CAP 21

A delightful aerobatic sport-scale ship for .40-.46 cu. in. 4-strokes and four or five function R/C equipment.

By Gordon E. Whitehead

As small aerobatic models go, the CAP 21 presented here has to be one of the best. With a .40 4-stroke up front, there's no difficulty keeping yourself interested in this ship as she's been designed specifically for performing complex aerobatics using just that size of motor. In fact, when I bought the Enya .40 4-C for this aeroplane, I got rid of all my 2-stroke .20s and .25s, deciding that as far as I was concerned, these engines were now obsolete for medium sized models.

I haven't been disappointed with that decision. The effortless puttering note of the 4-stroke is a really welcome relief from the unpleasant yowl of the 2-strokes, whilst going for a lightweight clean lined model enabled me to make full use of the Enya's power. The model presented here is Stand-Off Scale, and it has been modified from the way it initially rose from the building board by having had the wing move forward, and having tail area increased. These changes have made the model very easy to handle, whilst improving its aerobatic prowess at the same time.

I am utilizing some of the bells and whistles on my JR8, employing the coupled flap/elevator and flaperon options. The former combination really squares off sharp corners, whilst drooping the flaperons for landing slows the ship down almost to walking pace. The flaperons come in handy for take-offs as well, and they cut the take-off run in half.

Just recently I've mounted the CAP 21 on floats and, with flaps deployed, take-offs and landings become one heck of a lot easier than with no flaps. So much is the improvement that I would recommend flaps to any budding water plane enthusiast, whatever craft he's modeling.

The novel airfoil shape scores maximum points for ease of building, and the wing needs no jigging strips as you can build it flat on the board. That airfoil works really well, too. It is reminiscent of a U-control aerobatic airfoil, and the CAP can be made to behave just like a ukie, performing square loops and horizontal eights at record low level — just as if she was on 52 foot lines.

Though I'm certainly hooked on the ship, I wasn't always so enthusiastic, and there's a bit of history about her that is worth re-telling. Here it comes!

As first built, she had an unpredictable tip-stall, and the elevators were overly sensitive. The tip-stall occurred in tight loops, when she would snap roll out, and at landing

when, if you slowed the ship too much, she dropped a wing. I checked the balance point, only to confirm what I already knew; it was about half an inch forward of the calculated C.G. position. So the first things I did was to add tail weight, and twist in some wash-out, using a 3 k.w. electric fan heater to facilitate the twisting. A slight improvement was noted, but nowhere near enough to make this into an aeroplane fit for publication.

Fed up with having 2 oz. of tail weight taped to the rear end, I moved the wing forward 3/4" thus dispensing with the need for the lead. There was a minimal improvement in that the elevators became marginally less sensitive, a result no doubt of lengthening the moment arm.

However, I haven't mentioned the best part yet. My CAP, as I explained above, has provision for flaperons. So, on drooping the flaps, whaddaya think I got? More lift? Wrong! My CAP 21 had **lift dumping flaps!** The minutest lowering of flap would dip the nose, whilst lowering them 30° would make the ship dive hard. Coupling flaps to elevators actually opened out loops.

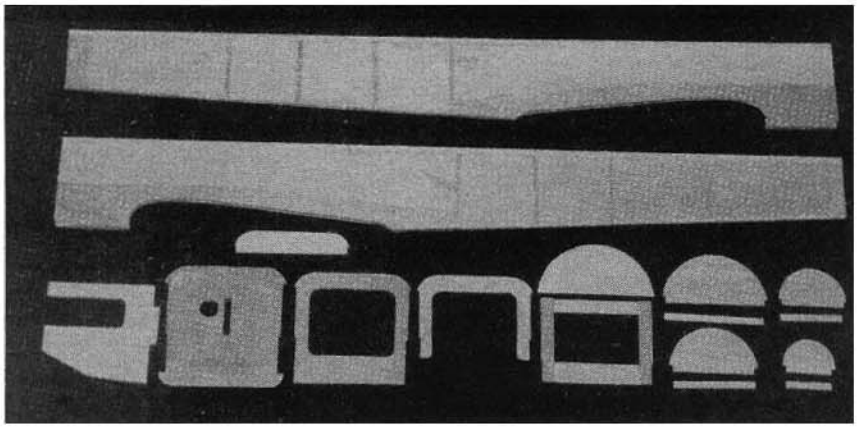
Another unusual feature was that for equal elevator deflection, outside loops were about 50% bigger in diameter than inside ones, requiring compensatory elevator differential.

