Vader Down Under

By Bill Evans

From a galaxy not so far away comes this intergalactic R/C sport ship. It's a pussycat in starship clothing.

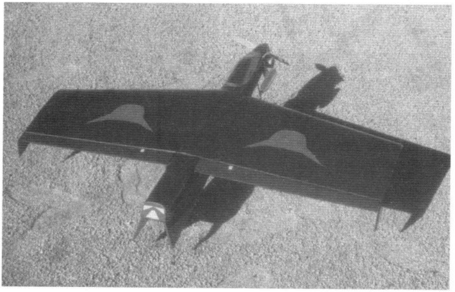
The *Vader Down Under* is the first aircraft known to fly with the vertical stabilizers on the bottom (beneath the thrust centerline) of the fuselage.

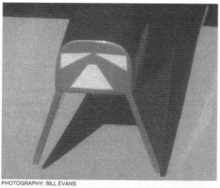
It, too, is of the *Simitar* series: that is, no aft mounted horizontal stabilizer or elevator. It operates on the principal of a flying wing, but does not look like one as its fuselage is more conventional in appearance.

The idea for the *Vader* came to me one day as I was flying my *Simitar Tracer* inverted for more than half the flight. The thought in my mind was, "Why must the vertical fin be on top? If I can take off with the fin(s) on top and fly with them on the bottom while inverted, why not start with them on the bottom?"

Since I envisioned that one large fin on the bottom would need a lot of ground clearance, I decided to go with two long fins with less height and tilted them out a few degrees. The result gave the appearance of Darth Vader's helmet (as in *Star Wars*). Also, since the fins were underneath, it seemed appropriate to add "Down Under" as an honor to all my mates in Australia, especially Steve and Bierta Raskin of Simitar Aircraft Down Under, Shaun Carrol, Merv and Joan Buckmaster, and the staff of *Airborne* magazine. Hence the name *Vader Down Under*.

Before you shy away because I have no tail to tell, let me tell you that I have designed, built and flown over seventy-five models in the *Simitar* series and more than thirty of them have been published in construction articles in various U.S. modeling magazines.





PHOTOGRAPHY: BILL EVANS

The most notable and distinguishing characteristic of the *Vader Down Under* is the fact that the vertical surfaces—on the tail **(above)** and on the wing tips—go down. This didn't seem to affect the directional stability of the model one bit. The wing **(at left)** has a less noticeable aspect from this angle. It has anhedral instead of the more usual dihedral. Again no difference in the stability of the model.

Vader Down Under at a glance

Wing span	48 inches
Fuselage length	40 inches
Airfoil	ESA *(Evans Simitar Airfoil)*
Wing Chord	16½ inches
Wing area	685 square inches
Weight	6 pounds
Wing loading	20.2 ounces per square foot
Engine required	.40 to .61 two stroke
Radio requirements (elevons, engine, nose gear)	4 channel minimum 4 standard servos

Foam Cores, X-Hinge, and Corefilm: **Soaring Research**
454 Wildrose Lane, Bishop, CA 93514; Phone 760-873-4932

Here's the *Simitar* scion himself, Bill Evans, holding the latest in this line, the *Vader Down Under.* An ardent proponent of tailless planes, he poses in front of California's White Mountains.

A bit later I'll get into the performance advantages of *Simitars.* However, the flight performance of the *Vader Down Under* is as smooth and stable as was expected. Control response is positive and instant; makes you feel like the ship is reading your mind. The one thing different is that, with the fins on the bottom, you need to fly it a bit closer for orientation reference until you get accustomed to not having fins on top. It is quite different looking in the air, much like watching a hawk! The anhedral in the wing and the tip plates that are swept down at the rear give it a more interesting and futuristic appearance.

Before beginning construction let's deal with the flight performance advantages of the *Simitar* series. A *Simitar* is a flying wing. The fuselage I have added is only for ease of mounting radio, battery, servos and fuel tank. If the scale were large enough, these components would be inside the wing itself. The fuselage does not change most of the flight characteristics from those of a pure flying wing. The performance advantage of a *Simitar* flying wing are:

A. A *Simitar* will not tip stall. As you reduce power and pull up elevator, when it reaches the point where a conventional ship would try to tip stall, it merely drops its nose and continues to fly straight ahead with the nose down a bit. So, the tail will never drop, cause a tip stall and a crash. How many times have we either tried to force a stab ship into the air or stretch the glide only to have it tip stall and crash. Never will it happen with a *Simitar.*

B. A *Simitar* has a wider speed range. Given the same weight, power and wing area as a conventional ship, the *Simitar* will fly slower; because it has less drag, it will fly faster.

