Cessna 172 H

BY **ERIC FEARNLEY**

A 57 in. span Class 2 scale model for a good range of engines from ·25 to ·40 cu. in. and full house R/C equipment.

ONE of the more pleasant tasks I have to perform as a free lance T.V. news cameraman is to meet the Air Anglia plane on contract to Anglia Television which ferries the urgent news film down to the studios at Norwich. Frequently news items filmed in early afternoon are flown 130 miles down to the studio, processed in colour, and transmitted on the tea time newscast. Few who watch T.V. realise the terrific effort put into this, particularly by the pilots who have a touch of the early American mail pilots' approach – the film must get through, whatever the weather.

When the weather is really bad, it's a Twin Commanche or Aztec, but more often than not over the last few years it has been 'Victor, Zulu', the hard worked Cessna 172H in orange and white livery that lands on a lonely air-strip. I never cease to marvel at the professional pilots who put the plane down almost anywhere. As the soldier said at Kirton Lindsey barracks – 'he's not going to land HERE, is he?' but he did.

Of course having such an intimate connection with VVZ, when lucky an air filming job in her as well, I had to get the drawing board out about two years ago and build a model.

Sufficient to say it is still flying, in fact I am right now testing a set of Blue Max radio in her.

One of the most difficult problems to overcome with high wing cabin models is getting enough strength in the cabin structure to carry the wing and suffer the shock of the occasional bad landing. The modern approach is steel tube brazed together. I did not want to use this, preferring a simple structure anyone can manage on the kitchen table. I therefore hit a compromise using plywood parts profusely to form a tee section at the cabin windows. This still allows a reasonably clear cabin interior to be shown, but it is not 'Class I' of course. Even with plywood, the cabin will break in a bad crash, such as when trying to take off very wet grass at full throttle, and hauling the stick back too far, causing a classic stall, wobble and snap roll, with obvious results. The only satisfaction is that if or when you do this, it all sticks back again with epoxy glue. After all, something has to go, and like modern car design thinking, it is better to let some part fail, to save the rest.

Two models were built by my son Brian and I as we wanted to operate almost anywhere in any wind strength, we opted for .40 power. I used the Super Tigre, and Stavely Analogue gear initially, now the Blue Max IC, which I find excellent for the fine control which makes a good scale flight, while Brian fitted O.S.40 and Gem radio. Many times we attempted formation flights, but the throttle response of the two different engines made it hard work. The Cessnas are extremely clean and with their scale wing section, starting with moderate lift at the centre section, and progressing to fully symmetrical at the tips, accelerate away at a touch of

the throttle which makes them ideal for windy conditions. On one occasion I paced mine against Brian's racer with the same S.T.40 and it was found that the two were not all that different, so obviously Cessnas have done their homework, and the fat fuselage is also very clean. Most aircraft drag comes from the frontal area of the wing depth, it seems, and as the Cessna has a thin wing, tapering to a knife edge at the tips, it is very efficient. In the light of experience I would say that a not too heavy model would fly very scale like on as little as .25 power. One of the difficulties is in fact getting it down with the .40, as the plane continues to fly down to almost idle throttle setting, and the throttle has to be set up very tight on idle to get a power-on landing without float. We often fly on a small grass air-strip 40 feet wide, and landing is none too easy, it being necessary to run the fuel out, or as I do, have the throttle to stop the engine at bottom setting, and kill the power at the last few feet of altitude. I am now considering whether to carve into the wing to fit flaps, which would have to be fully drooped to produce an air brake effect, rather than increase lift, which we do not want.

