AERONCA TANDEM

Build a vintage replica of this 60in sport scale lightplane, designed by Harry Gilkes

Harry's Aeronca Tandem is based on a vintage free flight model designed back in the 1940s. Subtle structural changes and the incorporation of R/C have turned it into a highly practical sports machine.

I suppose we must go back many years for the start of the Aeronca Tandem story, to the mid 1930s to be exact, when Aeronca laid down the specification for an enclosed tandem two seater to be designed around a basic 35/36ft wing.

Moving onto the 1942 American Nationals, there appeared in Class B free flight what we would now call a very "stand off" scale model of the Tandem of some 4ft wing span, but with an Ohlsson 23 up front! By the way, this was an entry in free flight duration, not scale, and weighed in at around 20ozs. With 4.1/2" of dihedral it must have been a bomb to trim!

However, to move on through the years, I first came across the Tandem in the early 70s, when I obtained a reduced photocopy of the original design by a fellow called Ronnie Albert. This drawing went into my filing system with the intention of building a free flight model one day.

In 1987 I was in my vintage period. Out came the file with the Tandem in and with one small drawing, a calculator and an OS 20 doing nothing, the model presented here was born – or I should say, Ronnie Albert's model was reborn! A little "better fed" than the original, it has grown up to sport a 60 inch (1524mm) wingspan. The "rebirth" was somewhat protracted, and the airframe was built in fits and starts, as work on other models allowed. The model was finally completed around early 1991, with the original motor replaced by an OS 26 FS.

I finally got around to a couple of test flights before arriving at one of the MPA Fly-Ins at Old Warden, where our editor was wandering around with his camera. Click, snap and pose was followed by the request, "Can we have the drawings please?" So here it is, but before we get into cutting and sanding, let's start with a few...

DATA FILE

AERONCA TANDEM

Designed By	Harry Gilkes
Type of Aircraft	Vintage Sport Scale
Wingspan	60in
Total Wing Area	485sq ins
Aerofoil	Clark Y
Dihedral at each tip	2.4in (5.6in on true vintage replica)
Fuselage Length	40.5in
Tailplane Span	20.25in
Tailplane Area	114sq ins
Tailplane Section	Symmetrical
Fin Height	8ins
Rec. Engine Range	.20-.25 two stroke, .26 four stroke
Fuel Tank Size	4oz
Rec No of Channels	3 channel
Control Functions	Rudder, Elevator, Throttle

Materials used in Construction

Fuselage	Balsa, Ply, Hardwood
Wing	Balsa, Ply, Hardwood
Tail Surfaces	Balsa, Ply
Weight Ready to fly	60-64ozs
Wing Loading	19-20oz/sq ft

General comments

The model is very much a stand off scale Sunday flier and while I have retained, as much as possible, the original structural appearance to try and appease the true blue vintage fanatics, certain changes have been made. The most noticeable is the reduction of the dihedral, which if retained would have been around 5.6ins (140mm).

To prove this point, have you ever flown a radio assist Junior 60 with original dihedral – it's slightly touchy on the rudder, to say the least. The only other major changes are to the tail feathers, where a rudder post has been added and the stabiliser spar of the original has been increased to act as the hinge support member for the elevator.

On my prototype the wings have been made in two parts, with 12swg (2.5mm) wire joiners fitted into brass tubes, bound and epoxied to the front and rear spars. Also, the wing panels are bolted on, in place of rubber bands, but the plan shows both methods of fixing. Whilst on the subject of the wings, **do not fly without the wing struts as these carry flight loads!**

The plan shows both the original free flight sections, together with an alternative non-under cambered section which is easier to build as it requires no packing under the spar. This section may also be preferred by those modellers who wish to modify the plan by adding scale size ailerons. I suggest you use top hinges and only about 1/2" dihedral per panel – ailerons have not been tried yet, so if you choose this route then you are on your own. For those who wish to produce a more scale like model, the appearance of the fuselage can be improved by adding a 1/4"sq. stringer just below the datum line, blending into the front 3/32" sheeting and tapering into the side, just under the stabiliser, at the rear. To complete the conversion a similar stringer should be run from the base of the fin and out over the cabin.

Another suggestion would be to extend the cabin glazing rearward and build a Grasshopper US Army observation version. This would require some slight revision to the side frame structure but I should imagine

anyone carrying out this sort of modification, plus ailerons, would have reached a reasonable level of expertise in our hobby.

