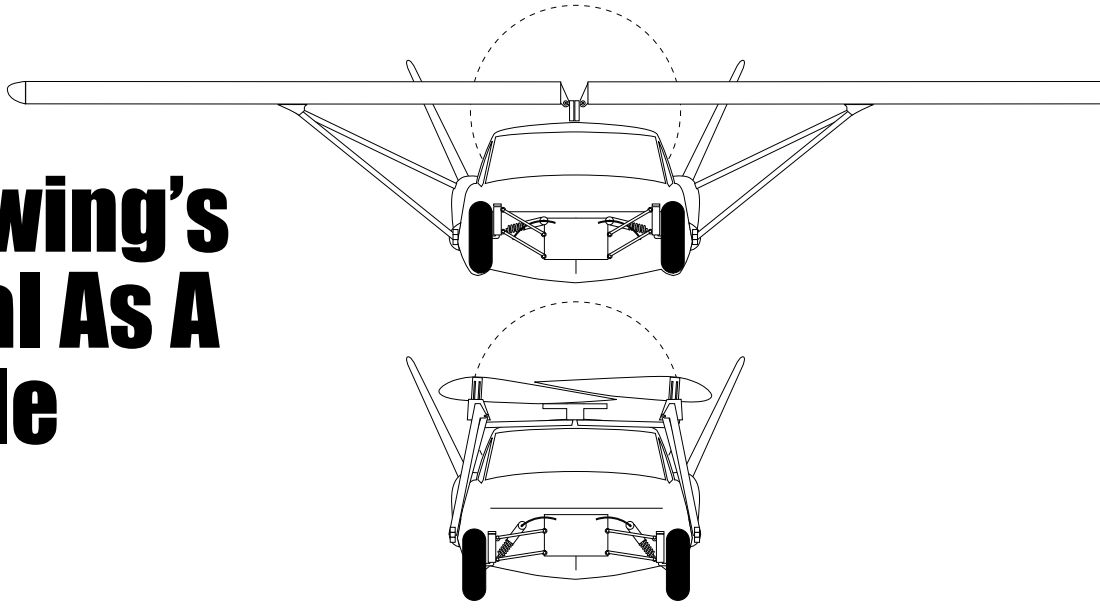
The Controlwing's Potential As A Roadable Aircraft

By George Gregory



ONE OF THE REAL PROBLEMS faced by designers of roadable aircraft is the difficulty of shifting the centre of gravity for different modes of operation. An aircraft is necessarily light on the nosewheel because the elevator has to rotate the aircraft for take-off. This is fine for aviating, but one doesn't really want a light nosewheel when barrelling down the highway at 100 km per hour. When driving, that is your control, and has a lot to do with the quality of the car's handling. Figuring a solution can be both complex and heavy.

Different people have approached this problem different ways. Molt Taylor, arguably the father of the modern roadable aircraft, simply removed the wings and the back half of the aircraft, turning them into a long trailer with small trailer wheels extending from the root of the wing. This left the driving part reasonably well balanced, but was complex and heavy, and real-world conversion times left room for improvement.

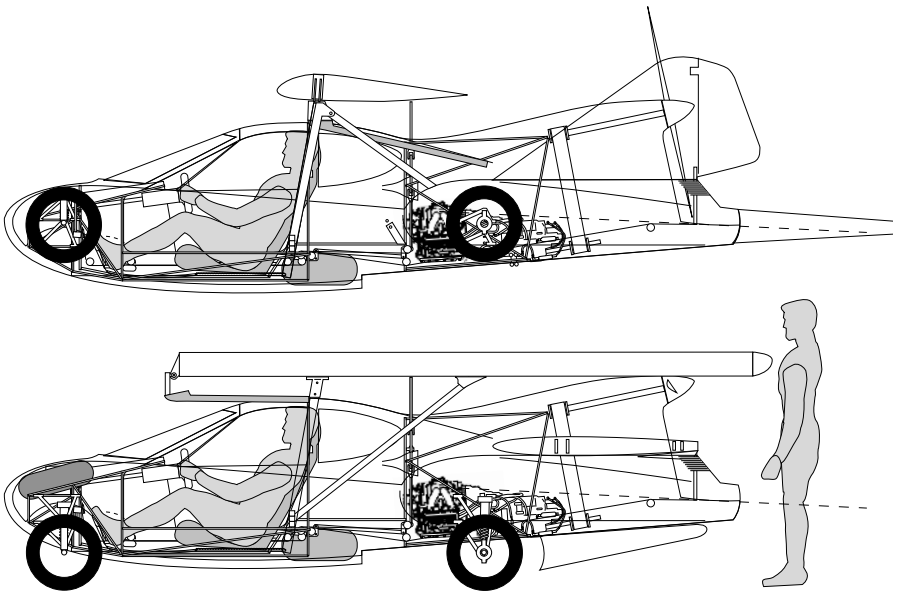
The Fulton Airphibian, the spiritual ancestor to Taylor's design, featured a non-portable airplane portion that you unhooked and drove away from. Even less convenient: it might be fine if you were going to lurk around your destination for a while, but lacked utility if you needed to drive part of your enroute trip, say to get through IMC while safely on the highway instead of the air.

The up-and-coming Transition, (see the March-April 2006 issue of the Recreational Flyer) uses a 3-surface approach to allow a little more weight on the nosewheel in both modes. The wheels can be placed further aft than otherwise because the canard would be able to help lift the nose up in conjunction with the elevators. In my opinion, this is better, but isn't a complete solution as you're still going to be somewhat lighter on the nose than is optimal for driving applications. Indeed, Terrafugia does not suggest their vehicle would be up to the task as a daily driver, but rather an airplane you could use for the occasional out-of-town commute. It is an airplane meant for occasional ground use.