Building the Wing

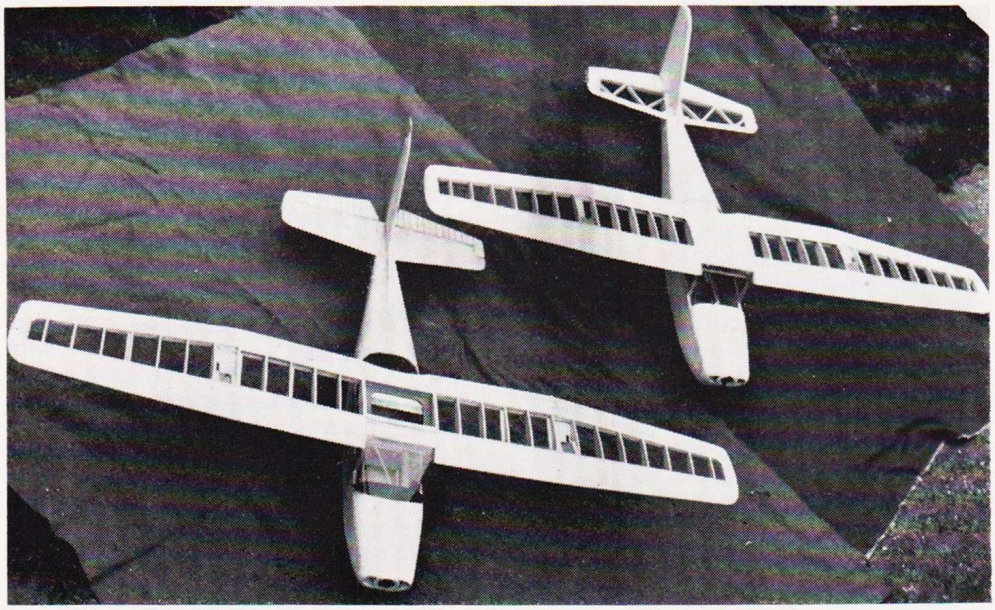
The thin section at the tips demands the use of spruce mainspars. But when covered in nylon the wings are very strong and retain the flexibility to resist damage. Purists will want to sheet up the wings for scale effect. This is fine, but they will then split on a rough landing.

Cut out a full set of ribs from a metal or ply template, including enough to later cut down for the tapered tips. Now count out enough for one outer tapered panel, and sandwich them together with the standard rib at one end, and the tip rib template at the other. Use a razor plane to get them to shape. Repeat for the other side, and mark the tops of each rib. It's easy to get a rib upside down if you do not. Fasten the mainspar down to the plan as far as the taper point, then block up the tips enough to allow for the taper towards the tips. Ensure that there is no bow in the outer spar which is raised off the plan at the outer panel. Fit the ribs in order, then the top spars, bending the tips down very slightly to meet at the outer ribs. Use white glue, which gives time to manoeuvre the whole structure with tapered strips, blocks and weights until the tips are showing a sort of washout at the tailing edge, caused by the change in section. This all sounds difficult but is not really.

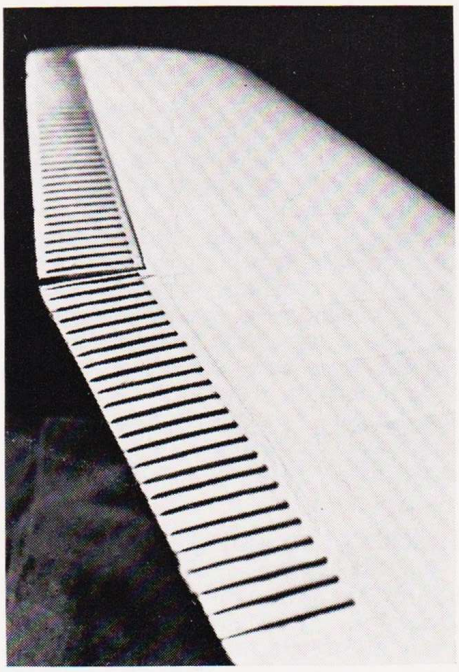
The trailing edge is fitted as far as the ailerons these being shaped from lightweight $\frac{1}{2}$ in. sheet balsa. If you want perfection, the tailing edge of the ailerons can be cut away and very hard stock glued on to prevent the sharp edge being damaged. The ribs are cut away to allow for the ailerons, and hard $\frac{1}{4}$ in. sheet added full depth, to take the mylar hinges. Remove from plans when the structure is set, and add tip blocks, and sub spars where the flaps normally go. Hardwood blocks are needed to take the strut fastening.