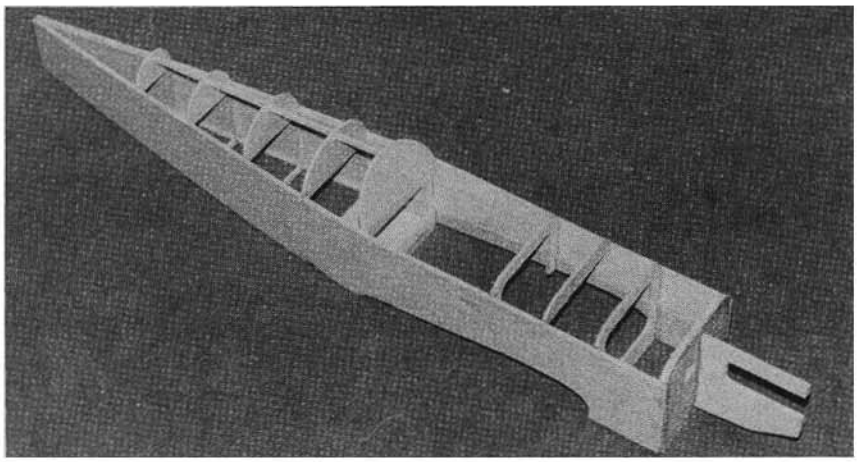
As you can imagine, this plane was a bundle of fun. Since she was a near scale version of a full size design, I began to wonder about the super human capabilities of the full size pilots. Certainly they would have to be supremely brave or foolhardy if the real ship behaved remotely like my model.

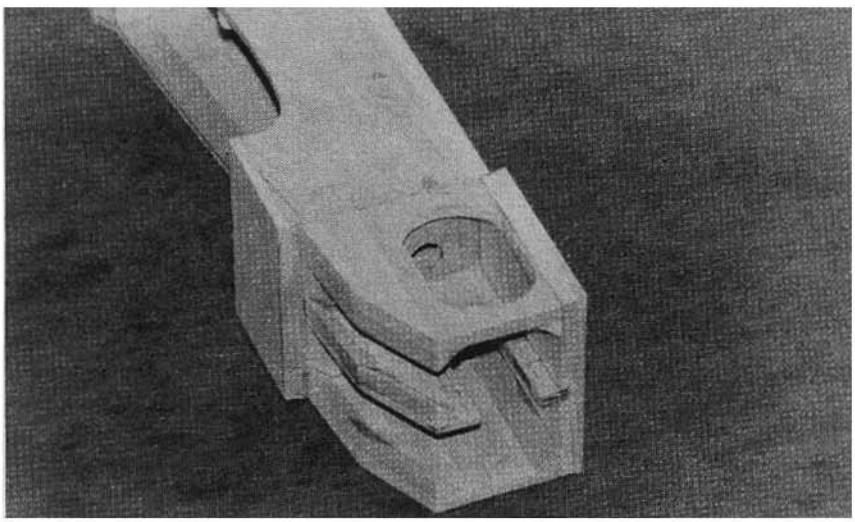
It was the behaviour with flaps that gave me the clue for a cure. Depressing flaps should increase lift and, therefore, enhance the tip vortices. The resultant down wash from these bigger vortices, on striking the tail, should cause a nose-up reaction, which was obviously missing from my CAP. So I reasoned that I should increase the size of the tail so that it would make better use of whatever down wash existed. I increased tail area from 17% of wing area to 25% by fastening slabs of 1/4" sheet balsa round the tail outline with pins and Scotch Tape. And, what a change resulted! The elevators were completely desensitized and, instead of being limited to 3/16" movement, could employ more normal deflections. The tip stall was completely eradicated since the large tail now fully controlled the wing, damping out any tendencies towards unwanted snap rolls. But what of the flaps? Drooping the flaps now caused a gentle nose-up reaction. Eureka! As soon as I arrived back home, I made a whole new bigger tail and we were in business.