Vintage buffs will probably prefer to build a replica of the original F/F model and covered with modern tissue like materials it would look very nostalgic against a blue summer sky, especially at a venue like Old Warden!

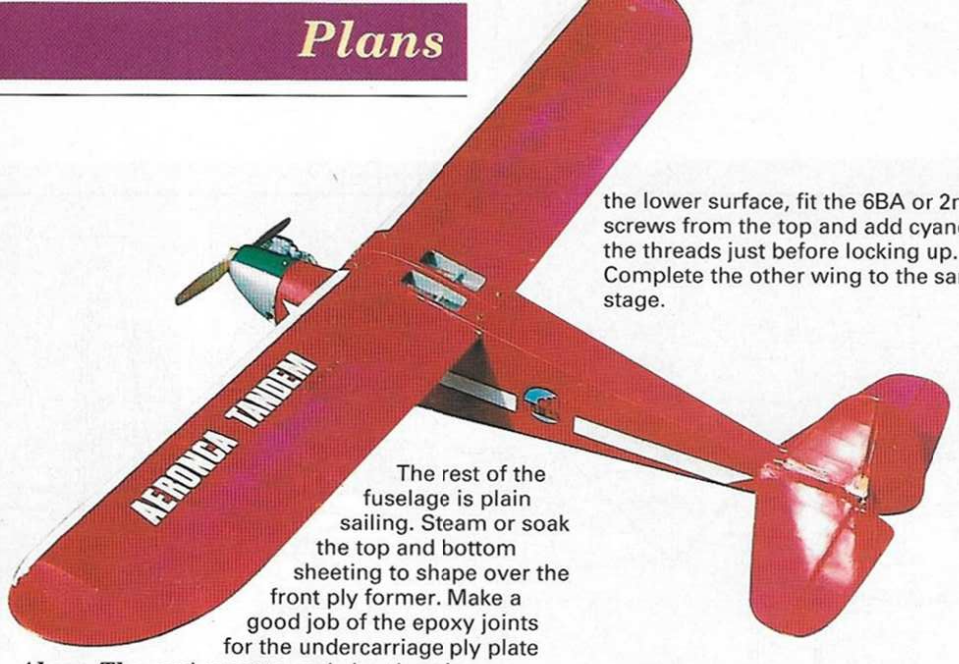
Finally a few words of warning on two points. First rudder movement; keep to the recommended throw, even with the reduced dihedral shown on the prototype. Second point is power; the prototype is powered by a well used OS 26 four stroke, swinging an 11 x 4 wooden prop, and has more, repeat more, than enough steam. So don't be tempted to use anything more than a plain bearing 20/25 two stroke. And finally, don't forget to fit the struts!

Building the fuselage

Build both sides over each other and separate with a fine razor saw or Stanley blade. Choose straight grained hard balsa for the longerons, uprights and diagonals.

After separating, glue on the front ply liners and local ply gussets using alephatic resin. Ensure you have a right hand and left hand side frame assembly. Complete the sides by filling the rear bay and the area over the undercarriage with sheet balsa. Next, build up the main formers from hardwood balsa strip and ply plates, also cut out the front ply former and cowl formers.

If you have built a rubber model this will bring back memories; it is just a big rubber model really. Join the sides by fitting the built up main formers. Use epoxy for this stage (and for the front ply former and wing bolt blocks). When pulling in the sides it is necessary to part razor saw the lower longeron F4/F5 and centre longeron at F4. Fill the cut with cyano or epoxy, and sand lightly.



Above: The prototype was covered in heatshrink film for a quick sports livery. A little research should reveal plenty of ideas for a more scale like finish. Below: The Tandem is the ideal workhorse for smaller four strokes. Two strokes are OK too, but no bigger than a .25 please.

Wings

The first stage, and this relates to all the flying surfaces, is to cut the tip formers and laminate the tips using white glue and pre-soaked strips of 1/4" x 1/16" balsa. Use polythene sheet and strip along the periphery of the templates to prevent the laminated parts sticking to the templates and worktop.

Next cut all the main wing rib blanks. Stack, sand and cut the basic size spar slots, then repeat the operation for the riblets. The front and main spars are made up from hard sheet with ply facings. Pin and weigh down well whilst drying, using alephatic glue to avoid warping. Next prepare the TE from hard straight grained wood by notching the rear for the ribs.

You are now ready to assemble the wing. If using the under cambered wing, place suitable packing under the front of the TE and all spars. Assemble all the ribs and riblets, except the tip rib, followed by the 3/32" x 3/8" LE capping, the root rib capping and the 1/4" sheet LE. Do not forget the local ply reinforcement on the LE and TE at the root.

