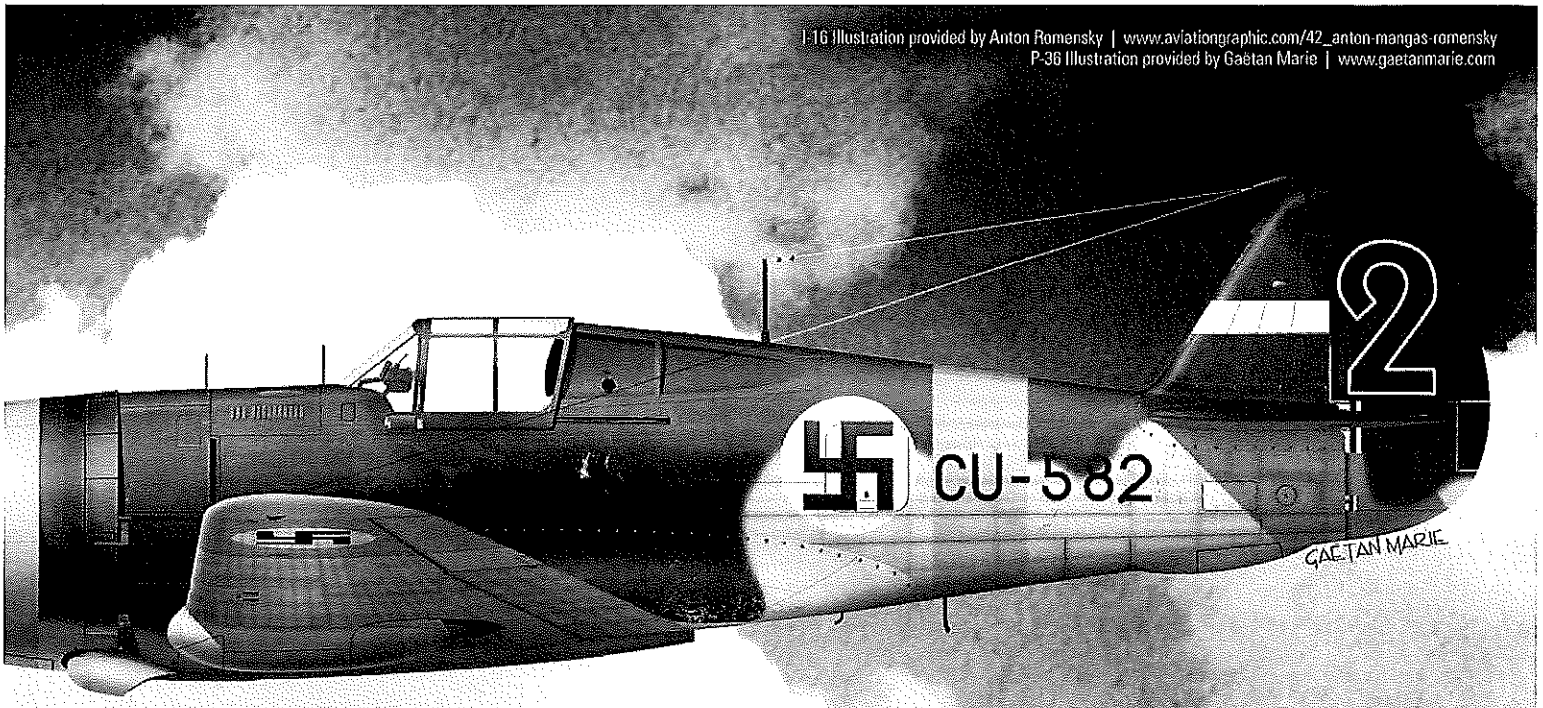


Face-Off

and flying opposing aircraft

Construction Style. Lightweight, stick-built, balsa structures have been our trademark. Keeping the weight low would be the key to scalelike performance. Other materials, such as Depron, could be used to create even lighter structures, but we both like the classic look and feel of a traditional balsa model.

Electronics. One of the design concepts was to "take back" from ARFs by using some ARF components for the models. With the popularity of 1,400 mm foam ARFs, a builder might have some spare equipment (motor, ESC, battery, etc.) from an old foamie that went to the hangar in the sky.

If you don't have any old parts lying around, Derek identified FMS as a good source for hardware when he built his 60-inch Grumman Bearcat. By shopping for similar-size models, a scratch builder can find the complete package of motor, ESC, and retracts.

This route isn't necessarily the cheapest way to go, but it is a nice way of sourcing parts that have been demonstrated to work well as a system in a model of similar size and somewhat greater weight than our aircraft.

The final criterion was the clincher. We agreed from the start that the two fighters that we chose must have met in combat and consequently, the Fighter Face-Off was born.

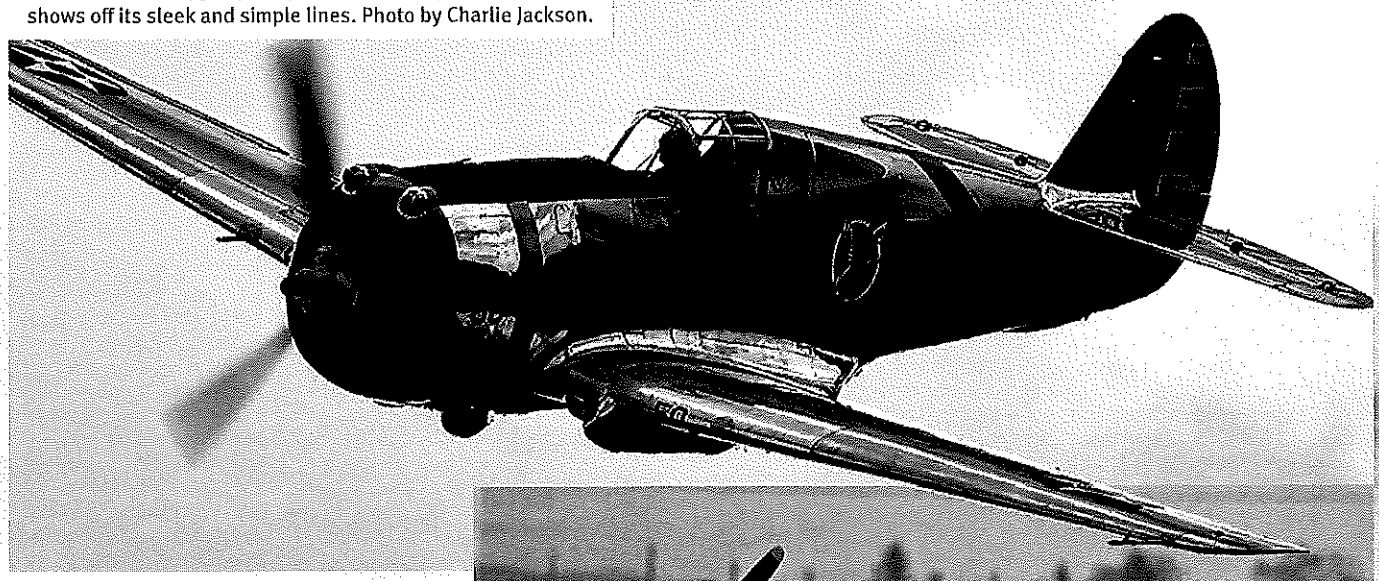
The Aircraft

At first blush, it seemed simple to find a pair of fighters and get to work, but it took longer to nail down our choices than we had expected. First, we ruled out the ubiquitous. We both love a nicely done P-51, but the RC world isn't looking for yet another one. We also ruled out aircraft that we had recently designed, which removed the Messerschmitt Bf 109 for me and the Hawker Hurricane for Derek.

