• The Omac 1 is an eight-passenger, executive turboprop aircraft. This new machine was designed and engineered by Larry Heuberger, who was the chief engineer for the Lear Jet. It appears the aircraft is going to be as popular as the Lear, but because it is a turboprop, it is much more fuel efficient than the straight jet airplane. In fact, if you were to take a look at any of our big commercial 747's or 707's, in the nacelle ring you would see a tremendous fan inside the cowling which gives the same effect as a propeller. If you want even more fuel efficiency, go to a big external propeller. However, all of this fuel efficiency costs you top speed. If you want more speed, take away your big fans and props and go to a straight jet. But enough about turboprops.

OMAC-1

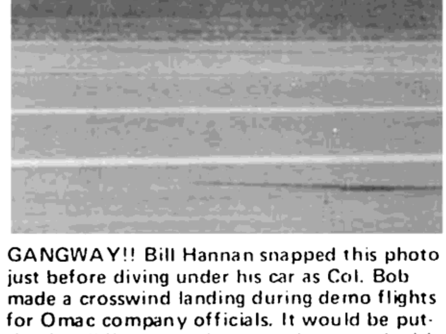
By Col. BOB THACKER . . . Not many models have been able to stump the Col. as completely as this one did, but he stuck with it and gradually got all the bugs ironed out to the point where the final version of the Omac is a fast, stable, impressive machine. Be the first on your block . . .

Being the world's greatest single-pusher flier in 1934, we thought, let's become the world's greatest canard flier in 1980. The exciting Omac three-views were presented to us by Bill Hannan, of Peanut Scale fame. Sometimes we wish he had kept the aircraft to himself!! However, we decided to go ahead with the project. So, what was done first? Actually the full-size airplane had not been flown when we started the engineering on this machine, so we were working with several unknowns. We built two balsa gliders, a little six-incher and a twelve-incher, and both flew well. We proved and substantiated that the aerodynamic principles were correct. Then we built a 24-inch all-balsa free flight profile, powered by a Cox .020. This aircraft flew exceptionally well, so we decided that we would go ahead with the big model. It was going to be approximately 1/6 scale and would use a .61 for power. So this is what we are really going to talk about: the trials and tribulations that we have had in developing this thing.

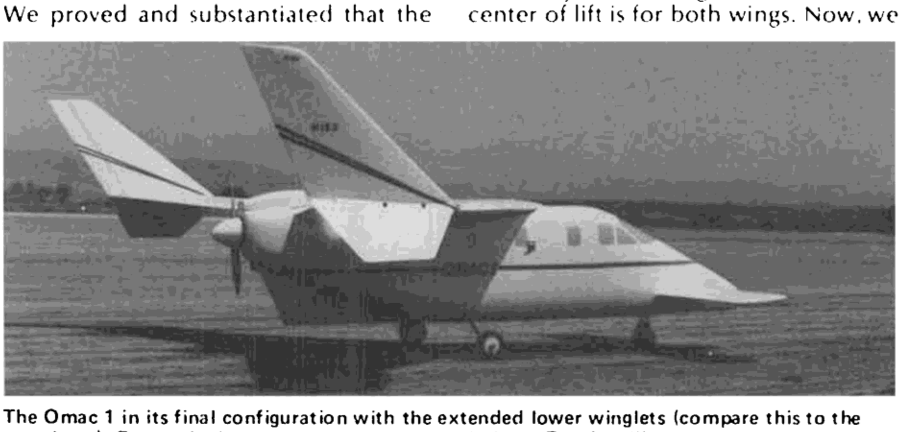
First, let's talk about the aerodynamic setup on the little .020 profile. The canard was set at plus 2-1/2 degrees incidence, the wing was set at zero degrees, and the thrust line was two degrees nose down. The wing tips were reflexed up just slightly at the aileron position, about two or three degrees. The C.G. is very hard to dicuss because we have no common reference points. Let's establish them right now!

