge to length and glue in place. Cut wingtip slightly oversize, sand a bevel on the wingtip and glue in place with it's gussets. When dry, sand to final shape.



Once both wing panels are built and the glue is dry, cut a vertical slot in the first rib of each panel for the dihedral brace. Carefully trial fit the 1/16" balsa dihedral brace in both wing panels, sand or trim as needed for a perfect fit.

It should slide in between the top and bottom spars with end butted squarely against the second rib. Glue in place with first ribs pinned to plans and wing tips propped up. Then add center leading edge, trailing edge and an aileron servo brace between ribs, spaced to fit servo's width.



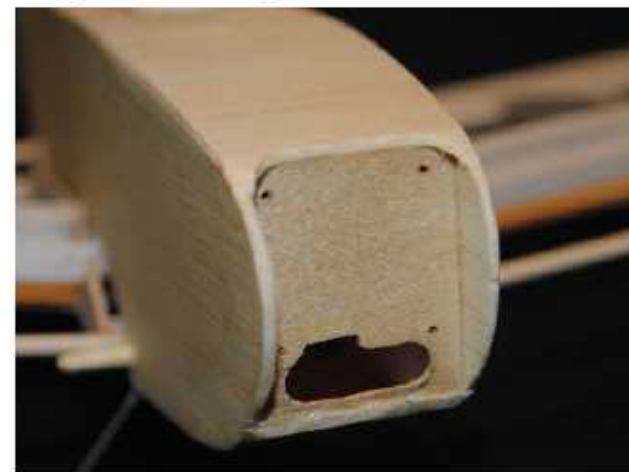
Sand a bevel on trailing edge of wing and leading edge of ailerons. Sand all wing edges smooth and cover with SoLite being careful to avoid warps.

Cut all fuselage parts out of 1/16" balsa and glue doublers to fuselage sides, making a right and a left side. Pre-drill the wing dowel holes holding fuselage sides together for best alignment. Glue both balsa bulkheads in place on one side then the other side, aligning carefully. Bend .062 music wire for landing gear and attach to front of bulkhead with epoxy or thick CA.



Make 1/16" ply firewall with an opening big enough for your ESC to pass through, and then

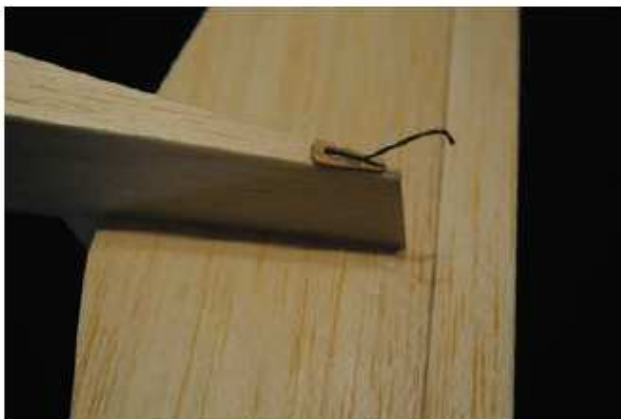
pre-drill motor mount holes. While paying close attention to alignment, pull fuselage sides together and glue firewall in place.



Then pull fuselage sides together and glue together at tail. Plank top and bottom from trailing edge forward with cross grain 1/16" balsa. Add rear top and bottom planking and sand fuselage edges smooth with fine sand paper.



Assemble fin, stabilizer and elevator from 1/16" balsa parts. Sand a bevel on back edge of stab and leading edge of elevator. Sand all other edges smooth and glue to fuselage so that they are straight and square. Using 1/32" ply and .032 wire, make and install tail skid.



The small-e needs a canopy. Either vacuum-form a clear one (and please include a pilot) or make a canopy out of balsa, hollowed and sanded to shape and glue it in place. Mine is 4 layers of 1/8" balsa.

