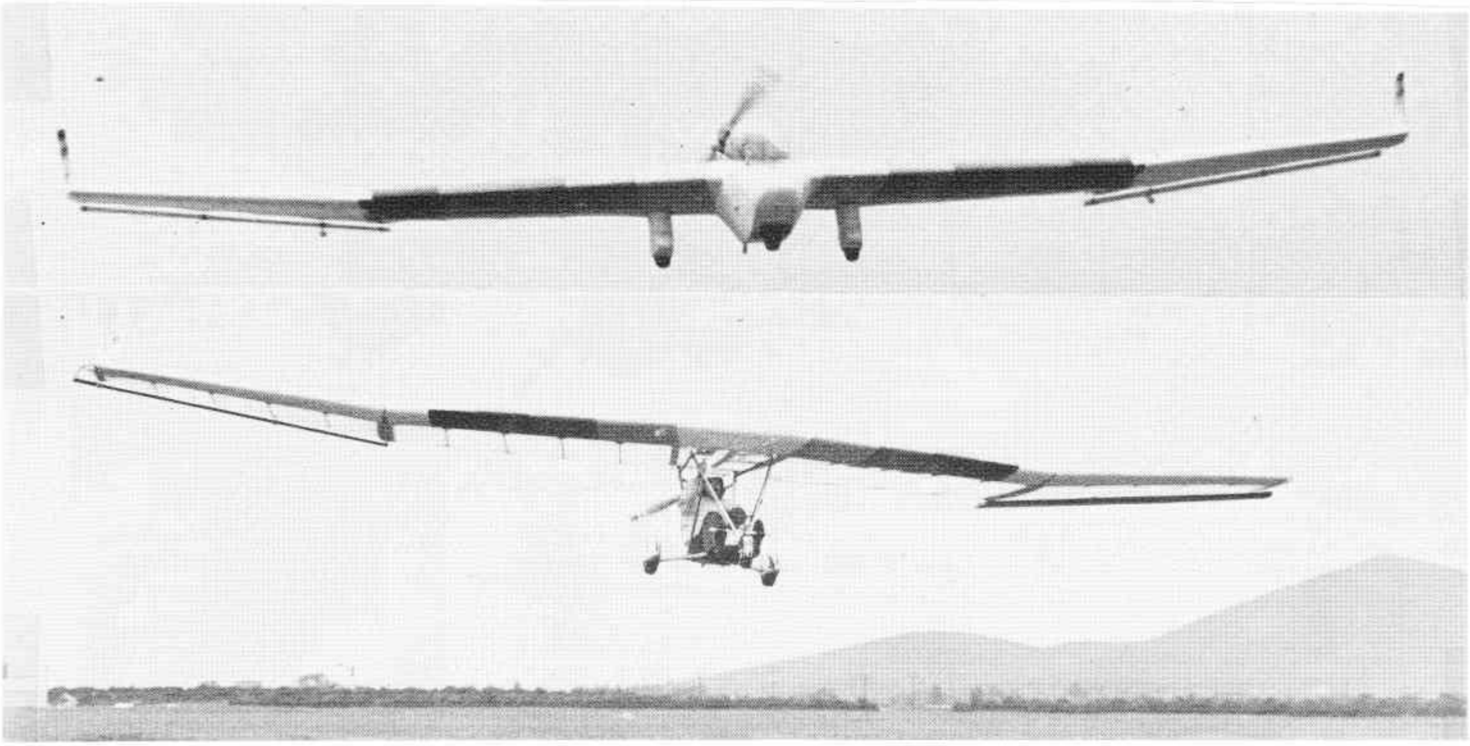
No. 86 AUGUST 1993

T.W.I.T.T. NEWSLETTER



TWO OF DON MITCHELL'S DESIGNS THAT WILL CONTINUE TO BE BUILT AND FLOWN IN THE YEARS AHEAD. TOP: THE U-2; BOTTOM: B-10. (NO THEY ARE NOT REALLY FORMATION FLYING.)

T.W.I.T.T.
(The Wing Is The Thing)
P. O. Box 20430
El Cajon, CA 92021

The number to the right of your name indicates the last issue of your current subscription, e.g., **9308** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, August 21, 1993, beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, Calif. (First hanger row on Joe Crosson Drive - East side of Gillespie.)

THE WING IS THE THING (T.W.I.T.T.)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation which is dedicated to furthering education and research in a variety of disciplines.

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The **T.W.I.T.T.** office is located at Hanger A-4, Gillespie Field, El Cajon, California.

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Meetings are held on the third Saturday of each month, at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive, east side of Gillespie).

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PRESIDENT'S CORNER

Well, even though we didn't have a formal program of last month's meeting until after the newsletter was published, we had a very good meeting. As usual, if you didn't come because of the lack of a pre-announced speaker, you missed an interesting discussion on propulsion concepts centered around HIAM, along with learning ways to test your design theories at very low cost. (Enough soapbox, already!!)

Our ability to store TWITT assets in Bob's hangers has been sharply limited due to subleasing. We will probably have to begin paying a rental fee to help offset some of Bob's costs since we are now taking up a larger portion of his useable space. You could help reduce the space needed if you would donate one folding chair to TWITT (a small tax deduction) so we can get rid of some of the bigger chairs. Perhaps you have an old, but serviceable, one in a closet that hardly ever gets used at home. Take a look and see what you can do. Thanks.