The first thing you are going to have to do on any canard is figure out where the center of lift is for both wings. Now, we

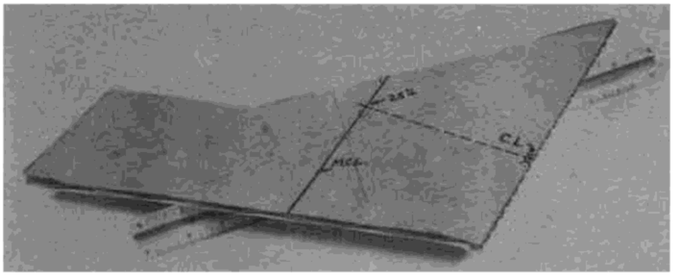
SPECIFICATIONS	
WINGSPAN	63 inches
WING CHORD (mean)	14-1/2 inches
WING AREA	1090 sq. in.
AIRFOIL	Florshime 8-1/2 C
WING PLANFORM	Delta + sweep
DIHEDRAL (each tip)	1-1/2°
FUSELAGE LENGTH	57 inches
STABILIZER SPAN	34 inches
STABILIZER AREA	196 sq. in.
TOTAL WING AREA (canard & main wing)	1286 sq. in.
ENGINE USED	K&B .61 Pumper
FUEL TANK SIZE	16 oz.
NO. OF CHANNELS	4-6
TOTAL WEIGHT	13-1/2 lbs.
WING LOADING	31 oz./sq. ft.

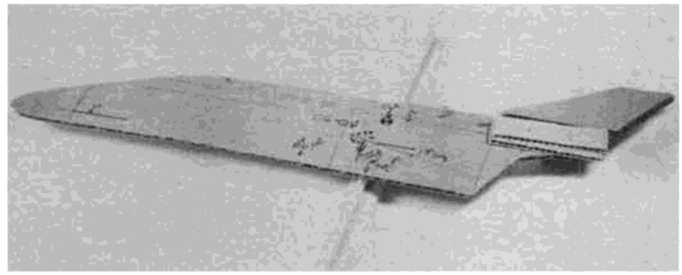


GANGWAY!! Bill Hannan snapped this photo just before diving under his car as Col. Bob made a crosswind landing during demo flights for Omac company officials. It would be putting it mildly to say they were impressed with the model's performance!



The Omac 1 in its final configuration with the extended lower winglets (compare this to the top photo). Extra winglet area was necessary to eliminate Dutch rolling.





For would-be canard designers, these photos demonstrate how to find the center of lift of a wing (left) and center of lateral area of a fuselage (right). Profiles of a half-wing and fuse are cut from cardboard and balanced over the edge of a ruler. Fully explained in text.

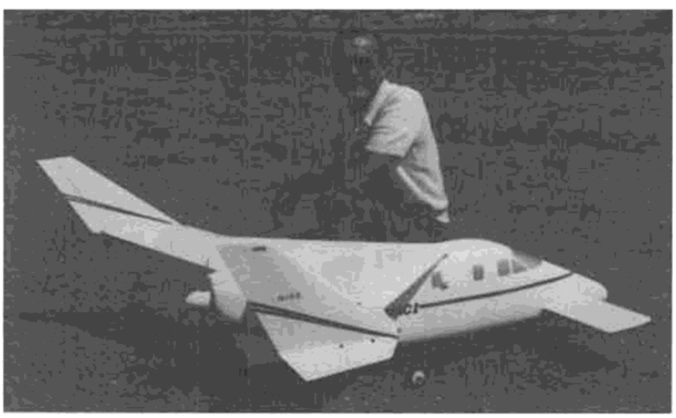
can give you four or five different formulas on how to find the center of lift of any wing, but we're not going to. The simplest and easiest way to do it is to take the planform right off of the magazine page (our apologies to Mr. C. Grant). Stick a piece of cardboard underneath the page, take a pin and go all the way around the extremities of one half of the wing, then take the cardboard out and cut out the half-wing. Now you are going to balance that half of the wing in two 90 degree planes. Just stick your ruler underneath it and balance it in one plane, mark a line on it, turn the little half-wing 90 degrees and mark another line on it. Where they intersect, draw a straight line along the airflow of the wing from front to back. The line that you have drawn on the wing, and we don't care how much sweep or whether it is a double delta or whatever planform, is going to be your *mean chord*. Now, 25% back from the leading edge of that chord, go straight over to the center of the fuselage and mark a little X. That is the center of lift on that wing. Repeat the procedure for the forward tail or canard. Now you've got two lifting points, one forward and one aft.

Now what we're going to do is figure out where to put the C.G. First, let's figure the canard area and the wing area. On this particular aircraft the forward canard is 20% of the lifting surface and the aft wing is 80% of the lifting surface.