After numerous combinations were considered, we settled in on two that we felt were perfect. Both aircraft were solid performers with excellent combat records, although each became outclassed early in the war.

What drew us to our pair was the unlikely path that set them on a collision course. Derek chose the Polikarpov I-16 Rata, while I took the Curtiss Hawk 75/P-36.

The Curtiss Hawk 75/P-36 in prewar U.S. Army Air Corps livery shows off its sleek and simple lines. Photo by Charlie Jackson.



Old-school stick-and-tissue construction is loaded with modern ARF hardware. The Hawk 75 is ready for its maiden flight.

Curtiss Hawk 75/P-36

In the US, the Curtiss-Wright Corporation was also making the leap to an all-metal, low-wing fighter through the introduction of the Hawk 75. First flown in 1935, this aircraft was developed as a private venture.

A year later, the U.S. Army awarded Curtiss a purchase contract for the Hawk under the designation of P-36 (export versions retained the Hawk 75 name). More than 200 P-36s were built for the U.S. Army Air Corps during the lead-up to WW II, but by 1941, the P-36 was rapidly being replaced by its more powerful sibling, the P-40.

The only combat seen by the P-36 was at Pearl Harbor, where Japanese aircraft were downed. Interestingly, the P-40 was credited with the other eight air victories on that infamous day.

Internationally, the Hawk 75 was a more successful aircraft. More than 900 were distributed around the world to countries including Argentina, China, Iran, and England. South African and Dutch pilots flew it against the Japanese in the Pacific, the Thais flew it against the French over Thailand, and the French flew it against Americans in Africa!

Like the I-16, the Hawk was still in service long after the war—Argentina was still flying Hawks in 1954. But the aircraft that were sold to France had the most colorful history.

The Hawk 75 performed on roughly equal terms against the Luftwaffe's early Bf 109s in the Battle of France. After France fell, Germany captured 30 French Hawk 75s. These were sold to Finland, where they flew against Soviet forces including the Polikarpov I-16. Well-loved by the Finnish pilots, the Sussu, or sweetheart, became an "ace maker" while racking up an incredible 12.6:1 kill ratio.

The Models

Over the next several articles, Derek and I will walk you through our parallel builds. We are happy to announce that the plans for these models will be distributed as free downloads through *Model Aviation* for those of you who would like to build along with us.

Parts outlines are included on the plans sheets for you intrepid hand cutters. For builders who wish to take a less manually intensive route, laser-cut kits will be available from Manzano Laser Works.

Now that I have used up my word count introducing the Fighter Face-Off, check back next month for the next installment in the series.

—Paul Kohlmann
ptkohlmann@aol.com

SOURCES:

FMS
www.fmsmodel.com

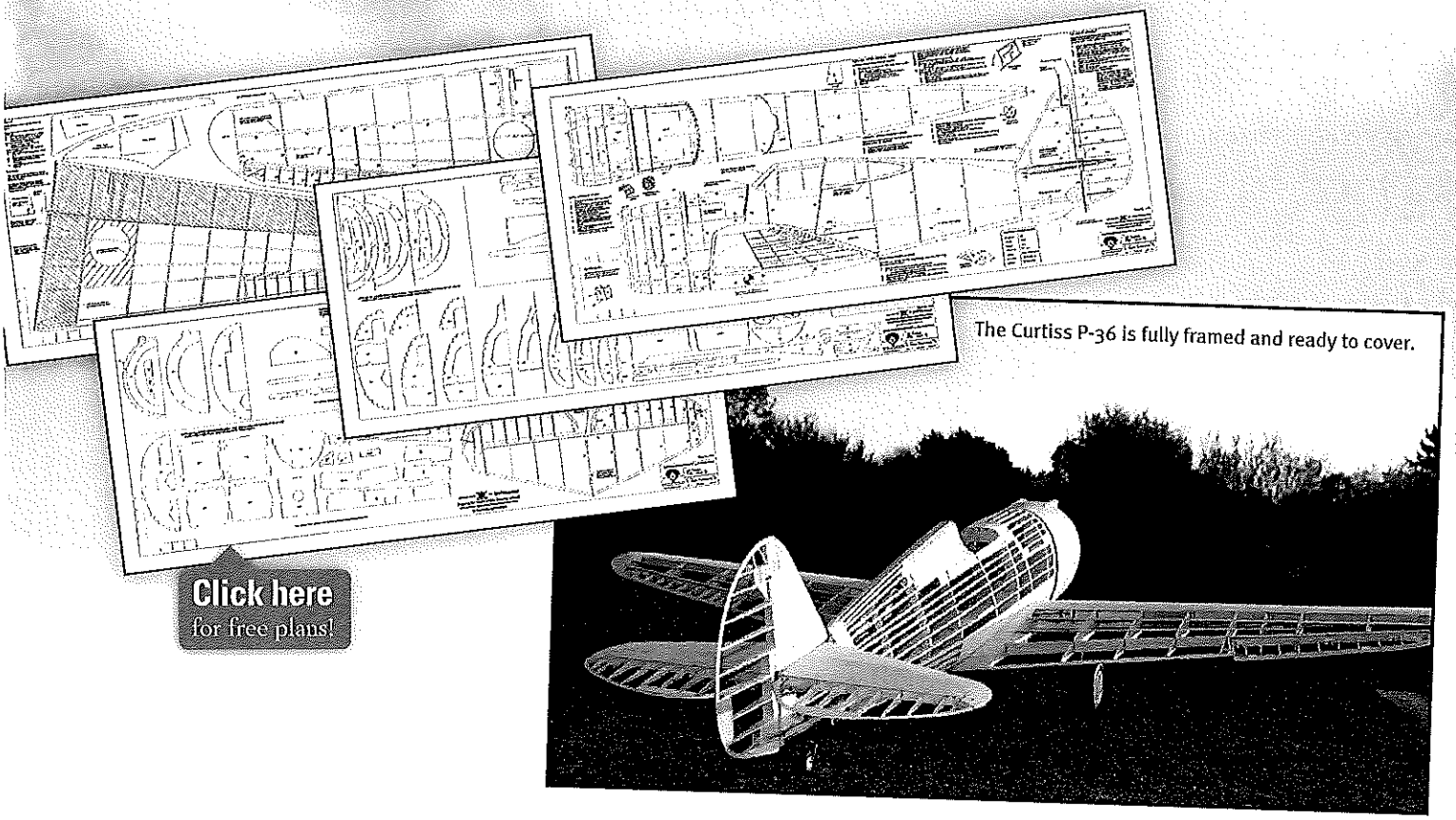
Model Aviation archives
http://library.modelaviation.com

Manzano Laser Works
tomj@tularosa.net
http://manzanolaser.com

"Workflow Planning," June 2015: It's always a good idea to map out a project before leaving the starting blocks. This article provides tips for breaking the build into manageable pieces.
"Building the M.20 Tail Group," July 2015: This is a primer on laminated outlines that will come in handy for both projects.