The Good Part

Is there a complete solution?

I think there is. The Controlwing idea (as I mentioned in the last issue) has been around for some time, but has never gained widespread acceptance. It is, admittedly, a novel approach as it dispenses with the conventional elevator in favour of a free-floating wing that rotates for takeoff rather than the fuselage. This means that the rear wheels can be placed pretty well where you want them - important for automotive applications. This also allows a lighter structure, because it means the transmission can be within easy reach of the rear wheels, and allows a more robust, permanent car-like suspension. No complex mechanism to move the rear suspension aft or shift weight forward would be needed. As well, the aircraft is somewhat more idiot-proof; it can't be stalled or spun, and the floating wing concept absorbs turbulence the aircraft encounters in the air, much like shock absorbers on a car soak up the bumps on the road. A NASA report done a few decades ago



One possible iteration of the Controlwing. This is not entirely unlike George Spratt's own Model 107, but is optimised for portability and, of course, has wheels and a transmission. Note the upside-down V-strut. This allows the wing to pivot on its spanwise axis in response to control inputs and enables the wings to absorb turbulence. The wings could be stowed on the top of the vehicle for in transit use, removed for a longer stay at a destination. There are no flaps, ailerons, or fuel lines to disconnect.

suggested the occupants of such a vehicle would feel about a quarter of the turbulence encountered by people riding in a conventional aircraft.

So this would eliminate some of the compromises inherent in the concept of a dual-use vehicle: transmissions and suspensions could be made simpler than they would otherwise be in such a compromise, and could be optimised for more frequent road use. What's not to love?

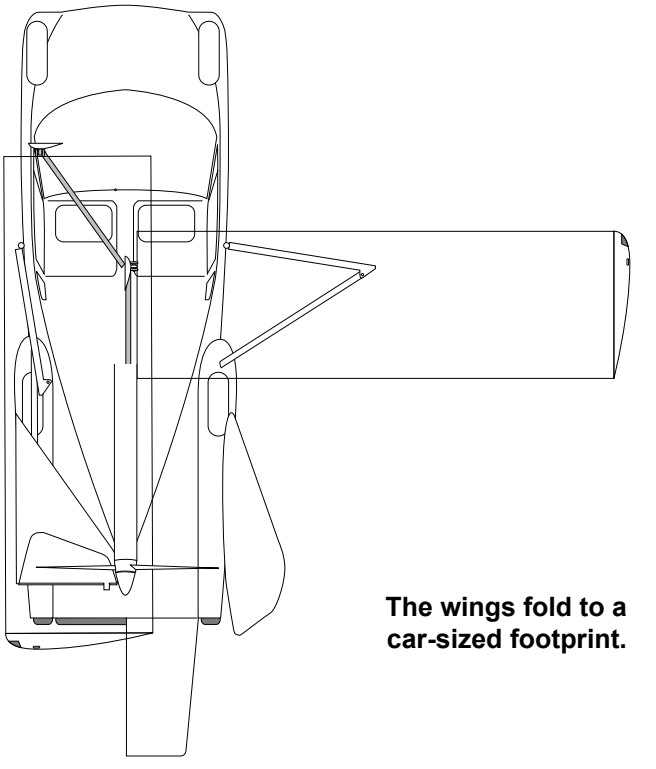
The Not-So-Good Part

Well, there are *some* issues. Some pilots may feel a little weird seeing the wing moving in flight independent of the fuselage, especially in turbulent air. If the smoother ride settles your stomach, the sight of the wings bobbing up and down in rough air might be enough to unsettle it again.

You can't dive a Controlwing. You can't do aerobatics. I used to consider this quite limiting until I thought of the last time I tried to dive an airplane. Normal descents (at least for a non-aerobat like myself) are generally performed with a reduction in power to set the rate of descent rather than aggressive use of the elevator. No big deal.

The system *does* fly differently, though. There is a collective stick in lieu of a normal elevator control; in fact, you control your altitude primarily with the throttle - all other things being equal, this is a constant speed aircraft. When you increase power, you don't get an increase in speed, but in altitude. Decreasing power produces a descent. It is possible to go faster, but you have to adjust the collective for a higher speed - which without a commeasurate increase in power would cause a descent - then adjust the power to maintain level flight.

However, there are ways the system could be made relatively transparent to the pilot. For instance, by designing an elevator-like control input into the



The wings fold to a car-sized footprint.

control wheel instead of a collective, pulling back on the wheel would yield a slower airspeed with an initial climb. Power would have to be added to maintain the climb, in practice much like we do anyways.

Finally - and this is an issue specific to roadable concerns - you can't put flaps on a Controlwing. The wings are going to be larger than we like, considering you'd have to do something with them when you're driving. They will be somewhat cumbersome. (It would be essential to design a folding mechanism that can be worked by one person. Unlike the good folks at Terrafugia [*www.terrafugia.com*], I wonder if an automatic, powered mechanism is the way to go, only because of weight concerns. It's a no-brainer *if* you can afford the extra weight; but it must be at any rate simple for one person to operate, even in gusty weather. Further, it would be handy if the entire wing section was removable for extended stays at a destination).

But none of these is what might be considered a fatal objection. It depends on your design goals: if you want the convenience of dual use, and aren't interested in doing loops and lomcevaks all over the sky then these are not problems.

Possibilities

The range of options are intriguing. What about an *amphibious* roadable? The utility of such a vehicle could not be overstated. Imagine a vehicle that could land both at the local airport *or* on a body of water, but could still be driven cross-country when inclement weather is encountered. If the flight portions could be made to be totally removable for extended stays at a particular destination, it might not even make a bad automobile; the rotating wing of the vehicle allows us to bypass some of the usual compromises necessary in other concepts.