You will see that the struts are fitted to the wings with double pieces of Mylar hinge material, with a small $\frac{1}{2}$ in. wood screw and washer. The struts, which are streamlined and fastened to the fuselage by brass slotted plates feeding into a brass socket on the fuselage sides. Thus the struts are semi-working in that they take extra loads imposed on the wings in high G manoeuvres, and yet in a crash will come away with the wing, without tearing anything more than the hinge material, which is easily replaced.

The leading edge of the wing is sheeted up with 1/16 in. or if you prefer it, 3/32 in. sanded after fitting, but before this is done it is best to finish the centre section, where the two wings are joined together with a ply plate, and there is also a ply base to take the hold-down nylon bolts at the rear. The aileron rods must now be fitted, with bell-cranks. Cut-outs in the ribs can be made with a sharpened piece of brass tube. The ailerons must work very freely, but without slop. The aircraft is very sensitive to aileron control, but it has been found dangerous to reduce the amount of control, as near the stall you may need a lot of response. In fact, the ailerons are very outstanding for their smoothness in flight, a point which shows the advantage of the thin tips. Many thick winged 'plank' models are very bad in lateral control, getting all or nothing. Perhaps some of the pattern



Left: if in doubt, build in twos! Bare air frames of Eric Fearnley's two prototypes show that structure is fairly simple and straightforward. Below: simulated corrugation on ailerons and flaps add character to model.



designers should study the Cessna approach to control design!

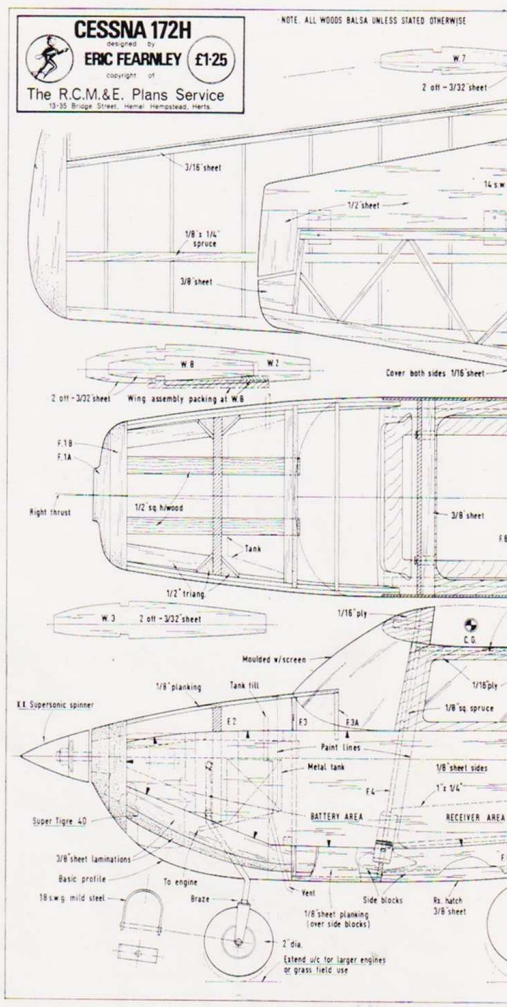
The Fuselage

Construction of the fuselage is straightforward, but there are quite a few plywood parts, and it's best to cut these out first. A note about plywood. There are many types and grades, from cheap packing material to marine ply. We have found that some marine plys are rather brittle, and shatter in a crash. Try to get some high grade flexible stock if you can, and with a new fret blade, take it slowly, not trying to force the blade through the wood, rather let it cut it's way through. The window frames can be cut together it you spot tack the two pieces together first. Clean them all up, and then cut the two fuselage sides out of firm but pliable stock. Add the doublers to the front, a left and right please! These can be stuck with impact adhesive.