Fighter Face-Off

Scratch-building and flying opposing aircraft



The Curtiss P-36 is fully framed and ready to cover.

by Paul Kohlmann and Derek Micko | Photos by the authors

Last month, Derek Micko and I introduced our "Fighter Face-Off" joint project. As explained in that article, together we have designed a pair of 60-inch, built-up balsa warbirds representing aircraft that met in combat. Derek went with the Polikarpov I-16 Rata, while I selected the Curtiss P-36/Hawk 75. Free, downloadable plans for these models are available on *Model Aviation*'s website.

Our opening article explained the goals of the Fighter Face-Off that we set for ourselves, and provided background information about the two aircraft that we were modeling. Now that those subjects are out of the way, Derek and I will share our construction experiences in the next installments.

Curtiss P-36/Hawk 75
Building the Tail Group

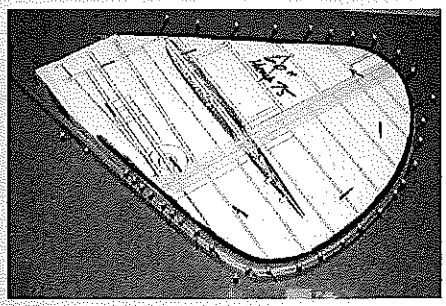
Laminated balsa outlines provide strong, lightweight enclosures for the tail group framework. Start by cutting forms for the fin/rudder and the stabilizer/elevator. Foam sheet or plywood works well for the forms.

Soften $^1/_2$-inch wide strips of $^1/_{16}$-inch balsa by soaking them overnight in water. To begin the lamination, wrap one strip around the form, pinning it in place as you go. Pull the strip tightly to avoid kinks in the balsa as it bends around the form. Put a thin, even layer of glue on one side of the next strip and repeat.

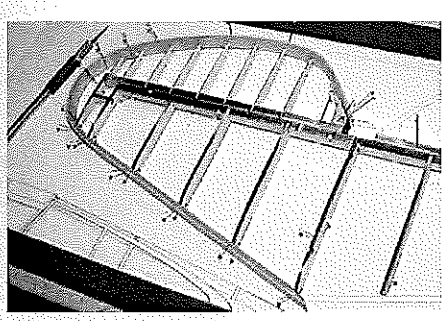
Move the pins from the first strip to the second as you go. Repeat for a third strip and set the lamination aside to dry. Carpenter's glue holds well and can easily be sanded. I like to let the outlines cure for a full 24 hours.

After everything has fully cured, pin the outlines down to the plans. Build up the inner framework by assembling the parts in numerical order. Feet on the underside of these parts will hold everything at the right angles.

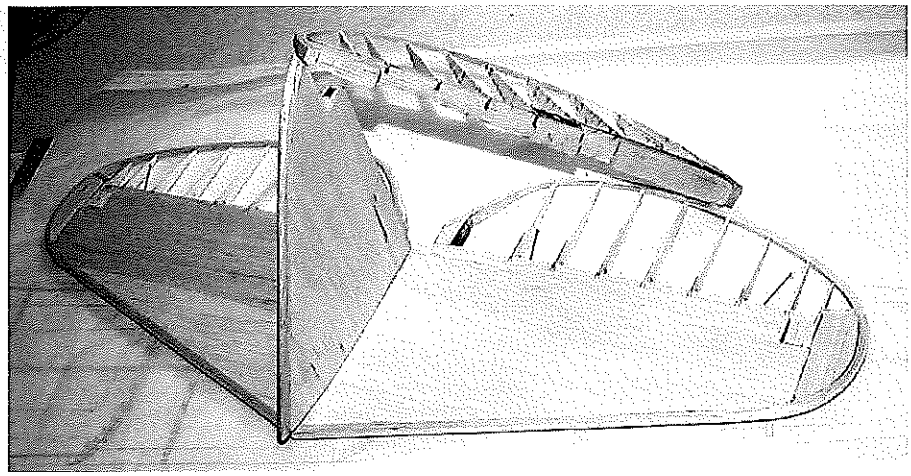
Be careful not to glue the parting lines for the rudder and elevators. They should only be connected by the outlines. Cut through the outlines after the framework is fully



The fin and rudder outline is made from three strips of 1/16-inch balsa and a foam form.



The tail group framework is built within the laminated outlines.



The completed tail group is shown after sheeting and shaping.

assembled to free the parts.

Sheet the upper side of the stabilizer and the fin while they are firmly pinned to the board. This will ensure that these assemblies stay true. After the sheeting cures, unpin these assemblies and remove the feet from the undersides. Now sheet the second sides of the fin and stabilizer.

With the tail group construction done, sand the tail group parts to shape by removing the excess material from the outlines. Protect the sheeting and frame parts with masking tape, and sand with 60-grit sandpaper to rough out the shapes. Remove the tape and finish with 220-grit sandpaper.

For the prototype, I used Robart 1/8-inch hinge points on all of the control surfaces. I also reproduced the complicated parting line of the full-scale Curtiss as shown on the plans. Curtiss used offset hinges for aerodynamic balancing.

This feature isn't necessary for my model, but it lends to the scalelike appearance. You are welcome to modify the rudder for a straight parting line to simplify the attachment. Simply relocate the hinge axis from where it is shown on the plans to the parting line between V1 and R1.

Building the Fuselage

The upper half of the fuselage is built flat on the building board. Pin the beltline keels K1 over the plans. Preassemble upper former halves F3T through F7T. Install all of the upper formers but F3T and F5T to stand vertically from the board. Use the plans' paper template to set the angle of F3T and F5T and glue them into place on the keels.

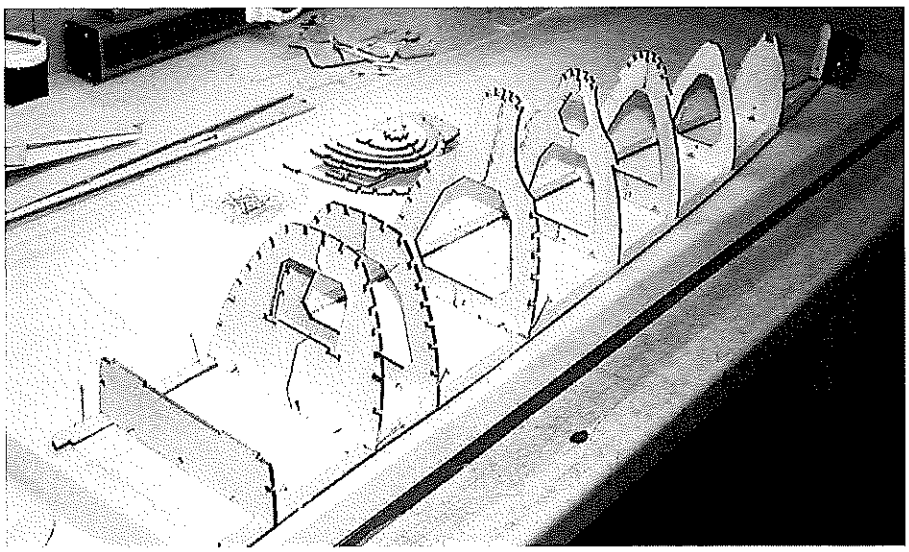
Tie the formers together with the spine keel K2, the battery tray BATT, and install the servo tray against K1.