C. A *Simitar* is aerodynamically stable. Hands off at quarter throttle, tap a bit of left aileron to get the right wing tip up a bit, let go, and a *Simitar* will do left turn 360s until you say quit! Anyone of any age who can tap left or right stick can fly a *Simitar* until the tank runs out and never have to touch up or down elevator. Since it will not stall, pitch control is not required for slow flying. (For first time flyers, take off and landing should be done by the instructor.)

D. Wind is not a factor with a *Simitar*! They have been easily flown in winds up to 70 mph! Adjust throttle to maintain zero ground speed and you can hover; ease off and it will fly backward. Vertical take offs and landings are no problem.

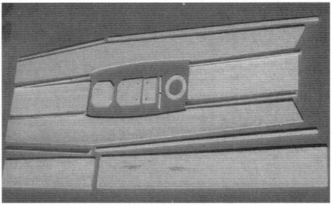
E. Aerobatics? A *Simitar* will do all maneuvers a conventional pattern ship can do, better and easier. It will tumble fore and aft as well as tumble tip to tip. Flat spins are no problem. Also, tight turns!

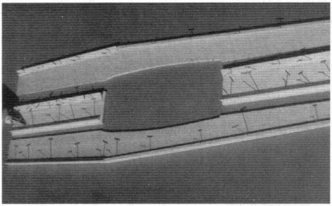
Just think about it. The fastest plane in the world, the SR-71, is a flying wing. The fastest passenger plane in the world, the *Concorde,* is a flying wing. The *Shuttle*—which has the world's distance record, goes into space and re-enters at 18,000 mph over the Indian Ocean to land at Edwards AFB—is a flying wing. Like the *Simitar*, none of these ships have aft mounted stabs. Ever wonder why? *Performance*!

News commentator, Paul Harvey, recently made the statement "Before not too much longer, no aircraft will be built with horizontal tails."

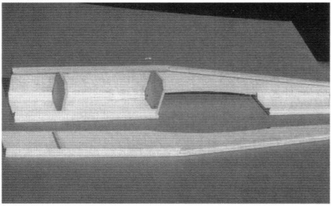
And obvious requirement of tails on the bottom side of a plane is the need for stalky landing gear—but you can swing a huge prop!

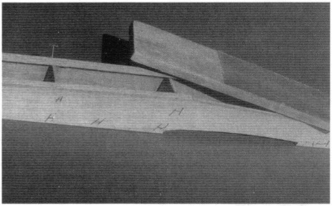
Vader Down Under





If you're a fast builder, you may match the author's 6-hour timetable for framing the *Vader*. Parts count on the fuselage is minimal **(above left)**. With the triangular stock longerons set and pinned in place **(above right)**, wick some CyA in place from the interior sides of the triangle stock. Align one side with the top sheeting and the front formers, then pin in place **(below left)**. After the second side is attached, sand the bottom flat to accept the bottom pieces **(below right)**.



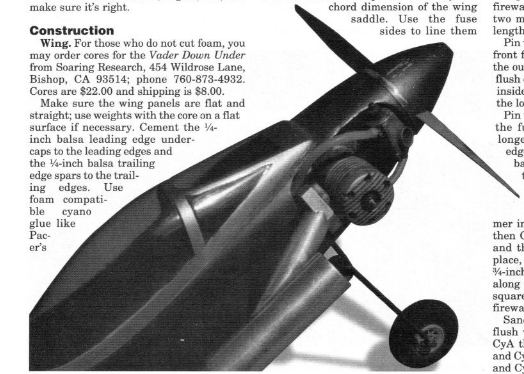


Construction is super simple; foam wing, fuse sides, top and bottom of sheet balsa. Takes about six hours of work time for construction, complete, ready to cover. Takes me at least six hours to cover; then about four hours to install radio, engine, etc., and make sure it's right.