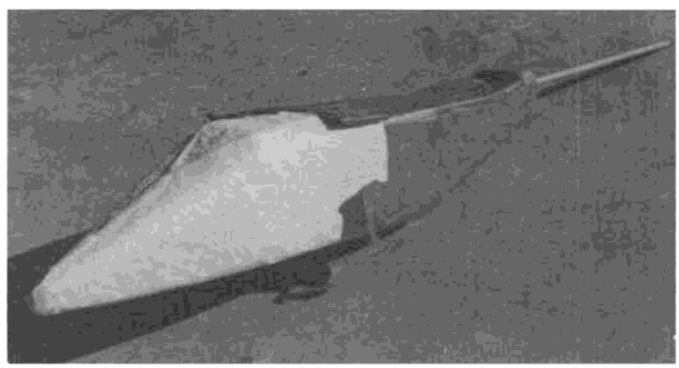
OK, now measure 20% forward of the aft lifting point (or 80% back from the lifting point on the canard); this establishes the *mean lifting point* of the entire aircraft. On a conventional aircraft, we always have the C.G. forward of the center of lift, right? On a canard, use 10% of the distance between the two centers of lift and put your C.G. forward of the mean lifting point by that amount. Canards are very, very forgiving of forward C.G.'s but they are absolutely unforgiving of aft C.G.'s.

We were not going to go into any of the gruesome details on building the big model, reasoning that if you want to take on this kind of project, you are experienced enough not to be told how to build a model airplane. But the so-called editor of this rag asked if we would fill in more space, so here goes! The fuselage is started by carving a foam plug to the correct shape. If you haven't made a large foam shape before, try this. Cut the general outline on a large bandsaw. Take a broom handle and ram it into you-know-where, then start shaping with very coarse sandpaper, being careful not to dent it. Foam is very soft!

After you are satisfied with the shape, final sand and glue a 1/8 ply ring on the cowl; this will give you something solid to put the glass cloth onto. We used two

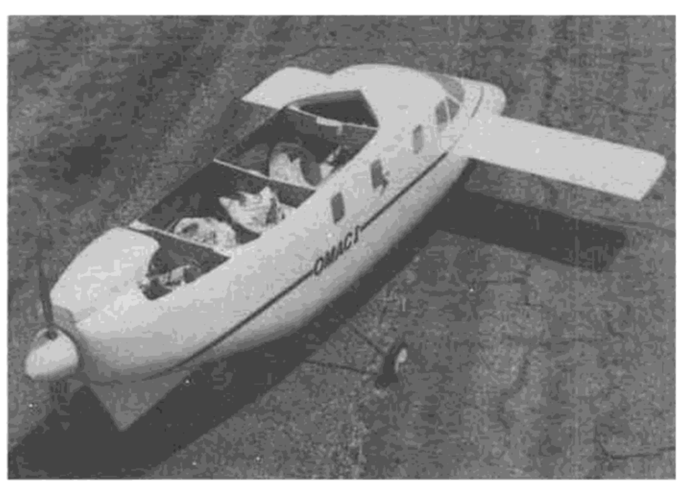


IT FLIES!! IT FLIES!! After five tries and five snap rolls on takeoff, the Col. finally got the darn thing to fly. He's understandably happy.



Col. Bob calls this his "dead porpoise," but we know better. It's actually his first try at making a glass-over-foam fuselage for the Omac. Polyester resin somehow got through the protective covering of Econokote and ate up the foam . . . what a mess! Solution was to use epoxy instead, works beautifully.

A family of Omacs. The 12-inch glider and 24-inch .020 F/F were built to prove the design's airworthiness before starting on the big one.



Not much radio mounting room in the fuselage, eh? Wadded-up newspapers keep resonance to a minimum.

layers of 6-oz. cloth, one of 4-oz., and finished with a layer of 2-oz. cloth. If necessary, add a layer of 3/4-oz. cloth for a final, smooth finish. The finished depth of material is approximately 1/32 of an inch, strong as steel but better.

The reason the plans show no bulkheads is that your fuselage will be slightly off, because it's a hand-shaped deal. For a pattern, just go in and make cardboard ones till they fit. Good luck!

What is that dead porpoise doing in the picture layout? Please, that's our first plug attempt . . . Econokote over polystyrene foam. We put on the polyester resin and the first glass layer . . . look what happened!! Evidently polyester resin will bleed through any film. *Epoxy* is the only way to go!

Wing and canard construction is strictly conventional and should present no problem for an experienced builder, so we'll skip any comments about them and get to the *really* interesting part of the story: the flight tests.