Next, build the battery hatch opening by gluing lower hatch rails K3 to formers F2T and F3T. Begin the hatch cover by clamping the upper hatch rails K4 to the lower rails. Don't glue these because they will create the hatch parting line.

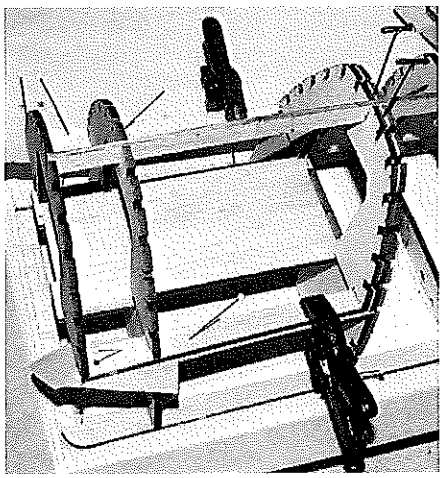
Glue hatch formers F1H, F2H, and F3H to the upper rails then tie all of the front formers together with keel K5. Leave a small gap between F3H and F3T to ensure that they don't get glued together.

After adding a few 1/8 x 3/16 stringers to keep the fuselage formers properly spaced, go to work on the Curtiss' characteristic side windows. Start by tracing the window's outline from the plans and cut two panels from 1/16 soft balsa. Wet the balsa panels and gently curl them to fit the pockets in formers F5, F6, and F7 and glue them into place. Complete the upper fuselage assembly by adding the rest of the stringers.

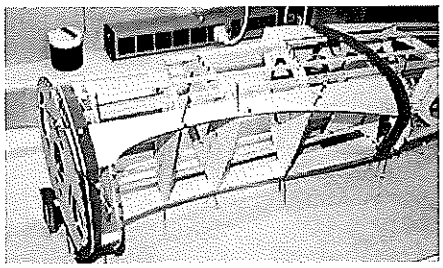
Unpin the upper fuselage. Preassemble thick balsa F0 and light plywood F1 to form the firewall. Glue the firewall assembly to keels K1, K3, K4, and K5 and to the BATT tray. Reinforce the



The P-36's upper fuselage is built on top of the plans.



The battery hatch is built in place. Note the T-pins that set the gap between the former F3 parts.



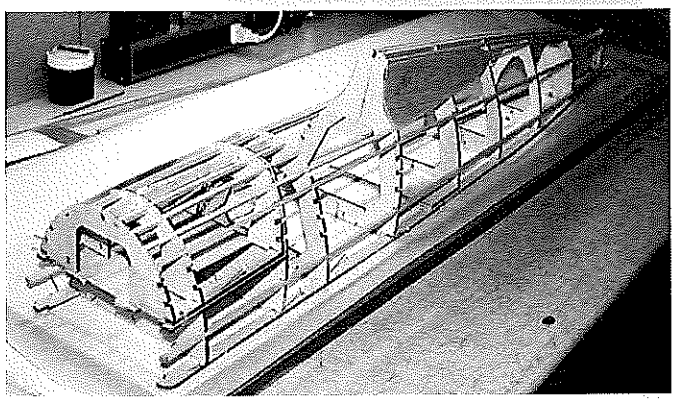
The wing saddles have been lightly wetted and curved into place.

wing pin hole in F2B by gluing plywood part WB in place.

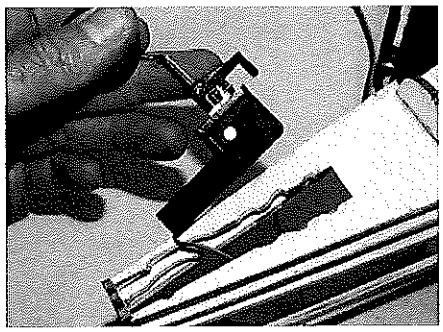
Create the tail wheel plate by gluing TW, F9B, and F10B together. Build the wing bolt boss by assembling parts WB1, WB2, and F6B. Use epoxy for maximum strength in these critical areas.

Install all of the lower fuselage formers by gluing them to their upper former mates. As before, all but F3B and F5B will be perpendicular to keels K1. Make all of the lower formers parallel with their upper halves. Tie the formers together with keels K6 and K7. Wet the

After building the left cowling frame on the board, the cowling opening was attached.



The inner panels of the side window are formed from wetted 1/16-inch balsa.



The tail wheel assembly is ready to accept the retract unit from the 55-inch FMS P-40.

outsides of the wing saddle parts WS so that they curve as you fit them into place over formers F1 through F6B. Now add the rest of the stringers, working from side to side and checking for twist as you go.

Free the battery hatch by cutting through keel K5 and the stringers between formers F1/F1H and F3H/F3T respectively. Lightly sand the fuselage and set it aside for now.

Building the Cowling

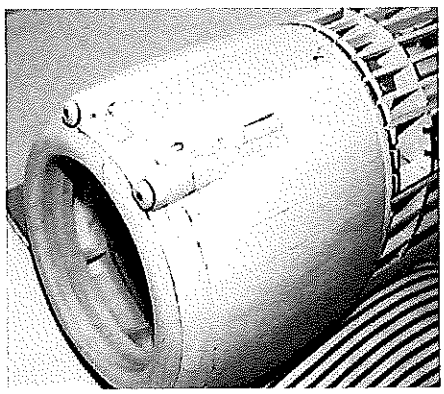
The United States Army Air Corps P-36 was powered by the Pratt & Whitney R-1830 engine. Export versions of the Hawk were ordered with either the Pratt & Whitney or the Wright Cyclone. Although the airframes were the same for both configurations, the cowlings were radically different.

The Cyclone-powered Hawk had a somewhat cylindrical cowling while the 1830-powered aircraft had better-looking curved sheet metal. The base design here is for the latter, but a builder could easily bash the simpler Cyclone cowling.

Start the cowling by preassembling the thick balsa parts C1 through C4, and then glue the stack together to create the cowling's opening. Preassemble the cowling formers C5 through C7. Build the first side of the cowling frame over the board by joining the left halves of C5 through C7 to keels C8 through C12 then glue the cowling opening to the front of the assembly.

Unpin the assembly and build the right side in the same way but directly on the assembly. After it cures, begin planking from C4 to C7 with 1/16-inch soft balsa. Fill in the area of the gun housings with scrap balsa.

Sand the cowling to shape with 60-grit sandpaper then finish sanding with 220-grit sandpaper. A mixture of lightweight spackle and Durham's water putty makes a great, lightweight filler that sands easily. I finished with one layer of 1/2-ounce fiberglass over the whole cowling and a second over the bottom half for the inevitable nose-over.



