PHOTOGRAPHY PAUL BELL

If you're looking for that "unusual" project, the author has just what you may be interested in. His canard sailplane incorporates some unique features that can broaden your building skills and experience.

SC-3

By Paul Bell

If you share the author's fascination with unusual planes, here's a canard sailplane that satisfies the need to be different.

Some unusual looking airplanes have been produced in the course of the history of aircraft development. Over the years I've been intrigued by such designs as flying wings, twin fuselage aircraft and especially canard configured planes. Some of the current flock of civilian business aircraft like the *Avtek 600*, the OMAC *Laser* and, of course, the Beech *Starship* qualify in that respect.

Back in the old days when I was primarily a power flyer (sic), I had two original designs featuring *Falcon 56* wings with no dihedral and a pusher engine in the .35 to .40 cubic inch category. The second of these was also flown off water (with a lot of effort) using a pair of large GeeBee floats. For the past few years I have been principally a sailplaner, and decided that a sailplane of unusual design, specifically canard configured, would be interesting so I set out to design one.

It has been my experience that when you appear at the flying field with some strange looking device, you will invariably become the center of attraction. Many believe that these things will not fly at all, let alone fly very well. My escapades with this particular sailplane followed that course. With its radical lines and Circus Pink and Maroon colors (Bell's factory colors) it attracts much attention.

When I finally started getting it into the air consistently, I got a lot of support including a few cheers. This plane was flown against three flying wings in the Unusual Design Category of the June 1987 Eastern Soaring League contest sponsored by my club, The Long Island Silent Flyers. Although it finished last, it also had a second place in the Original Design Competition held during the same contest. Interested?

Design

The design process involved selecting a convenient size. Two-meter fit the bill because it's small enough to minimize building time (which I did a fair amount of during the testing phase) but is still large enough to produce good performance. I settled on a *Sagitta 600* wing but with the polyhedral break taken out. The design (shown in the construction photos) used a copy of the *Sagitta* aileron version wing. The first rebuild offered an opportunity to save some weight by getting rid of the ailerons and associated framework and going to a pivoting wing concept. I have been using this method on both my *Sagitta 600* and *900* for a couple of years (copied from my good friend Len Hauff) so that I have quite a bit of experience with these.

Two payoffs to this approach are a lighter wing, especially in the outer panel and a stiffer roll control system. The other very significant consideration to the selection of this wing was that if the whole program came out to be a bust (pun intended), then I could always use the wing on another *Sagitta 600*.

I have a computer program that I developed for my IBM PC Jr. to do performance calculations. This program is based on the *Sailplane Designer's Handbook* formulae and graphs of Eric Lister, with some additions primarily related to specific airfoil selections and a lot of graphical output which makes it very easy to compare different designs, as well as some stability formulas for canards. The additions were obtained from magazine articles and Herk Stokely's *Soartech* publications.

Well, after a few iterations related to canard area, fuselage length and C.G. location, the program promised better L/D than my conventional *Sagitta 600*. Boy oh boy, all that performance and a terrific (unusual?) looking craft in the same package. The guys at the field would go wild.

I might as well tell you right off the top that if you are looking for a high performance glider, this isn't it unless you intend to fly only in straight lines. Let me explain. Elsewhere in this article you will find a figure comparing Rutan Aircraft's *Solitaire*, a stabilizer-in-the-front configuration sailplane, with a couple of conventionally designed Schweizers. It can be seen that the *Solitaire* doesn't have as good a sink rate in straight flight as the others, but that could be related to a lot of things like airfoil selection, aspect ratio, wing loading and so on.

both areas to determine the "wing loading".

The fuselage is a simple box—except that I had to put a round nose on it for aesthetic reasons—designed to keep the wing and canard separated and house the radio equipment. There's lots of room in it and you should be able to move your equipment around to achieve a balance without any ballast at all. There are ballast boxes front and rear just in case you miss a little. Although the computer program wanted the fuselage to be a little longer, I again made it so that three foot stock will work to minimize waste. Compromises, compromises.

The fuselage is all light ⅛th balsa with corner longerons, covered with K&B light fiberglass cloth and then painted with Hobbypoxy. A little trick that I learned from Dan Mass, another Long Island Silent Flyer club member, is to apply the fiberglass cloth with nitrate dope, thinned about 50%, just like you were going to silk an airframe. As a matter of interest, Dan does use silk in this application. The beauty of his method is that if you make a small error putting down the cloth, a little dope or thinner allows an easy fix. You could MonoKote the fuselage to save some time, but the extra strength of the glass cloth over the relatively light balsa helps a lot.

Plans

The plans for this article were drawn on an IBM PC jr using ProDesign II. My good friend George Druhak, of Safari Systems, which does Computer Aided Design and Graphics work, did the plotting.