It took about four months to finish the model. We set it up exactly like the .020 model and were ready to amaze the troops at Mile Square, right after the 1980 MACS Show. Well, the first high-speed taxi went quite well. The airplane handled well on the ground but would not rotate (no, we didn't have the elevator hooked up backwards). To make a long story short, we decided it was now or never, so caution to the wind, balls to the wall, full power, we went steaming down the runway, full up stick . . . the left tire whirled off, the plane snapped on its back and went scraping down the runway. What a humilation for the world's greatest single-pusher flier!!! Obviously, the reason it snapped on its back (we thought) was that it lost a wheel. You can imagine what that model looked like after it went tearing down the asphalt at 60 miles an hour, upside down, on its top and two winglets!! We repaired the model in a week and came back with really no aerodynamic changes. Guess what happened? Exactly the same thing. It snapped on its back and broke the wing in three places and tore most of the winglets off. There must be something that we are doing wrong here!!! We could not get the big model to fly like the small one, so we started changing the thrust line. We went from two degrees nose down to zero and that had no effect on the airplane, so we went from a zero thrust line to four degrees nose up and that had no effect on the airplane either. Finally we decided the C.G. was a bit too far forward, so we started moving the C.G. aft and got it to snap-roll on its back at half the speed that it was formerly doing it. Well, it was back to the shop for a complete rethinking on what could be wrong.

We took a hard look at the little .020 and suddenly realized we had forgotten to figure in one of the most important things. The fuselage on the big model is so wide at the canard location that we were losing almost 50% of the lifting surface! We built another .020 profile and flew it, and then built a little false fuselage up front. You guessed it, it wouldn't fly because there was not enough exposed lifting surface in the forward canard.

Meanwhile, back at the ranch in Reno, Nevada, the big Omac 1 was undergoing tests. The designers had swept the wing, so we built a new wing with the authorized sweep and new winglets. We also enlarged the forward tailplane by what the fuselage was covering up, effectively moving that area outside the fuselage. So, in essence, we really had three completely new flight surfaces for the aircraft. The final configuration, or next to last configuration, is the one that you see in most of the photos, with the winglets and the enlarged forward canard and the sweep.

Now, to give you a little bit more information on the setup that gave us our first successful flight. The forward canard was set at plus four degrees. The wing was set at zero, but each wing tip is washed out 1/2 inch. The winglets are toed in two degrees, the thrust line is set at two degrees nose down, and the C.G. is as briefed . . . *DON'T CHANGE IT!!* Lo and behold, we finally got the airplane to take off!!! It took 250 paces for liftoff and then began a very slight drift to the left. A little aileron cranked in, no response. It was still drifting to the left. A little more right aileron, no response. Full right aileron and no response, so we touched a little bit of rudder and *wow*, it really took effect! Sure enough, the ailerons are most ineffective and the rudder is very effective. The model also had a very severe Dutch roll on the first flight. Now, we're not exactly sure *why* we have a Dutch roll, but there is one sure way to correct it: start adding more lateral area aft of the C.G.

Our thanks to Sitting Bull who said, "If your arrow flies poorly, just add bigger tail feathers." What are we talking about when we talk about this center of lateral area? If it is so all-important, how do you figure it out so that you will stay out of trouble? Rather than give any formulas, let's use the same pin-through-the-plan technique as before. Shove a piece of cardboard under the plans, take a pin and go all the way around the lateral area (side view) of your aircraft, and cut it out. If you are running two rudders, as on the Omac, cut another rudder and glue it right over the first rudder. Balance the little airplane two ways and draw lines through it where those two balance points meet. That is your center of lateral area. *The further aft on a canard that you can get your lateral area, the more stability you are going to have.* It must be aft of the C.G. and very close to the aircraft's center of lift. To get rid of the Dutch roll we increased the lateral area aft of the C.G. and lowered the center of lateral area by going under the wing with a larger sub-rudder. We took the little .020 and put big sub-rudders underneath the wing; immediately the Dutch roll of the .020 model was gone. Then we started cutting off the sub-rudders with a big pair of scissors until the Dutch roll came back. Picked up the balsa wood we just cut off the winglet, glued them back on with Jet, and flew the model again . . . no Dutch roll. So, we enlarged the Omac winglets the same percentage beneath the wing as on the .020. We are flying the Omac on rudder, elevator, throttle, and flaps. It flies beautifully. Nice and smooth. No problem. It flies just like any normal airplane . . . with the C.G. shown. *DON'T CHANGE IT!!*

Let's look at that aileron control problem. A delta wing and swept to boot means great dihedral effect, which means little if any aileron reaction. So, if we were doing it again, we'd use ailerons but *up only*, no down, and coupled to the rudders.

We are extremely pleased with the airplane and hope this article excites you enough to take on a project just a little bit different. We would be most happy to answer any questions we possibly can if you are having troubles with your canard. Happy landings. ●