Check which engine you are going to use, and adjust the bearer width to match. At this stage select your fuel tank. A square clunk tank will fit across the fuselage, or in my case a tinplate one was made. The two sides can now be stuck to the cabin formers checking that they are both level. The tail and nose formers are added, using bands. Take care to avoid the banana shape which occurs when one side is stiffer than the other. When all is set, the extra can be added. The tail end is planked up with strip about $\frac{1}{2}$ in. wide. The front is blocked up as shown. It's best to build up with masses of block, and then razor plane everything down afterwards until a smooth contour is produced. Depending on which engine you use, it may be necessary to remove the front piece at the bottom to allow the engine to slide in. It is easily refitted with epoxy. Originally it was possible to remove the engine without taking the front out, but I altered the steerable nose unit to a fixed one, as on grass runways it is better fixed.

On rough grass I found that the steerable nosewheel facility ineffective as steering corrections tended to get out of place, resulting in an abortive run. On nice tarmac though it is very pleasant to guide the aircraft back after a landing. If enough movement is set up to allow a U-turn on the runway however, it is too touchy on take off, the wheelbase being short. The real 172 has only eight degrees of turn on the nosewheel, after which it has free caster in conjunction with wheel brakes. 'VVZ has been seen to do an about turn many times on the width of a perimeter track. Her sister craft did it once too often I believe, and turned over in a strong wind.

The front leg is formed from 8g., wire. The forked end to take the wheel is a piece of scrap steel which is silver soldered onto the leg. If you want it moving I suggest silver soldering a piece of steel bundy tube to the forks, and sliding it on the leg stump, retaining with a collar at the bottom. A tiller arm is needed to couple to the rudder. Use a shock link in the line though as if you make an error and hit nosewheel first, you will lose a few teeth off your servo. I prefer a fixed one, having tried both. It answers rudder without getting



touchy this way. On take off, just give it a hefty dose of right rudder and it will not over-correct. The main wheels are straightforward, formed from 8g. wire, and clipped to the plywood base plate in the fuse bottom pieces of tin, and 6 B.A., bolts. The outside is faired round with soft block after installing, to blend with the rounded bottom edge of the structure.

Two hatches are cut into the bottom, for the receiver and battery access, and the rear one for the servos to be 'got at'. The position of the servos is a matter for the individual and depends on the way the weight distribution is going. With a .40 engine it will be more likely nose heavy, but with a smaller one the opposite can be true. If you want to fit out the cabin the gear can be stowed quite easily under the seats with a little care. I put a black sub floor across mine to hide the obvious works.

Fitting the windows calls for a paper template, and then a well warmed acetate sheet wrapped round, tacking in place with UHU. The frames are then masked with tape, and Devcon is wiped round the joint to fill in, the surplus being wiped away.

Final trim is to fit a paper frame edge cut from silvered paper decoration material, after doping.