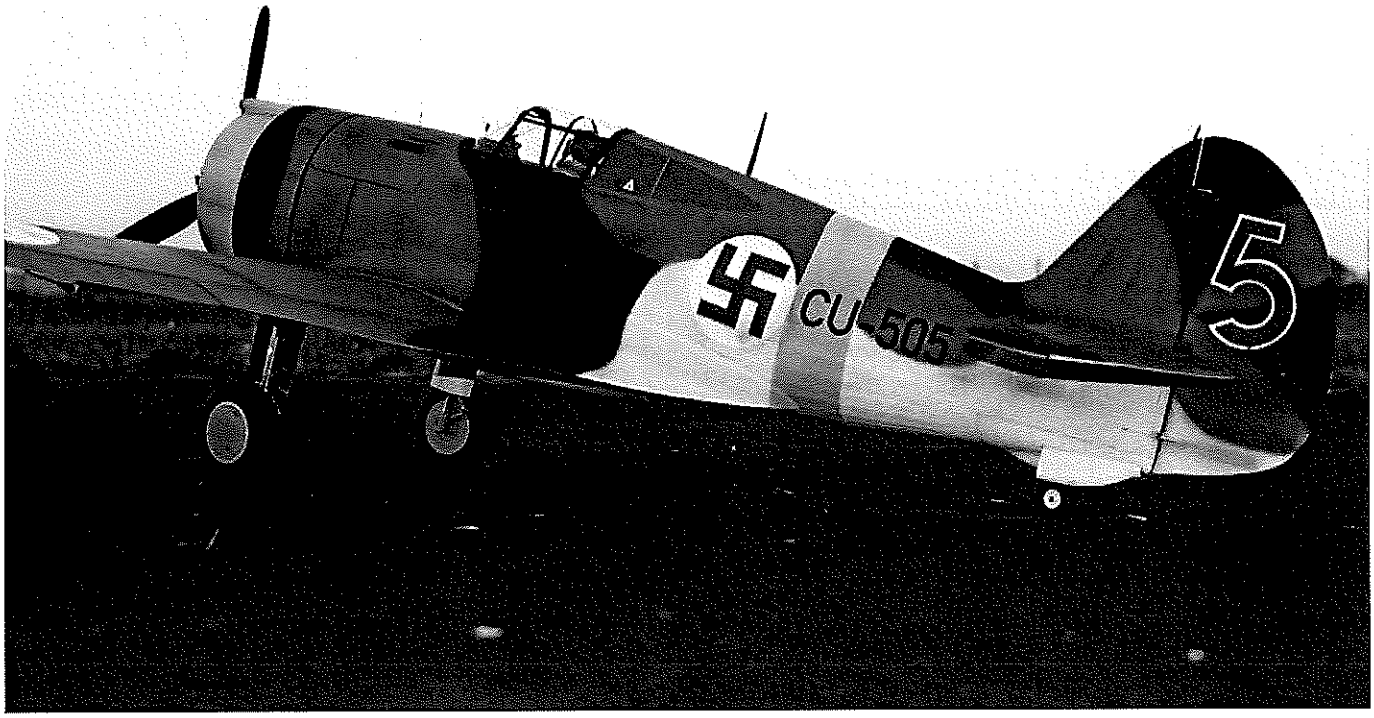
The finished cowling is shown after sanding it to shape.

That's All (for Now) Folks!

This puts us through most of this project's woodwork. In the next installment, I'll knock out the wing and install the internals. After covering, I'll need to nail down a paint scheme from the huge number of options that the P-36/Hawk 75 series wore. Until then, fly low and build light!

BONUS CONTENT

Fighter Face-Off



The completed Hawk in the colors of the Finnish Air Force, 1943.

Curtiss P-36/Hawk 75 Framing the Wing

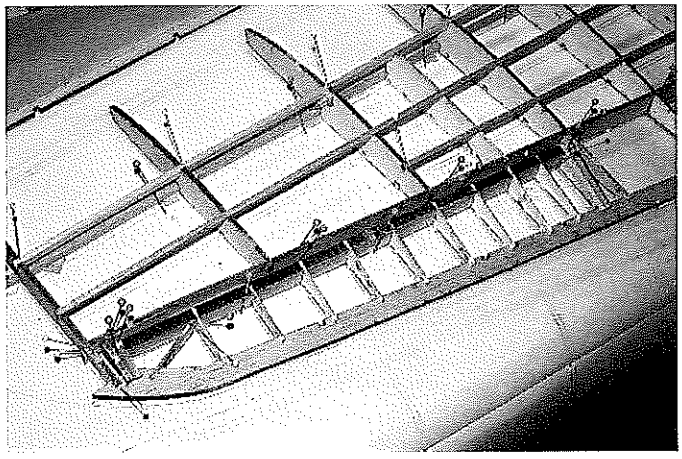
The wing is built on the board in the conventional way. The feet are on the ribs and the spars set the correct washout.

Begin by locating all of the parts for the wing assembly. Four $^1/_8$ x $^3/_{16}$-inch main spars are needed. I used balsa main spars on the prototype, but you can use basswood if you are concerned about strength.

Pin the lower main spar to the board after shimming up from the board with $^1/_{16}$-inch scrap. Raising the spars will place them deeper in the ribs, allowing the sheeting to cover the main spars later.

Pin rear spar (RS) perpendicular to the board using ribs W2 and W10 to space it back from the main spar's position. Glue the rest of the ribs to the lower main spar and RS. Use the dihedral angle gauge printed on the plans to set the angle of rib W1. Now glue the trailing edge (TE) to the pads at the back of the ribs. Install the upper main spar, two $^1/_8$-inch square balsa stringers, and shear webs S2 through S7 to lock the ribs together.

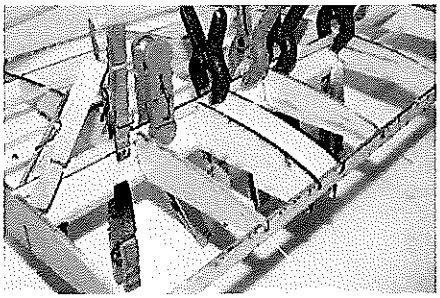
The ailerons are next. Build the aileron pocket in the wing by gluing parts A1 through A3 into place. A2 is a doubler to beef up the rear spar. Glue it to RS. Now pin aileron leading edge (LE) A4 into place, but don't glue it. This will form the aileron's parting line. Glue the riblet parts A5 through A16 into place. These are positioned to replicate the construction of the full-scale Curtiss.



Detail of the aileron also shows the basic layout of the wing structure.

Main Retracts and Sheeting

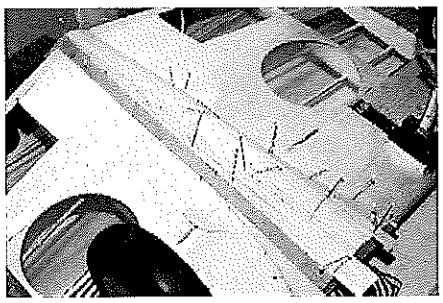
Unpin the assembly to install the parts that create the main retract bay. Epoxy plywood shear web S1 securely to the back of the main spars and to ribs W1 through W4. Epoxy plywood half-ribs G1 and G2 to the main spars and to S1. Use LE to ensure that the ribs are aligned at their LEs. Glue LE into place



The retract bay is constructed from plywood shear web S1, and plywood half ribs G1 and G2. The LE is temporarily pinned in place to align these parts.

Coloring the front of the LE with a marker makes accurately shaping it easier.