Next trim and fit the laminated tip; cut off the rear end of the tip rib to suit. Remove the wing from the board and turn over. Fit the 3/32" x 3/8" LE capping, together with local gussets, the LE wing bolt blocks and the top local blocks to fair the LE to the laminated tip. Now sand the wing overall, including blending the lower faces of the spars with the tip. Round off the tip and LE, and also blend the top ribs as required.

Finally, complete the half panel by fitting the strut anchorage blocks; use 30 minute epoxy for these joints – not the quick drying type (this comment applies to all epoxy areas). When the blocks are dry and sanded flush with the lower surface, fit the 6BA or 2mm screws from the top and add cyano to the threads just before locking up. Complete the other wing to the same stage.

The rest of the fuselage is plain sailing. Steam or soak the top and bottom sheeting to shape over the front ply former. Make a good job of the epoxy joints for the undercarriage ply plate and gussets, and also the wing anchorage blocks. To complete the fuselage add local sheeting, the wing LE seat, cable exit support sheet, not forgetting the 1/8" dia dowels behind the windscreen. Now we can get down to the flying surfaces, starting with the...

Now we come to joining the wing panels; this is straight forward. Line up the centre sections, checking that you have the dihedral required. The easiest way is to make up a couple of blocks to slide under the wing at an appropriate point to give the dihedral indicated on the plan (if you are building the true vintage version you will need to modify the bottom of the spars at the centre to give around 5.1/2in dihedral – but be warned, you are on your own!).

Check the panels line up, with no twist or warps relative to each other, then add the 1/16" or 2mm ply joiners. Note these are full depth – see the root section. Glue and clamp lightly, again use a good quality epoxy. If you wish to make a two piece wing with wire joiners, as mentioned earlier under the general comments section, just make up the extra ribs, face with 1/64" ply, and fit brass or aluminium 12swg tubes, bound to the main and rear spars. Do this with the wing assembled, as for the one piece wing, and then cut through the ply joiners and tubes with a razor saw; this will ensure that your panels are in line. To complete the two piece wing, fit the extra ply face ribs and cover each half root with 1/64" (.4mm) ply. The one piece wing only requires the ply covering to be added before, in both cases, the glazed panel opening is cut out. That leaves the...

Centre section fairing

This is made up from ply and balsa, and is trimmed to fit the wing, being the same width as the fuselage. Note, if you are using the bolted on wing, don't forget to fit the hardwood blocks to the TE section of the wing.

The actual cover can, of course, be made in two parts to suit the two piece wing. It is best to fit this to the wing after covering, not forgetting the glazed section cut out. To complete the flying surfaces we come to the...

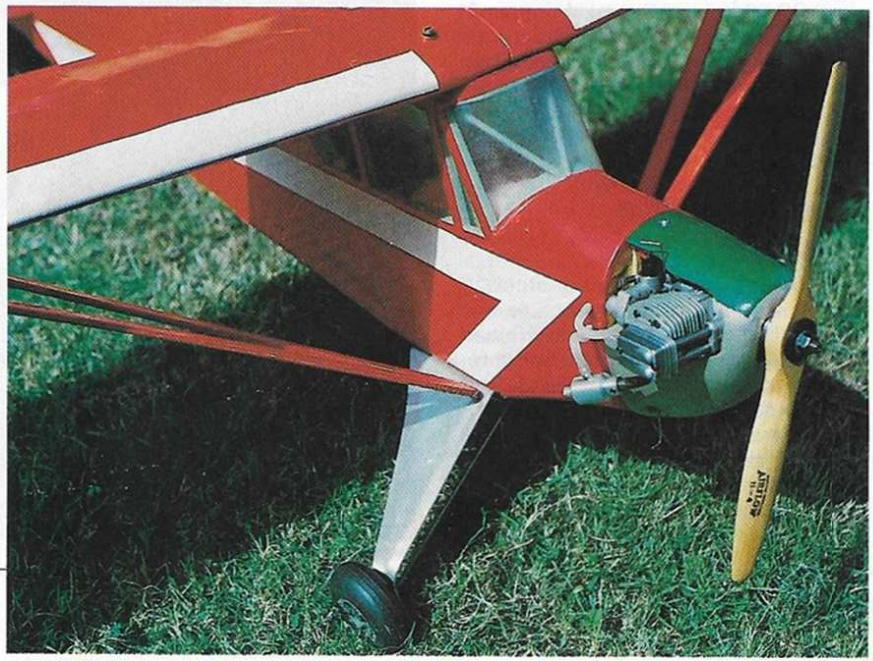
Tail feathers

These are straight forward and both vertical and horizontal surfaces are built in one piece; cut though the hinge line after final shaping. For both units tack glue the hinge spars together, pack up the TE and LE sections with scrap 1/8" balsa, then trim the laminated tips to fit. Finally fit the ribs or local 1/2in pieces (2" x 1/4" laminates). When dry, remove from the board and finish to the streamlined section shown.