Construction

Wing. For those who do not cut foam, you may order cores for the *Vader Down Under* from Soaring Research, 454 Wildrose Lane, Bishop, CA 93514; phone 760-873-4932. Cores are $22.00 and shipping is $8.00.

Make sure the wing panels are flat and straight; use weights with the core on a flat surface if necessary. Cement the ¼-inch balsa leading edge undercaps to the leading edges and the ¼-inch balsa trailing edge spars to the trailing edges. Use foam compatible cyano glue like Pacer's ZAP-O, Sig Mfg's Odorless Thick CyA, or carpenters glue *(warning: do not use regular CyA on foam)*. Set these aside to dry.



Fuselage. Cut out the fuse pieces; place the fuse front and rear top pieces on a flat work surface and separate them by the chord dimension of the wing saddle. Use the fuse sides to line them up, then pin the front and rear top to the work surface.

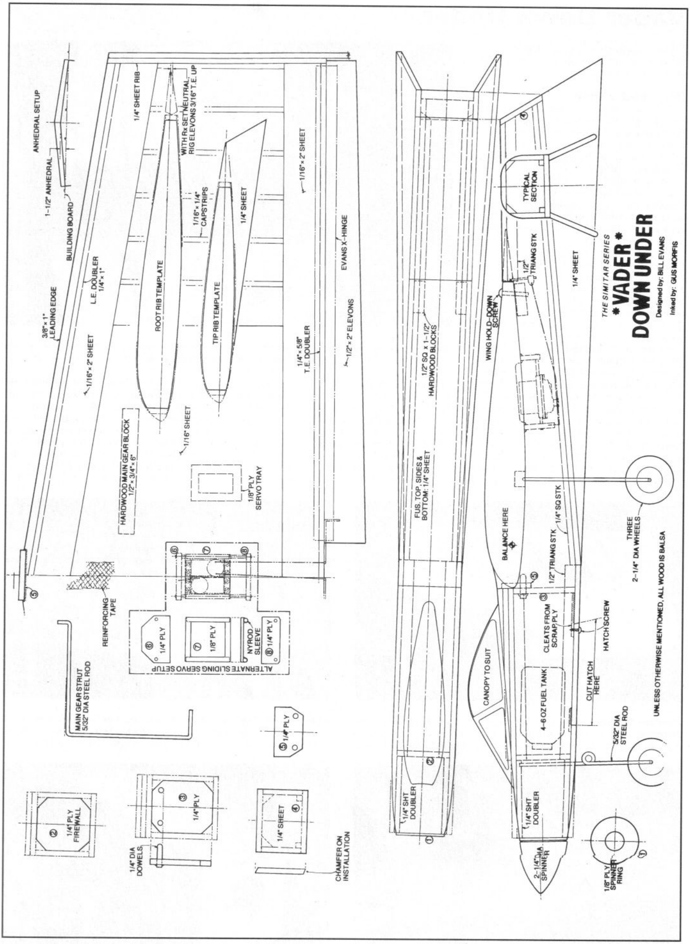
Mark the location of the firewall and former on the fuse sides and front top. Cut two pieces of ½-inch triangle stock to fit along the distance from the back of the firewall to the front of the former; now cut two more pieces of ½-inch triangle to the length of the rear top.

Pin the ½-inch triangle longerons onto the front fuse top, each of them ¼ inch in from the outer edge (to allow the fuse sides to fit flush on the outside). Apply thin CyA to the inside edge only. (The CyA will run under the longeron.)

Pin the ½-inch triangle rear longerons to the fuse top rear. Locate each of these longerons ¼ inch in from the outside edges, left and right, but flush front to back. Apply CyA to the inside edge between the longerons and the top front and top rear.

Pin one fuse side to the front and rear tops; pin the firewall and former in place against the top and the side, then CyA the side to the top, the firewall, and the former. Pin the second side into place, and CyA it into place. Pin and CyA ¾-inch triangle bottom longerons into place along the fuse sides. Pin and CyA ¼-inch square strips around the back side of the firewall.

Sand the bottom edges of the fuse side flush with the bottom longerons. Pin and CyA the front fuse bottom into place. Pin and CyA the rear bottom fuse into place. Pin and CyA the rear end plate into place.