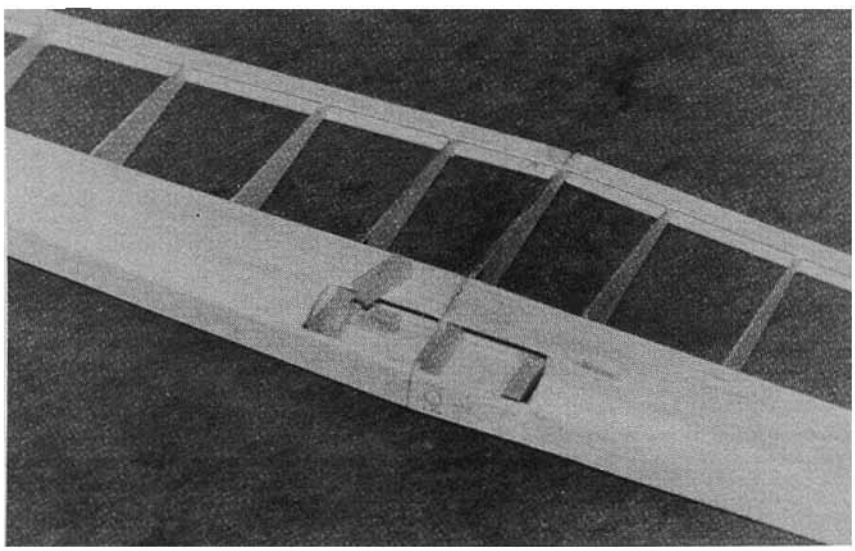
It is true to say that this plane, like some of my previous designs, has usefully furthered my knowledge of applied aerodynamics. I hope that the discourse above helps out you modelers as well. Before this experience, I thought that a bad tip-stall could only be reduced and not cured. Moreover, I also thought that the palliatives of wing wash-out and moving the C.G. forward were the only answers. However, if you recheck the steps I followed, you will note that I moved the C.G. **back,** as it was already well forward, and that adding wash-out did next to nothing. So, if you have a model which has a tip-stall problem, just make the tail around 50% bigger and I reckon you'll cure it.

Right. End of lesson and back to the









LEFT ABOVE: Fuselage parts prior to assembly. LEFT BELOW: Basic fuselage structure ready for top decking to be added.

CAP 21. I'll describe maneuvers later and will outline construction now.

CONSTRUCTION

The model is of conventional construction and most details are included on the plan, so these building instructions will be brief.

First make two fuselage sides and the various formers. Make up the basic fuselage as shown on the photos. Paper patterns are made for the decking as a guide for cutting these items to shape. The canopy frame is added before covering the fuselage, but the canopy and windshield are glued in place afterwards using contact adhesive. The cowling is permanently fixed, with the engine being fitted and removed through the side opening.

Each wing is assembled separately, and the wash-out packing is inserted immediately before the leading edge sheet and the spar webs are glued in place to ensure permanency of wash-out. I servo taped the two aileron servos directly to the top surface of the wing centre section; however, a conventional single aileron servo arrangement may require you to build bearers into the centre section.

The landing gear is a commercial dural one. The wheel pants are a simple design, but do not like long grass; however, the plane looks odd without them.

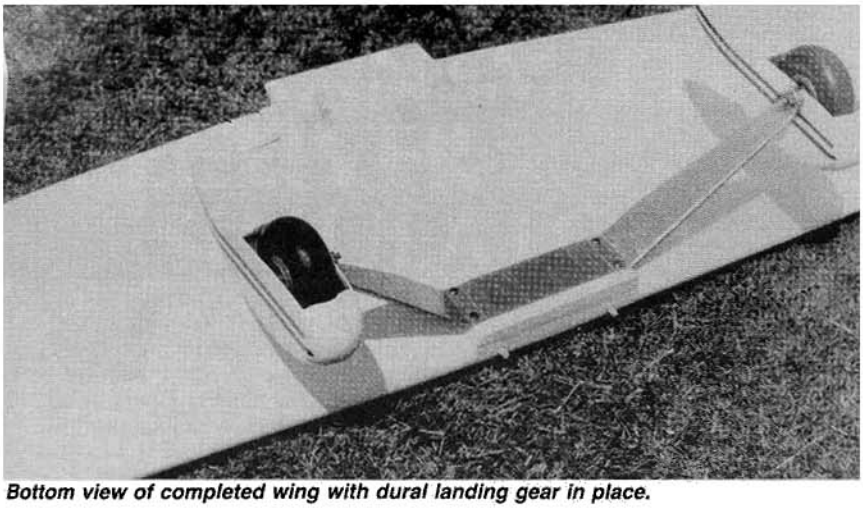
I covered the prototype in Solarfilm, cutting the registration and trim also from Solarfilm.

Flying:

Right at the start I hinted that this ship is a jewel to fly. Mine weighs just on 4 lbs., and uses the Enya .40 4C with a Taipan 11 x 5 and 10% nitro, 10% castor, 80% methanol fuel, with K.R.22 rust inhibitor added.