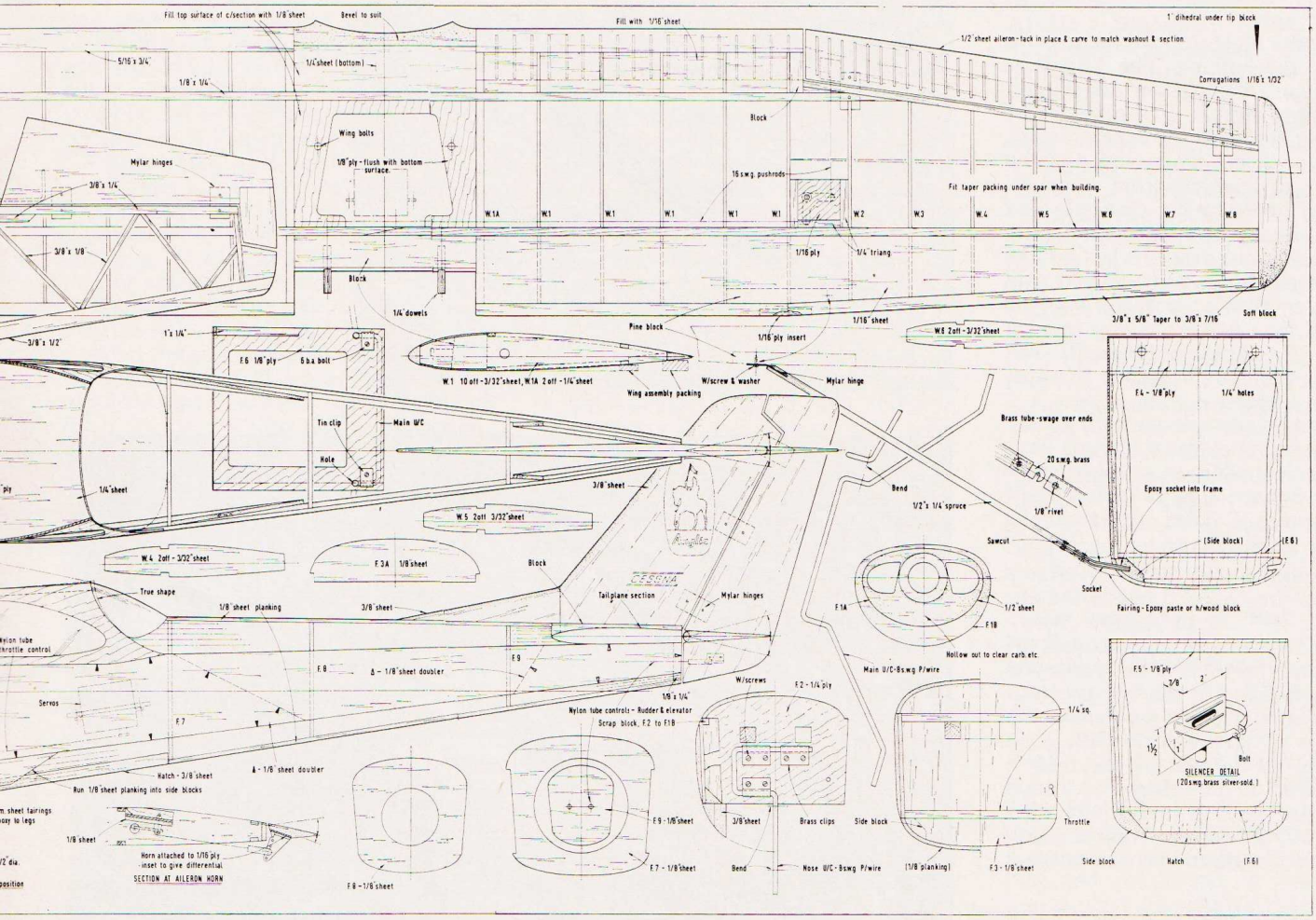
The tail is straight forward as shown on the plan. The original was open framed, covered with nylon, but I later sheeted this up with 1/16 in. to stiffen it. The fin and rudder are 3/8 in. sheet planed to streamline section. Note that there is a stiffener at the tail. This was added after I lost engine on take off, and was forced to do a down wind landing on the grass in strong wind. The nose-wheel dug in and over it went, in spite of full up elevator, knocking the tail off. As I had tail weight in anyway, we may as well beef it up.

Flying

Well, here we are all finished, the aircraft giving off that aroma of a blend of fuel proofer, dope, epoxy, contact adhesives, rubber, and a trace of castor oil (at today's prices you'll be lucky . . . Ed!) that is Chanel No. 5 to a model builder.