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Fuse construction is now complete. Round the fuse corners to the plans and apply sandpaper as needed.

Back to the wing

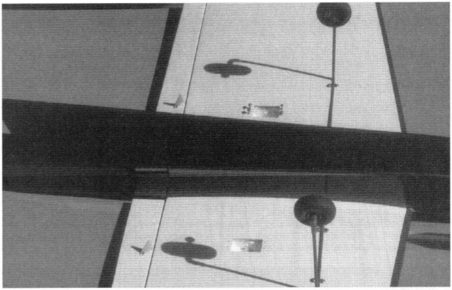
Plane and sand the 1/4-inch leading edge doublers and the trailing edge spars so that the sheeting will fit over them. Do not sand any of the core away.

Sheet the wings. I used Corefilm (available from Soaring Research) to apply the 1/16-inch sheeting to the leading edge, trailing edges, and center section. Now sand the leading edge sheeting flush to the doublers and then pin and cement the 1/4 × 1-inch capstrips on 2-inch centers from the end of the inboard sheeting to the tip of the wing.

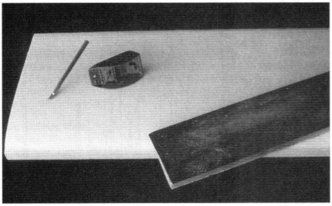
Shape and sand the leading edge. Note: the leading edge bottom is nearly flat and the leading edge top curve is fairly steep. Do not round the leading edge very much; a max radius of 1/16 inch is desirable. Apply wing tips, carve and sand to airfoil shape. Then finish sand the wing panels. Join wing panels using 5-minute epoxy.

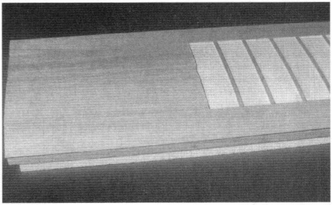
Fit the elevons to the wing. I used my X-Hinges (available from Soaring Research) to attach the elevons to the wing. (Note: If you use mechanical elevon mixing, form and install the elevon control rods before you attach the elevons.) Cut and cement end grain balsa into the wing at the bolt location to obviate crush of the wing when bolting to the fuse. (*Some use center drilled dowels or fiberglass pushrods for this purpose—Ed.*) Fit the 1/4-inch plywood wingplate into the leading edge of the wing at the center section. Set the wing and the wing plate into place on the fuse and check for fit before gluing the wing plate to the wing. Now, using waxed or greased temporary 1/4-inch dowels, set the wing and plate into place, align them, and glue the plate to wing with 5-minute epoxy.

Place the hardwood gear blocks at the correct location on the bottom of the wing, mark the area and remove the sheeting and foam so that the blocks are flush with the sheeted bottom wing surface. Glue these in place using 5-minute epoxy. Now, sand and cover the wing. (Note: If you use electronic elevon mixing install 1/8-inch ply servo plates, flush with the bottom surface of the wing and dig out the foam for servo pockets prior to covering the wing bottom.)

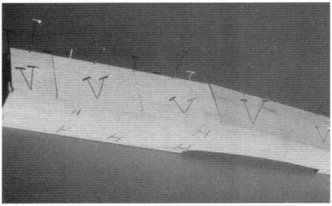


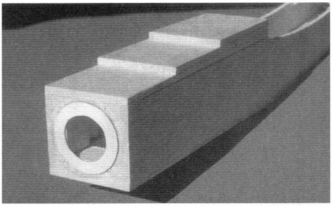
Choose a mechanical sliding tray mixer for the elevons (shown on the plan) or individual servos in each wing for electronic mixing, as shown above. For the latter, cut out bays, and inlay a ply mounting plate.

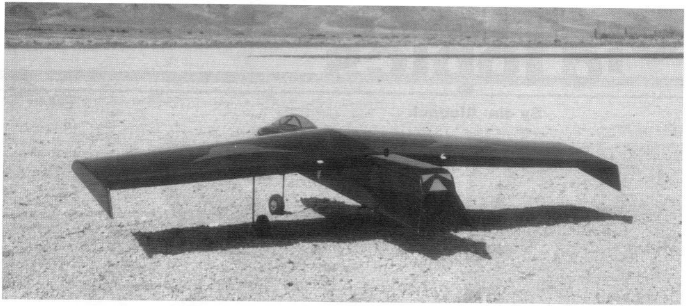




Plane and sand the balsa leading edge doubler and the trailing edge to match the contour of the wing **(above left)**. Use your preferred method to sheet the foam core **(above right)**, and trim the sheeting flush with the trailing edge and the leading edge doubler. Then attach and glue the leading edge. Bottom fuselage sheeting is added, along with a tank access hatch **(below left)**. The nose filler pieces and stepped top front sheeting are added **(below right)** to be contoured to shape.