The vertical fins on the *SC-3* each have a vertical spar which "plugs in" to a reinforced box structure. To align each fin, a small 1/16 inch dowel at the rear of the fin keeps it nice and straight.

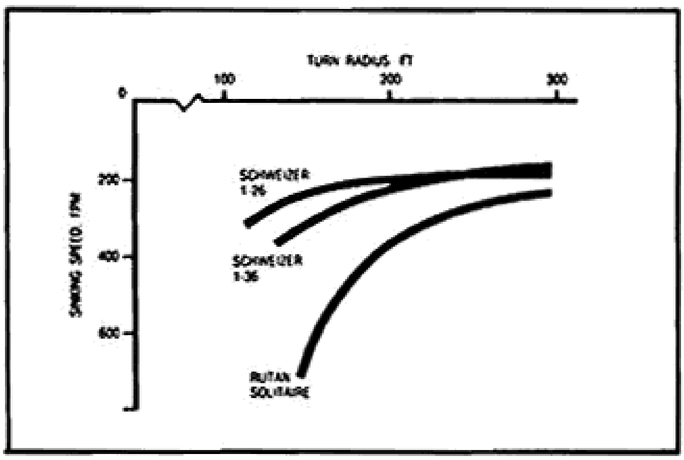
Flying

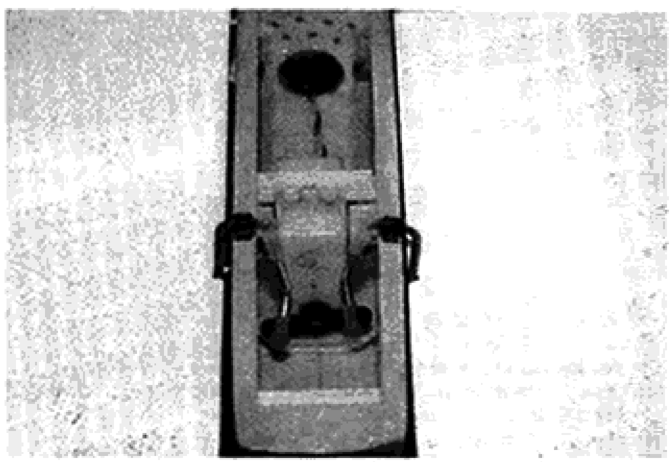
I knew we'd have to get to this part sooner or later. Even with the C.G. located as shown on the plans, this is not a plane for the beginning flyer. The initial calculations for the C.G. location were based on the previously discussed powered vehicles and data that I dug up in a *Model Aviation* article by Ron Van Putte from some time ago. This data also suggested the proper vertical fin size.

At first the C.G. was too far aft, resulting in a main wing stall that preceded the canard stall. The airplane would just sort of back out of the air as the speed was reduced. This characteristic produced a couple of really spectacular shows before I got things straightened out. As long as you fly relatively fast, there is no problem, but as the speed comes down, so does the glider. Therefore, please put the C.G. where it is shown.

I might also mention that you should not put it too much further forward than this because there may not be enough canard power to pull out of a dive. The consequences of this situation near the ground will give you a chance to make some modifications to the ments. We'll see how that works some other time.

SC-3





Canards have some non-traditional properties, one of which is a high sink rate in a tight turn. Check the graph **(above left)** which plots the sink rate vs turn radius for two conventional Schweizer sailplanes and the Rutan-designed *Solitaire*, a full size-canard glider. Short, stiff pushrods are needed for the wingeron mechanism **(above right)** which is a fairly simple installation. Check the text for bending and treating the rods.

When you build the canard, build both sides at the same time with the pivot tubes as one piece and then cut the two sides apart when you are done. Pay some attention to getting the tubes lined up and square so that you don't end up with one of those airplanes that looks crooked all the time because the wing and tail aren't aligned.

The vertical fins are NACA 0009 sections, fully symmetric, and each one is six percent of the wing area. The only cute feature of these is that the main "spar" plugs into a pocket in the wing at what would have been the polyhedral break. Alignment is achieved through a small dowel at the aft end and, after insertion, they are held in place with a piece of Scotch Magic Mending Tape, or equivalent, on either side of the fins near the trailing edge. This was, again, aimed at saving weight outboard on the wings and also makes it very convenient for transport.

I suppose the fact that I am a Structural Engineer for Grumman Aerospace might have something to do with my sensitivity to weight, but I should also give some credit to Herk Stokely for my weight consciousness. Some time back I sent him some pictures and explained a few of the ideas that I wanted to try out. Herk offered lots of encouragement. He pointed out that the key to turning flat (minimizing sink rate) is a light wing loading. Here, I believe, that I did pretty well. All-up, the plane weighs 36 ounces for a combined wing and canard loading of 7.2 ounces/square foot. The canard is also a lifting surface, unlike a conventional stabilizer, which lifts down, so I believe it is fair to use the total of