A perfectly round hole for the main wheels was created by sanding with a bottle wrapped with 60-grit sandpaper.



Planking the belly pan after assembling the pan framework.

after the gear bay parts have cured. Stack and glue parts WT to form the wingtip.

Pin the assembly to the board and allow the pads under the retract ribs to hang over the edge. Now sheet the upper wing surface from the main spar to the LE while the assembly is true to the board's flat surface. Also sheet the rest of the area between ribs W1 and W2. When the sheeting is fully cured, unpin and check for straightness. Sheet the lower surfaces, including the space between W2 and W3 for the main wheel cutout.

The retract bay is now a rigid assembly of plywood parts tied together by the upper and lower sheeting. Double up parts G3 and G4 and epoxy them to the outsides of ribs G1 and G2 and to the sheeting to form the retract mount bosses.
Finish the wing assembly by completing the LE. Sand any overhang from the sheeting back flush with the front of part LE. Now glue a strip of 1/4-inch soft balsa to the front face of the LE. Tape over the sheeting to protect it while shaping. Now sand the nose profile in the LE with 60-grit sandpaper.

Open the lower sheeting for the main wheel and strut where shown on the plans. Start small and fine-tune by installing your retract assembly. I used a bottle wrapped with sandpaper to make a perfect radius. When fitted, drop the retracts into place to mark and drill the retract bosses. Thread the holes with the retract mounting screws and harden the holes with CA adhesive.

The Belly Pan

After joining the wing with the plywood dihedral brace and fitting it to the fuselage, the belly pan can be built in place. Start by gluing the keel B1 and front former B2 together. Pin these into place with B1 running along the parting line between the wing halves, and B2 against the back of fuselage former F2. Put waxed paper between the wing and the belly pan to prevent the belly pan from being glued to the wing. Now glue formers B3 through B5 into place.

Plank the belly pan with 1/16-inch balsa. Wetting the strips and using carpenter's glue make this task simpler than it might sound. Although there will be more of them, narrow strips are easier to work with. When planked, install a pin in pan former B2 to engage into F2, and magnets in the back of the pan to make it removeable.

Plastic Parts

The canopy, tail gear fairing, and main gear doors are provided as plastic parts in the short kit from Manzano Laser Works. For those who are hand cutting, these parts will be available from Park Flyer Plastics for a limited time.

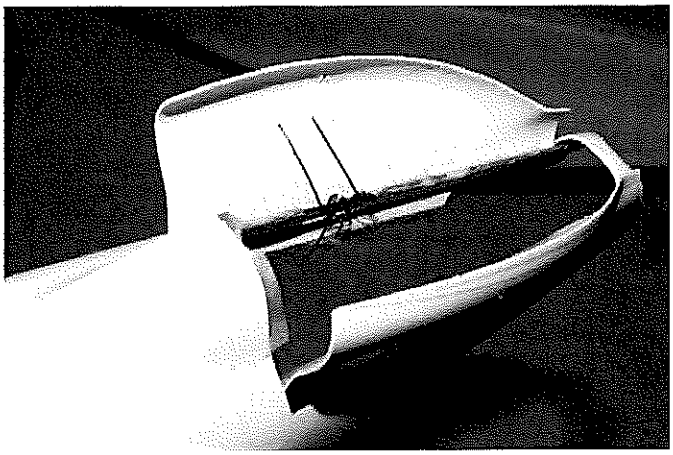
The tail fairing is a small project on its own when rigged with functioning doors. Start by marking and cutting the doors free. Ensure that the opening is long enough for the tail wheel to clear the back and for the strut to clear the front. Sand the opening and the doors carefully so that there is a small and even gap between them. A spare fairing is included in case you don't get it right the first time.

The door hinges are made from 1/16-inch aluminum tubing and music wire. The tubing was cut into three parts for each door. Two were epoxied to the inside of the fairing and one to the door itself. The music wire was inserted through all three tubes to serve as the hinge pin to align them. Roughening the plastic helped the epoxy stick.

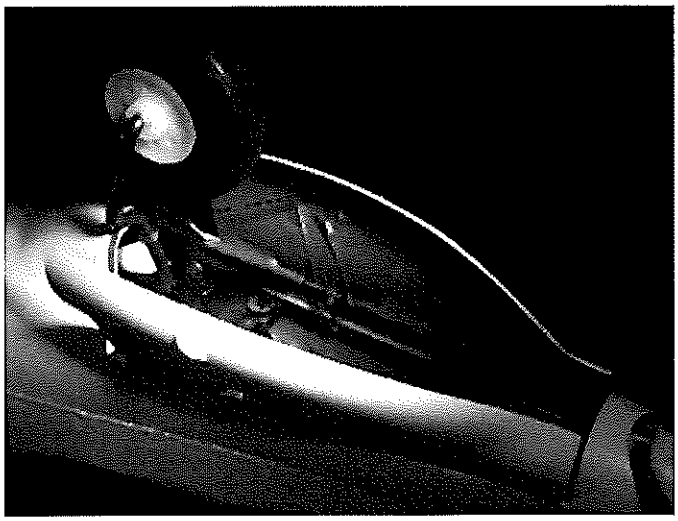
Next, springs were made by wrapping a broken guitar string around a wire clamped in a vise. One string has made 20 springs so far. When captured by the wire hinge pin, two of these tiny springs flipped each door open.

A bit of Kevlar fishing line tied to the tail wheel strut was used to pull the doors closed. Drill a small hole in each door. Tie the line to the strut with several inches to spare on each side. Thread the line through the holes in the doors from the inside. Retract the tail wheel.

Close the door and pull the line tight. A



Tail wheel fairing with tube and wire hinges and wire springs.



Kevlar lines from the doors to the strut pull the door shut as the tail wheel retracts.

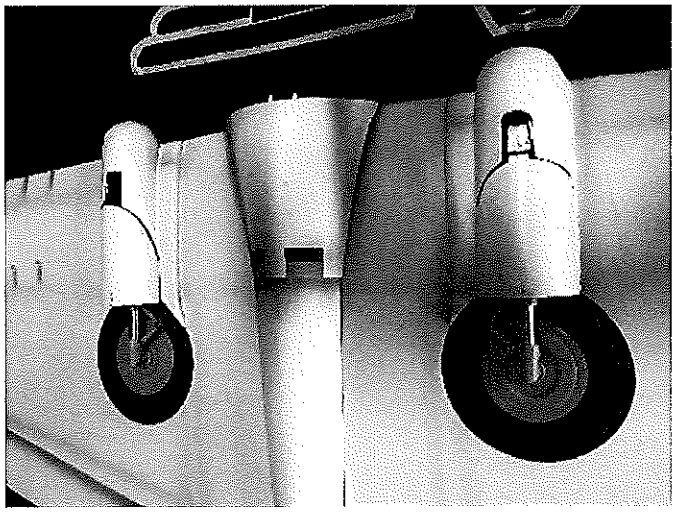
dab of 5-minute epoxy on the outside of the door will hold the line in place. Open the retract and confirm that the door opens properly. Another small dab of epoxy on the inside of the door will hold the line in place for life. Trim the excess line and repeat on the other side.

For the main doors, I departed from the scale design for the sake of simplicity. The P-36 had a three-piece door system that included a door mounted to the rotating strut, a middle door hinged at the wing, and a third small door that dropped between the wing fairing and the middle door. I like a challenge, but this was too much for this model.