A canopy really sets the *Vader* off. Suitable canopies are available from Sig or Wing Manufacturing.

Complete and sand the vertical fins. Sand and cover the wing; cover the fuse; epoxy the vertical fins to the fuse bottom at the angle shown on the plan. Sand and cover the wing tip plates. Leave bare balsa on the wing tips and matching area on the top plates. CyA the tip plates to the wing tips as shown on the plan.

For those new to the concept of the *Simitar* series, an explanation of the control surface function and component installation will be helpful.

First, a *Simitar* requires only pitch (elevator) and roll (aileron) functions for flight. Except for pattern flying, a rudder is not required.

Simitar control surfaces are elevons which serve as ailerons and elevators. In essence, consider the control surfaces as full strip ailerons which provide both aileron control and elevator control. This means some form of mixing is needed. Such mixing can be provided by mechanical or electronic means.

The best mechanical method is to use my sliding tray (*Future 60*, ***FM*** 4/98 page 30), which works as follows. One of the servos in the tray is set up as you would for strip ailerons. The second servo is for elevator and its control arm is attached to a stationary bulkhead at the front of the tray so that it will slide the whole tray fore and aft to give the elevator function.

Electronic mixing can be provided by either a radio with built-in mixing or by using Ace's Christy Mixer or the Quillen Mixer (Quillen Engineering, 561 North 750 West, Hobart, IN 46342; phone: 219-759-5298) which plug in between the servos and the receiver. Both mixers work very well and are in the $25.00 to $45.00 price range. Alternatively, some of the newer radio systems have built-in elevon mixing or flaperon mixing functions. I have used several of the Futabas in this line, such as the 6VA, 7NFK, 7UAF, 7UAFS, & 7UAP and 9VAP.

Final preps

Use 1/8-inch ply trays to mount the servos in the wing; epoxy the trays flush on the bottom of the wing after sheeting. Grind a hole in the bottom center of the wing and use a piece of piano wire with a hook bent on one end to tunnel out for each servo lead. The lead is then easily fished through with a piece of string.

If you don't have a radio with electronic mixing you can try mechanical mixing using a sliding radio tray. Details for one can be found in my article on the *Future Sixty* (***FM*** 4/98, CD049).

Install the landing gear, engine, fuel tank, and all the radio components. Hook up all the controls and check to make sure there is no binding. Check to make sure your aircraft balances (level to slightly nose down) at the c.g. location indicated on the plans (approximately 1½ inches behind the leading edge of the wing, with no fuel in the tank.)

Ready for flight

I put in as much control throw as I can get, then use what I need (3/8 to ½ inch of up, down, left and right is fine). Remember, control is not like a light switch (on or off), it's like a dimmer switch: use only as much pressure on the stick as you need to make it do what you want! Set the nose wheel height so that, while setting on a flat surface, the leading edge of the wing is ¼ inch higher than the trailing edge (measured at the hinge line). Also the trailing edge of the elevons are set 1/8-inch up with the transmitter trim at neutral. (*All flying wings require this setting, called reflex—Ed.*)

Check all surfaces for proper motion. (Remember left aileron command results in the left elevon going up and the right going down; and the up elevator command results in both elevons going up!)

Ah yes, flight performance of the *Vader Down Under* is very smooth and graceful; gives the feeling that it's an extension of yourself in the air; seems to always do the right thing, often before you command it. Are the thumbs quicker than the eye? Bill Winter said to me, "Why does my *Simitar* do what I want it to before I tell it to? Does it read my mind?"

Remember, be safe, be courteous to other flyers, have fun! And tight turns!

Finish is your choice. On an unconventional model like this it might also be a good idea to set it up with a highly visible and distinctive trim scheme to determine orientation.