Let me just repeat that she has no unwanted tip stalling tendency. However, her stall with flaps up is

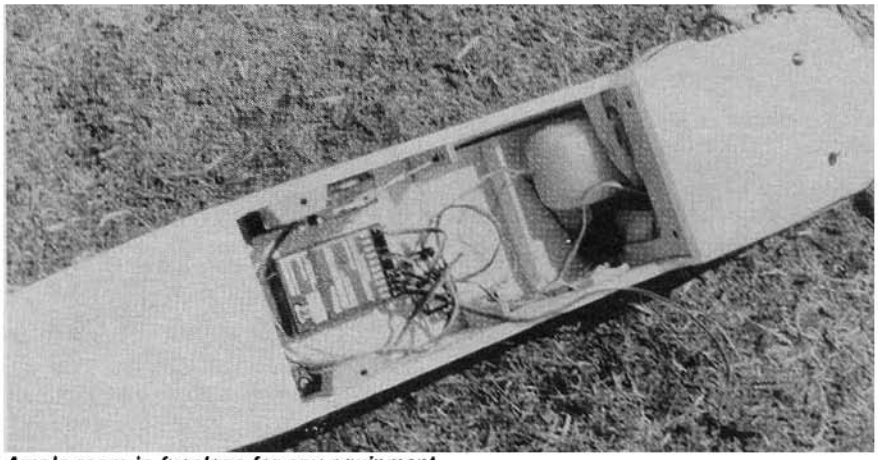
LEFT ABOVE: Cowl top and sides in place. Note triangular reinforcement strips. LEFT BELOW: Basic wing assembly showing blocks for landing gear plate. Leading edge strip has yet to be added.



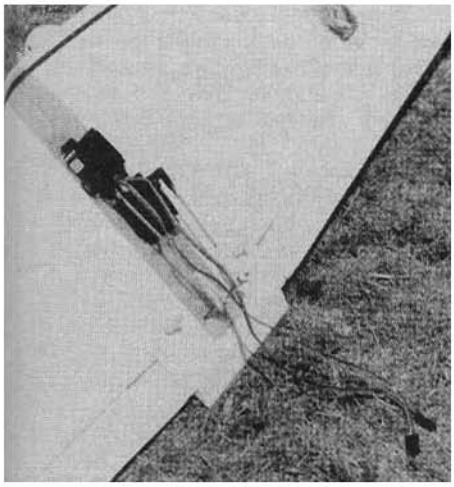
Bottom view of completed wing with dural landing gear in place.

quite sharp, and the model snap rolls readily when commanded to do so. The relatively high aspect ratio slows down the snap roll from what is normal for a pattern ship and this feature enables you to achieve knife edge to knife edge 1½ snap rolls with reasonable accuracy. Because of the low power, prolonged knife edge is not possible; so you need to roll her into knife edge, wait only a second, then perform the snaps, recover in knife edge, then roll back level fairly smartly.

I set out to produce a plane suitable for turnaround maneuvers, and succeeded in that she can manage all of the new FAI Schedule. The only



Ample room in fuselage for any equipment.

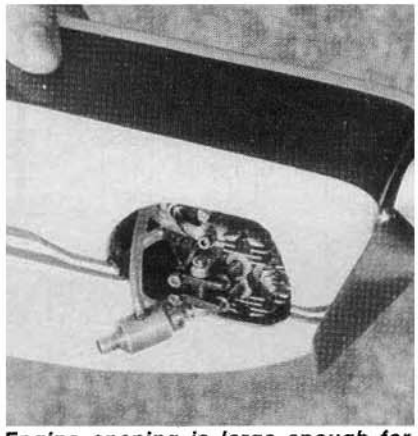


Tandem arrangement of flaperon servos. The servos are stuck to the wing top surface with double sided servo tape.

maneuver she really struggles with is the rolling square loop. The hard part with this figure is to exit the upward half roll with enough speed left to push over level and perform the next half roll. Practice makes this possible though, even if rarely perfectly!

The model is quite good for hesitation rolls. You can start a sequence off by rolling inverted, pausing, then rolling erect. Do a turnaround maneuver, and on the way back to a three point roll, hesitating at the 120 and 240 positions followed by another turnaround. On each pass you add one more hesitation. Try it — it's fun, and I can usually manage up to about 16-point hesitation rolls.