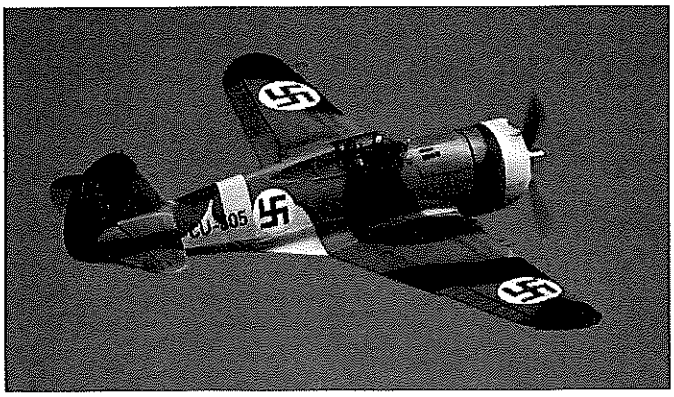
The system on the prototype was simplified to two doors: a door mounted to the rotating strut and a fixed cover that was notched to make clearance for the strut when it was extended. By making the parting line curved, the gap was kept small. Balsa scrap was used for the brackets between the strut and the door. A bead of silicone fastened the parts together. This allowed the parts to be fitted perfectly while providing a flexible joint.

Covering and Finishing

My prototype was covered in Polyspan and sprayed with household latex paints. These topics were covered in detail in the October 2015 issue of *Model Aviation*. The article can be found at www.modelaviation.com/images/article/ma-construction-series/ma-construction-series-8-polyspan-and-paint.pdf.



A simplified gear door arrangement made from one fixed and one rotating part.



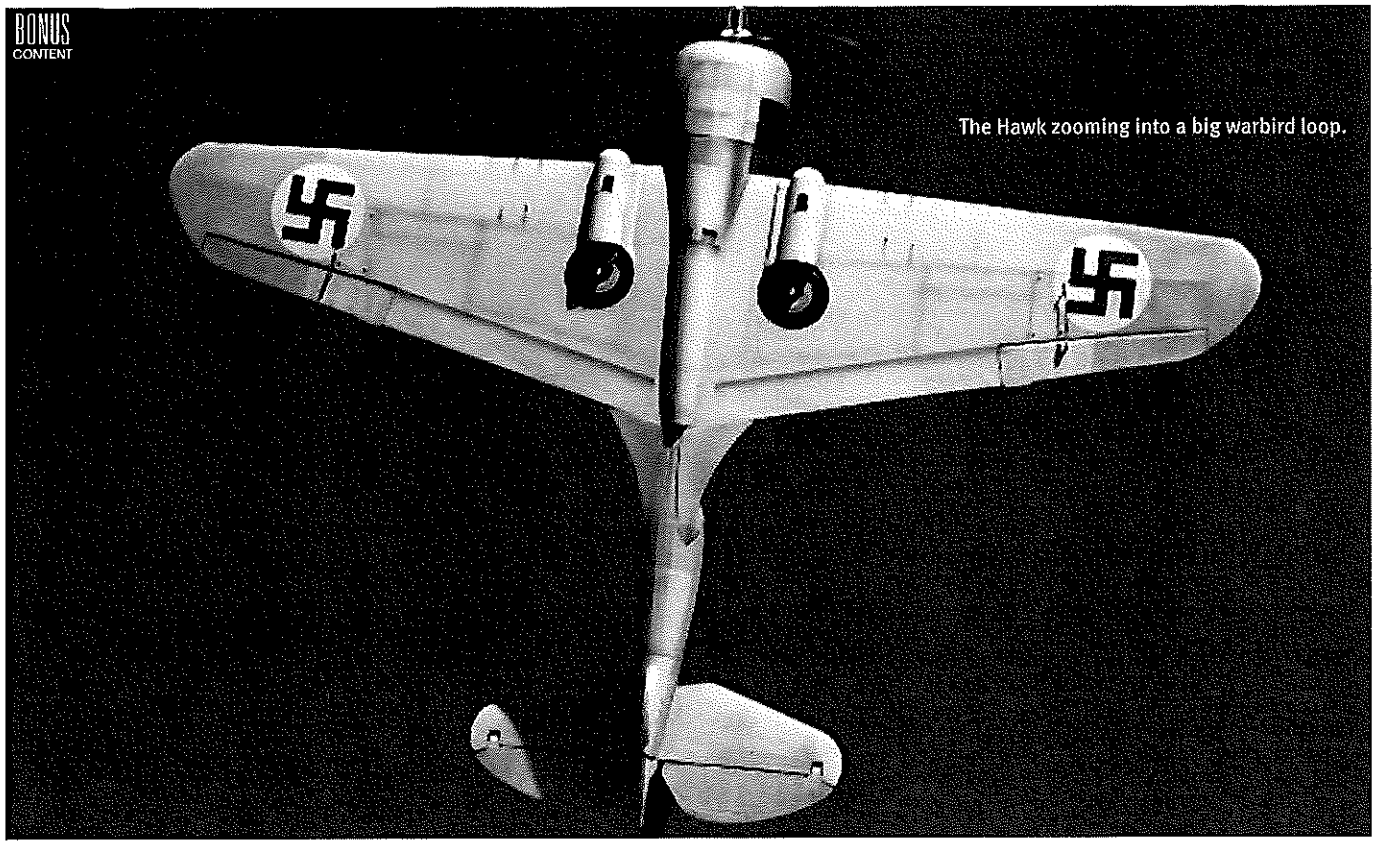
This is what the author's Sussu looks like when it's hungry for some Ratas!

Narrowing down the choices for paint schemes for your Hawk can be the toughest part of this project. Options for U.S. Army aircraft range from aluminum with colorful prewar markings to the solid olive drab and grey of the defenders at Pearl Harbor. There are also some wild experimental camouflage schemes used during war games before hostilities erupted.

The export models of the Hawk offer an incredible range of options including the beautiful Vichy French aircraft that flew against the allies in North Africa. The striking red and yellow stripes, tricolor camouflage, and French roundels were a close second choice for my Hawk.

Ultimately, I was drawn to the schemes of the Finnish Air Force (FAF) for some time. The black and green camouflage patterns, combined with generous yellow identification bands, make for a pretty aircraft that offers excellent visual orientability. And of course, it

BONUS CONTENT



The Hawk zooming into a big warbird loop.

was the Finnish Hawks that were pitted against the I-16s that form the counterpart of the "Fighter Face-Off."

And now a word on the markings. Finland adopted the blue hakaristi as a national insignia in 1918. This came to be after an early benefactor of the FAF donated an aircraft adorned with what was once recognized as a symbol of good luck. Finland discontinued the use of the hakaristi as an insignia after World War II because of its negative association with the Nazi swastika.

The markings are vinyl and were printed by Callie Graphics. As usual, they are perfect. Callie Soden has the file for those interested in finishing their Hawks in FAF colors.

Flying the Hawk

The maiden of the prototype was flown after the covering was complete, but before it was painted. Although bigger than my other projects, the Hawk floated off of the ground during taxi testing, similar to other infield models. All-up weight was 56 ounces with a 3,800 mAh 4S LiPo battery installed.