Before you rush out to fly it, though, let's have a double check on things. If the wings are warped, and they cannot be straightened, a little opposite rudder and aileron trimmed in now will prevent a crash on the first flight, but it will not cure it, as you will always have a change of trim according to the flying speed at the time – not the best way to get a good precise pattern. Moral is to build true if possible. Second, check wing and tail incidence on a flat table, measuring height from floor datum line of each against plan. There is a little longitudinal dihedral built in, though not as much as the real one by a long way. The amount of l.d. is set by the power available – scalewise the real aircraft is not a ball of fire, and has a fair l.d. built in. We are going to fly faster than scale, so we reduce it. Simply, this means that if we apply full power, it will put it's nose up and climb, when we reduce power it drops its nose. If it stalls on full power, or over climbs, reduce the power – you have too much. It should be about right on medium throttle. Then when it's windy you can apply the reserve power you do not normally use to give extra up wind penetration, provided you add in down trim to overcome the excessive climb. The procedure is like full size, extra boost for quick take-off, holding it into wind with a little right rudder. When plenty of speed is on the clock, ease it off the ground with a little elevator but not too much, and almost before it breaks ground take the elevator off. As soon as you have a safe height throttle back to just over half revs for cruising flight. Only modellers bat around at full bore all the time. Real pilots have more regard for the motor, and find their most economical cruising speed.

Having mastered the take-off, the flight proper is very easy, as the model has no vices. It WILL stall, but requires a brute force to make it usually. In a 60 degree nose up it will falter, and drop a wing very suddenly, but this attitude can never be reached with normal flying, and it can be judged as nearly stall proof under average conditions. If you have a good differential aileron control, it will turn easily, with just a little up elevator



Above: the inspiriation and the result – full-size 'VVZ in the background with prototype model. Below: Eric Fearley built two prototypes of his Cessna 172H, both of which flew very well indeed. Second machine seen in action below.

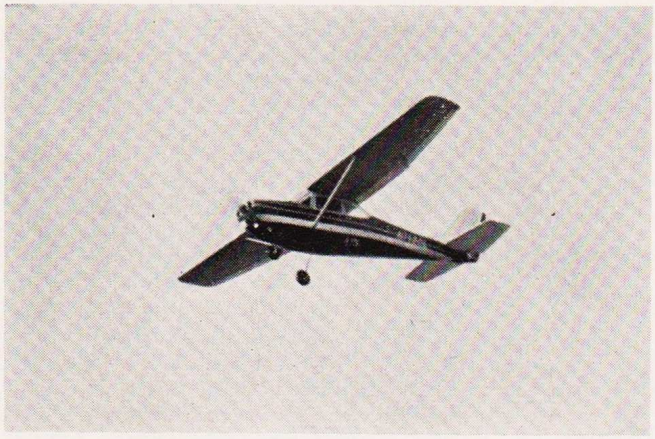
put in to keep the nose level with the horizon. It flies quite well with rudder only though not with the same precision as ailerons. Its big weakness is during take off at full bore, with too much elevator in, when it will spin very quickly, and ailerons do not work. As in full size flying, the right thing to do is kick in opposite rudder during a stall condition, but I doubt if you will remember or have time, as this is theory only. The answer is not to drag it off too soon. It's better to take off too late than too soon.