Another fun maneuver is to pull up as for a loop, then while going over the



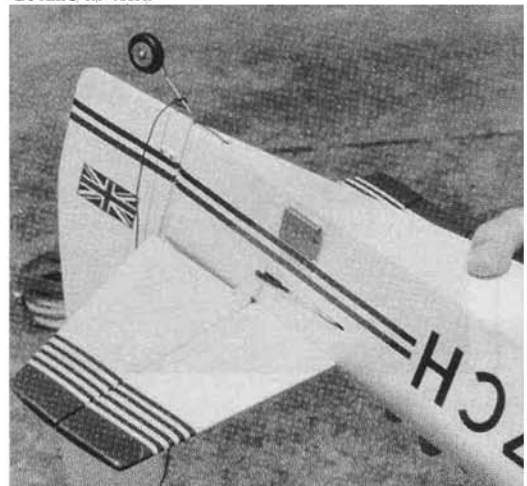
Engine opening is large enough for insertion of engine. Plenty of cooling air flow here.

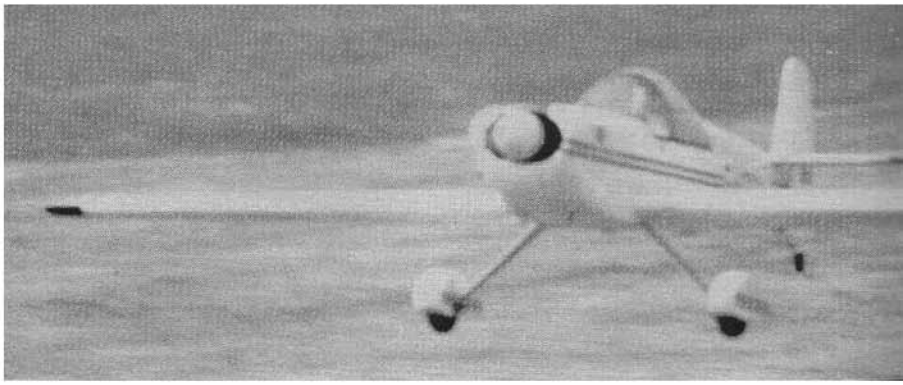
top, roll slowly through half a roll, so that when you reach the down-going side you push through the bottom of the loop inverted. Then you go back over the top, again half rolling so that you finally leave the maneuver erect. I call that the Siamese loop, as it is a sort of joined-up Chinese loop. While going over the apex of the figure, the plane is in knife edge flight and you will need to inject an appropriate rudder command to maintain the circular flight path.

Hitherto, the typical sport pattern ship has always been a speed machine. I reckon that this is why you rarely see the pilots of these planes attempt reasonably complex combination figures, particularly those involving autorotation. Hopefully, turnaround will change all that. Despite this ship's low power compared to what has been an acceptable norm, it really makes you want to experiment. For instance, why not try half rolls in each leg of a hexagonal loop? The slow forward speed of this ship, her instant and positive reactions to the controls, and the lack of that distracting piercing 2-stroke howl, enable you to fly her as an extension of your thoughts. As long as you don't need more than one complete upward roll you'll be satisfied.

So why not take the plunge? Surprise yourself with just how nice it is to aerobat a plane around the sky without sounding like a swarm of angry hornets. Get a .40 4-stroke, or even better a .45 or .46, and have a ball with this near scale version of the neatest aerobatic plane in existence.□

Note the lead weight in this early view of the tail group. Lead eventually removed, details in text.





From RCModeler Nov. 1985

CAP 21

Designed By:
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TYPE AIRCRAFT
Sport Scale Aerobatic

WINGSPAN
54 Inches

WING CHORD
8" (Avg.)

TOTAL WING AREA
420 Sq. In.

WING LOCATION
Low Wing

AIRFOIL
Symmetrical

WING PLANFORM
Double Taper

DIHEDRAL EACH TIP
N A

O.A. FUSELAGE LENGTH
40¾ Inches

RADIO COMPARTMENT SIZE
(L) 10" x (W) 3½" x (H) 2½"

STABILIZER SPAN
20 Inches

STABILIZER CHORD (incl. elev.)
5½ Inches

STABILIZER AREA
110 Sq. In.

STAB. AIRFOIL SECTION
Flat

STABILIZER LOCATION
Top Of Fuselage

VERTICAL FIN HEIGHT
8½ Inches

VERTICAL FIN WIDTH (incl. rud.)
7 Inches

REC. ENGINE SIZE
.40-.46 4-stroke

FUEL TANK SIZE
6 Oz.

LANDING GEAR
Conventional

REC. NO. OF CHANNELS
4-5

CONTROL FUNCTIONS
Rud., Elev., Ail., Throt
Flaperons (Opt.)

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage ..... Balsa, Ply
Wing ..... Balsa, Spruce
Empennage ..... Balsa
Wt. Ready To Fly ..... 63 Oz.
Wing Loading ..... 21½ Oz. Sq. Ft.