Ground handling with the wide track was good. The transition between tail wheel and rudder steering wasn't particularly noticeable as the tail came up. At half throttle, the Hawk was pulling strongly and climbing at a scale angle. The gear pulled up as planned and we were away.

The somewhat large elevators and rudder were effective, but the more modest scale ailerons were more so than I expected. Scale flight was a breeze, with majestic maneuvers and appropriate speeds. The Finnish pilots who flew the Hawk 75 called it the Sussu, or "sweetheart." I found that the personality of the model was consistent with the full-scale version.

But when the stick went all the way forward, the Hawk took on another tone. It's no pylon racer, but the airplane scoots!

The landing was challenging only in the sense that the Hawk didn't want to come down. I floated by the runway on the first attempts. For me, 60 inches is a large model and seeing it float just like my 10-ounce aircraft was astounding. But after the turn to final approach was moved out, the landings were featherlight.

Wrapping It Up

Now that Derek and Paul have gotten the bugs out of their warbirds, it's time to bring the I-16 and the Hawk together at a field. They look forward to seeing the scrappy airplanes tearing up the sky. Watch for a video of the Hawk and the Rat meeting and having an actual Fighter Face-Off!

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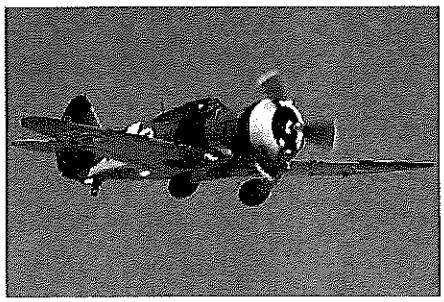
SOURCES:

Manzano Laser Works
www.manzanolaser.com

Park Flyer Plastics
parkflyerplastics.com

Callie Graphics
https://callie-graphics.com

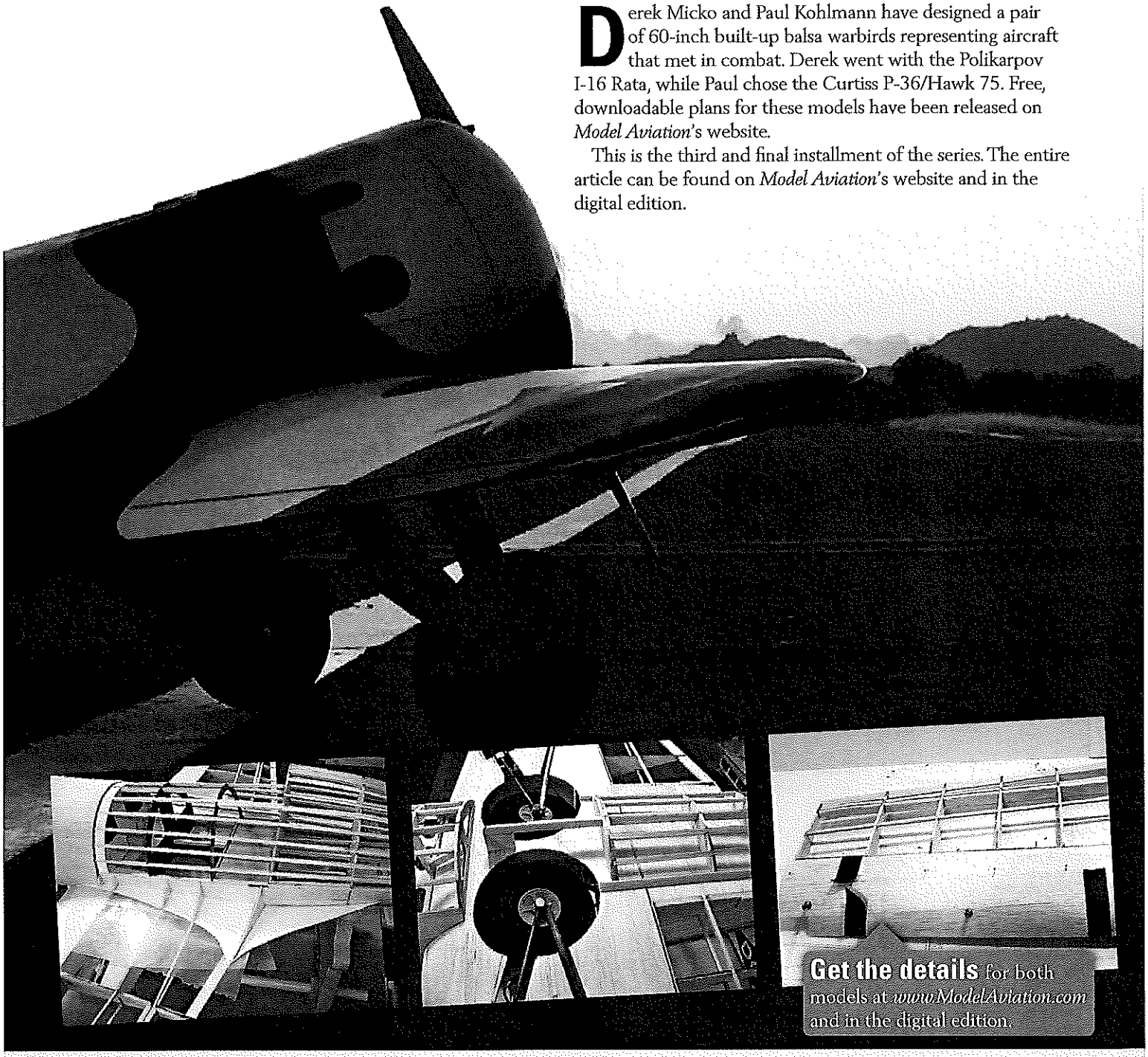
Dave Brown Products
www.dbproducts.com



Distinctive Curtiss landing gear dropping down for landing.

Derek Micko and Paul Kohlmann have designed a pair of 60-inch built-up balsa warbirds representing aircraft that met in combat. Derek went with the Polikarpov I-16 Rata, while Paul chose the Curtiss P-36/Hawk 75. Free, downloadable plans for these models have been released on *Model Aviation*'s website.

This is the third and final installment of the series. The entire article can be found on *Model Aviation*'s website and in the digital edition.



Get the details for both models at *www.ModelAviation.com* and in the digital edition.

Flying the Hawk

The transition between tail wheel and rudder steering wasn't particularly noticeable as the tail came up. At half throttle, the Hawk pulled strongly and climbed at a scalelike angle. The gear pulled up as planned and the aircraft was away.

The large elevators and rudder were quite effective, and the modest scale ailerons were more effective than I'd expected. Scale flight was a breeze, with majestic maneuvers and appropriate speeds.

The Finnish pilots who flew the full-scale Hawk 75 called it the Sussu, or "sweetheart." I found that the personality of the model was consistent with that of the full-scale aircraft, but after the stick went all the way forward, the Hawk took on another tone. It is no pylon racer, but it scoots!

The landing was challenging only in the sense that the Hawk didn't want to come down. I floated by the runway on the first attempts. For me, 60 inches is a large model and seeing it float like my 10-ounce models was astounding. After I moved the turn to final approach farther out, the landings were feather light.