Fit the anti warp spar to the lower surface of the stabiliser unit and finally, cover the centre section with 1/64" (.4mm) ply. The last operation is to split the hinge line along the tacked joint and radius the LE of the hinged surfaces only. At this stage you can mark the centre line of the stab on the fuselage rear bay – note the two angles shown, dependent on either the sport or vintage version. So now we come to the bits and pieces namely...

Cowl, struts and undercarriage

Starting with the cowl, this is again a matter of choice, with either the full sports scale cowl or the open bottom vintage version. In both cases the cowl is built up from 1/2" balsa layers, as per the sketch or plan, on a 1/16" backing (see F1). Cut out the middle of this ply



backing to fit over your engine and commercial engine mount, before gluing on the balsa layers. Carve and sand the cowl to shape as per the plan and photos, and provide three or four hardwood blocks on F1 to take the fixing screws. If you go for the full cowl, don't forget the air exit slots.

As mentioned earlier, I had originally intended to fit an OS 20 RC, canted over slightly, with a home made pancake type silencer fitted inside the cowl.

Next item on the list is the wing struts which must not, under any circumstances, be omitted. These are made from a good quality hardwood or laminated from 1/16" ply. The dimensions on the plan are approximate; the final lengths should be obtained by assembling the model and made to suit. A couple of points; the hook end should lie flush against the inside of the undercarriage, and secondly, all joints, both wood and wire, should be well bound and epoxied.

The struts are retained on the thread of the screws built into the wing with over size washers and nyloc nuts. Final bits and pieces are the undercarriage and tail wheel assemblies. The latter can be a commercial type, or simply build a block into the tail end of the fuselage and make up a pivoted unit, supported in a plastic tube (or hardwood block).

The main landing gear is a simple choice of a built up unit, as per the original free flight version, with balsa or ply filling and covered with tissue or silk/nylon. If you choose to copy the prototype unit, use good quality dural and solder a large washer (or nut) each side of the alloy leg on the centre leg/ axle.

So now we have a complete set of airframe parts and we can get on with one or two minor fitting details. Starting with the motor mount/engine installation. The mount is a standard unit which can be retained by blind nuts pulled into the back of F1. Decide on your particular choice of motor installation/cowl, fit the motor (temporarily) and cut/trim the cowl to suit. Then locate the cowl retaining bolts, with local reinforcements in the cowl to take the screws. I use plastic tube, cyano'd in place.

Finally, drill a hole for your throttle tube outer and don't forget an air exit and fuel drain holes, as required, in the cowl.

Regarding the bolted wing option, I used long brass 4 BAs, but commercial 5mm nylon types might be a better option. While dealing with bits and pieces, don't forget the radio access hatch behind the undercarriage. This can be stiffened internally by 1/8" or 3/16" balsa on the inner face, to locate against the inside of the longerons. The windscreen and windows can be cut to size and fitted after covering.

Covering & colour schemes

I had originally intended to cover the prototype in the Aeronca house colours of yellow fuselage and vertical surfaces, with white wings and horizontal tail surfaces.

However, due to the prolonged building time it actually got finished in all red, using Glosstex on the fuselage and Fibrecote on the flying surfaces. Whilst on colour schemes, I have seen in a full size aviation publication a picture of a beautiful Tandem finished with a dark blue fuselage, fin and rudder, with silver doped flying surfaces, together with white and black numbering – the usual American N markings. (I suppose you could always use your MPA number!)

Back to finishing, the usual proofing of the cowl, tank bay and any other fuel vulnerable areas was completed before covering, all parts being covered prior to hinging. So that leaves the installation of...

Fuel tank and guidance equipment

The fuel tank used is a 4oz SLEC with all tubing exiting through a central hole in F1. On the original the lower area in front of undercarriage is detachable – see photos. The tank is well supported in foam.