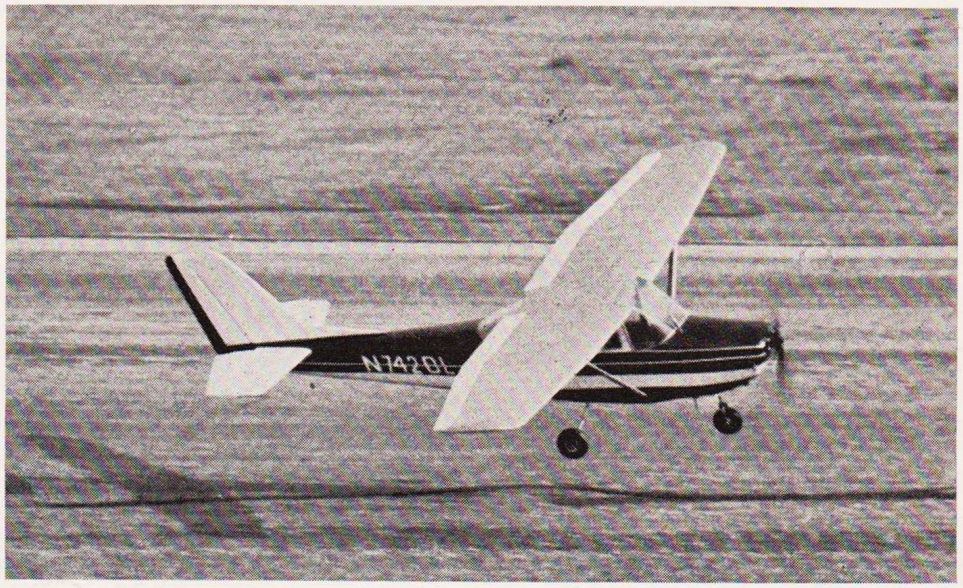
Now for the most difficult manoeuvre in flying – the landing. The Cessna is fast, and tends to float on the last leg of the landing circuit, if the centre of gravity is wrong. In the nose heavy state, it drops in well, but when you pour on the elevator to keep the front wheel off till the main wheels touch – the only way to stop a bounce, it will suddenly run out of elevator, and drop the last bit like a stone. In the tail heavy state, it will touch down like a feather, but the trouble will be the float as you bring it in to the threshold position. It will also be longitudinally unstable. It wants flaps really I suppose. The answer is a mid position, fairly critical c of g, and plenty of reserve elevator to fall back on. Most scale models are over-sensitive to elevator but the Cessna is fairly soft on this control. I have suggested the right throw on the plans.

On reflection I may have overstated my hand on the 'vices' it has in the air. In fact it is the sort of aircraft where it can be trimmed out at a couple of hundred feet, throttled back, while you pour yourself a cup of tea. My previous remarks all apply to my own state where I fly off a very narrow strip with grass runway, and all the rest of the field is sudden death in the shape of rough mud-ploughed land. It takes quite a bit of skill to hit the runway with a plank job, let alone a scale model, under these conditions.

So let's take it from the top – again you are ready to land. The aircraft is cruising at about 150 ft. Fly upwind over the touch down point until you are about 50 yards past the transmitter, then turn across wind to the left and do a second leg for another 50 yards. Now turn downwind, and throttling back until you are losing height let it drift away. If it is windy, watch it carefully, and start to turn across for the third leg when about 50 yards past your landing point, as you will not make much ground, wind. If it is calm however, you will need to let it go 100 yards or more, as the glide is flat, and you may overshoot. Aim to get the aircraft down to about 50 ft. for the last leg. Turn across wind, watching the angle of descent, and then turn on the last leg back towards the transmitter. Most people turn too late on the last leg, and find themselves out of line with the runway. Turn tight so that you are dead lined up with touch down point.

It now only remains to keep the aircraft dead straight as it comes towards you. Do not try weaving about, just correct to keep on course. You can now judge your rate of descent. Keep your eye on the ground from time to time, and the nose a little down. As you reach threshold point start to slow down with a little up elevator. Just before the wheels are to touch, feel in more elevator to take the nose wheel up and use the main wheels for the initial shock. If you hit nosewheel first it will bounce up into the air again. The real one would probably be severly damaged in this condition. Don't try to hit the right





spot. If you have plenty of room, land properly regardless of how near or far you are from the Tx. It's better to do a good landing well away from you, than a bad one 'on the spot'. You will soon learn to judge the distance as you put the flying time in. You will never learn to land properly if your are pre-occupied with hitting a spot on the runway. As you gain experience, you will be able to come in a little high, and side slip a little height off with alternative left right aileron until you are right for the spot. This is for the expert though, as inevitably speed builds up in this state, and your elevator has to be applied at exactly the right moment, increasing it as the speed drops, so as not to kite up again, finally hauling the aircraft into a fully stalled condition about an inch off the runway, the hight angle of attack then air braking the model down to a feather touch down. Leave this to the expert!

Both prototypes are still in flying state after two-and-a-half years, and many hundreds of flights. I hope you are as lucky, and get a similar enjoyment from your 172H.