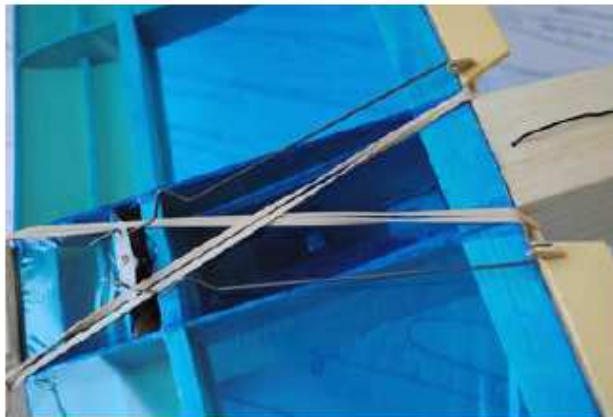
The balsa canopy makes the fuselage top stiffer where the battery mounts. If using a vacuum formed canopy, a 1/64" ply or 1/16" balsa doubler (on inside of fuselage under canopy) will strengthen that area to minimize damage from pulling on battery velcro.

Fuselage and tail assembly (and elevator) may now be sprayed with a few light coats of clear lacquer or dope, sanding very lightly between coats. Paint the balsa canopy with silver craft paint. Finally, install wheels.



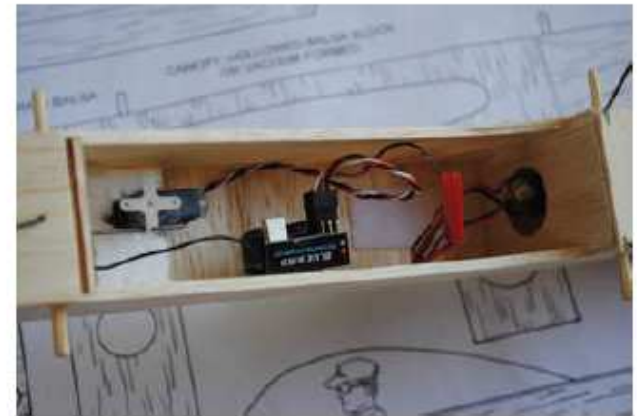
Shorten the ESC-to-motor wires to a minimum length and solder (no connector) with correct motor rotation. Now is a good time to arm your ESC's brake for best glide performance. Install motor and ESC onto fuselage. Install prop.

Attach ailerons to wing trailing edge using clear cellophane tape. Install servo in wing with control arm centered on bottom and servo wire on top of wing. A small drop of epoxy will hold servo, but permit removal, if needed. Make and install control horns from 1/32" ply and push rods from .032 music wire. A "v" in the push rod makes minor adjustments easy.



At this point it's good to check that the model balances on, or slightly behind, the main spar. Put a battery, receiver and servo in the fuselage, install wing and check balance.

Then locate and install those items accordingly. My small-e balanced perfectly with the battery against the front bulkhead, receiver in the middle and the servo near the rear of the "cabin".



Attach the battery and receiver with Velcro and the servo with servo tape or epoxy. Or sandwich servo between fuselage sides in a tiny styrofoam block and secure with epoxy. Make and install elevator pushrod and horn.



My finished small-e weighs 133g or 4.7 oz. With a 370 mAh 2S battery. The motor draws 4.1A at 6.8V for 28W spinning a GWS 6050 sf prop. I recommend trying a variety of batteries and props to find the best combination.



As a side point the 370 2S lipo advertises 25-40C discharge rate. That would imply a minimum constant output of 9.3A. In practice it managed a meager 4.1A output at best. By contrast an older 610 2S 20C LiPo supplied 6.8A at 7.4V to that same motor with a 7060 prop for 50W of power! The small-e performs very well on 28W, but the point is clear, don't believe all the battery claims, and experiment a little for the best performance.



Before flying, take some pictures of your small-e and send them to RCMF-FSP. Install wing with 4 #18 or 2 #33 rubber bands. Program your radio with some expo in ailerons and elevator. My ailerons go 1/4" up and 1/4" down. My elevator goes up 5/32" and down 5/32". At that, it is easy to control and will do nice, smooth, easy aerobatics.



small-e ROG's in a few feet and climbs nicely at full power. It tracks like an arrow and is stable and self righting like a trainer, but as with most small models, things happen pretty quickly, so be alert.

It will fly the length of the park inverted as smoothly and steadily as a much bigger model. It does nice big round loops and even vertical 8's. Slow it down and it is as pretty and graceful as a rubber powered model.

After a successful first flight spend some time adjusting control throws and other transmitter settings to your liking. Please don't ignore this necessary step, set-up is important to the lasting enjoyment of any model. Happy landings!