Turning to the radio equipment, installation is a little different to normal practice in that the servos are fitted upside down and access is through the bottom of the fuselage – see plan.

The receiver is installed below the servos, with a ply plate fitted between the fuselage sides to cover the linkages. The plate rests on 1/4"sq. balsa rails, glued to the inside of the fuselage sides. The plate is retained by the foam wrapping around the Rx and the detachable cover behind the undercarriage. The nicad is behind the fuel tank.

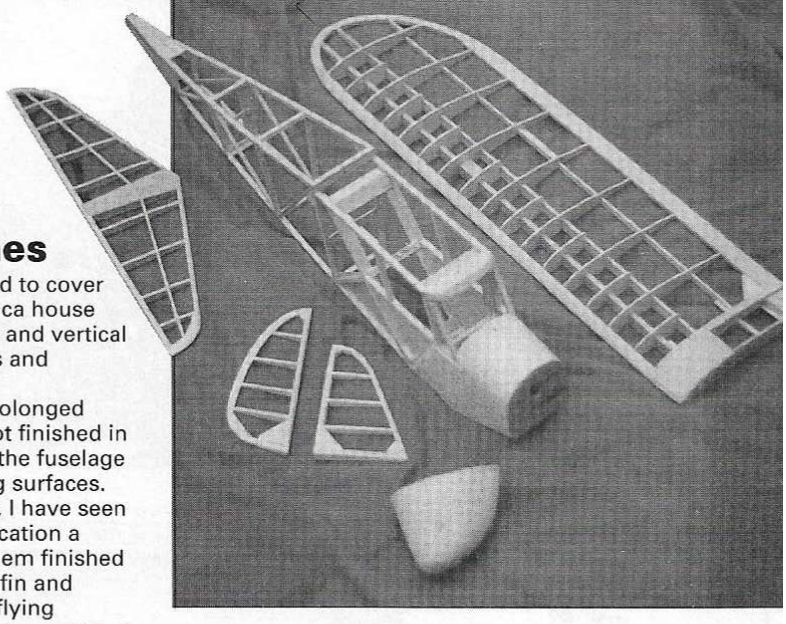
Setting up

The balance point shown on the plan is for the airframe less wings i.e., all radio equipment, tank, engine, undercarriage etc. Using this method saves the inconvenience of putting on and taking off wings whilst obtaining balance. The final CG should be around 30-33% of the wing chord for first flights.

Now we come back to that dihedral and the yaw it causes! Do not exceed the throws listed below; these figures are on low throws (40-50%) using Futaba Challenger gear:

Rudder	5/8" each way
Elevator	5/8" up, 3/4" down
Sidethrust	2 degrees

The rudder horn on the prototype was made from 2mm ply, extending



1. 1/8" of an inch from the surface of the rudder. The holes are hardened with cyano. A normal horn is used on the elevator, with a 1/4"sq. pushrod, the rudder being closed loop cable operated.

The all up weight of the prototype came out at 4.1/4lbs, but this included very heavy hardwood spars and extra root bracing to allow for non working struts. Using a normal 500 pack and careful selection of materials it should be possible to get down to around 4lbs mark.

OK, let's get down to...

Construction is all traditional stuff, including laminated balsa wing tips. Remember to build light and keep it straight!

Flying the Tandem

No real problems here, as long as you keep to the recommended throws. Check that there are no warps and that the centre of gravity is in the correct place.

The Tandem will handle windy conditions quite well, as those who saw it fly at one rather blowy Old Warden meeting will testify, but do try and test fly yours in calm or light wind conditions. Due to the rather deep side area and shortish movement arm, the Tandem can get a little touchy on the ground if it's a bit windy and pointing out of wind. Best technique, which I found applies to most vintage three channel models, is to get the tail up using very low power. Once the tail is up, just apply a little right rudder and around half or two thirds power, and she's away.

The Tandem will happily fly round on third power, climbing quite rapidly on any thing over two thirds. I think it looks best on a low fly past and it sits nicely in the air. On any thing over the throws recommended the Tandem becomes mildly aerobatic, with loops, stall turns and even rudder rolls (ugh!).

Well that's the Aeronca Tandem vintage replica. I like it and I enjoy flying it. If you decide to build one let our editor have a picture, especially if you build it in true vintage style or if you decide to experiment and try a four channel version or modify it to a WWII Grasshopper. It would be nice to see an Aeronca Tandem invasion at next Old Warden Vintage Day! See you there? In the meantime, fly with safety and have many happy landings!