Don't forget about the SHA Workshop at Tehachapi over the Labor Day weekend. There will be morning demonstrations at the field, along with seminars in the afternoon (see last month's newsletter for speakers and topics). Bruce Carmichael has done an excellent job in putting together a well rounded program that should be a must for any homebuilder (which includes a majority of TWITT members).

We now have a commercial free copy of the Arts & Entertainment (A&E) First Flight show on Flying Wings. It is about 23 minutes long, narrated by Neil Armstrong and includes good shots of the Northrop designs and some of the early attempts at flying wing development. If you would like a copy we can provide one at a cost of $8, including a VHS cassette and postage.

I hope the summer months have found all of you flying your favorite type of air vehicle, be it conventional or tailless, and enjoying the fruits of the winter's labor. If there is a good story behind some of that flying, please write and share it with others TWITTers.

Continued good flying,

Andy

AUGUST PROGRAM

This month we are pleased to host **Richard Avalon** from San Bruno, who will speak to the group about the **Don Mitchell's designs** and where they are going in the future (see Letters to the Editor for a brief preview). Richard has been quite involved with Don's projects over the years, including being a test pilot for the Mitchell Aircraft Company.

Also on the agenda will be about fifteen minutes to continue discussion on **Budd Love's HIAM systems**. There was a good exchange of information and ideas last month, and we hope that will provide a foundation for more dialogue.

We know this will be a most interesting meeting, so make sure to mark your calendar. The hanger will probably be hot, so wear your "coolest" duds, and bring plenty of change for the soda kitty.

MINUTES OF THE JULY 17, 1993 MEETING

Andy called the small group of "really hardcore" TWITT members to order for an informal meeting. We had one visitor, Curtis Clark, an airline pilot who owns a Cessna 140, Cub, and Schweizer Teal. Bob got him to relate a story about soaring a Boeing 737 along a standing wave on the backside of a thunderstorm.

The floor was turned over to Budd Love for his segment on an aspect of HIAM. Due to the small group it was decided that some of his material would be presented again next month, hopefully to a large audience so that there would be a better interchange of information and ideas.

Budd began by saying that the graph in the July newsletter needed to be explained in order for most people to fully understand the concept of using compressed air as a means of propulsion. However, he is going to defer this part of the subject until the August meeting.

Bob Chase had suggested a discussion on putting the air outlet in the midsection of the wing to reduce the amount of pitching moment. This would be particularly important in a flying wing derivative since there is no conventional tail to help offset this pitching tendency.

Budd went on to explain some of the problems with HIAM in a flying wing, one of them being the pitching moment. Another problem is one of ground clearance, in that HIAM must have a high clearance in order to achieve the greatest efficiency from the jet flap. Therefore, a typical high-wing transport aircraft makes the best aircraft for HIAM.

One of the important features of HIAM is that the ducts have long mixing tubes which help create the level of efficiency needed to make the whole system work. By having the exit point at mid-section this efficiency is lost and the amount of thrust achieved is reduced.

HIAM differs from lift augmentation systems in that HIAM is also meant to provide the main propulsion system once the jet flaps are retracted for flight. That means this increase in efficiency is very necessary to provide the level of thrust necessary to get good takeoff performance, as well as, cruise performance.

There was a brief discussion on whether or not the main engine, which provides the power for turning the compressed air turbine, will provide a certain amount of residual thrust to augment that of the HIAM ducts. It was determined that there is some thrust available from the engine, but it is not a significant amount. Budd has not figured this into his projections, so performance should be a little better due to the residual thrust.

Jerry Blumenthal asked the question of whether or not you could run the ducts span-wise, overlapping them in such a way to achieve the same approximate length as HIAM's ducts. Budd's response was that the final bending of the flow from a spanwise direction to the thrust direction would result in too much lost efficiency to produce the desired results.

Tuto Figueroa offered an explanation of how subsonic and supersonic ejectors would affect the mixing of primary and secondary air within the ducting system. He showed that the mixing tubes could be shortened by adding more ejectors at the entrance to achieve the same L/D results of a single ejector in a long tube. HIAM currently has eight supersonic ejectors for each duct to produce the levels of thrust necessary for both lift and propulsion.

Bob Fronius described an early experiment that was done at Convair using compressed air and a system of venturies. It produced enough thrust to lift a heavy hammer, but flight control was not possible due to the primitive nature of the model. Bob suggested Budd produce some demonstration models that could use compressed air to show actual results.

The meeting then progressed into viewing a video provided by Alan Halleck of Beaverton, Oregon, showing his two RC flying wings. He went through their development, pictured the pieces and how they went together, and then a terrific flight shots slope soaring. They are heavy and take a lot of wind, but boy do they move. His latest version with vertical tips seems to track extremely well and is quite maneuverable.

Andy then introduced Bob Chase who was to tell us a little bit about how he uses paper airplanes to test his various design and flight theories (such as last months cut-out in the newsletter).

First, Bob summarized some of the basic concepts he has come up with for producing a flying wing model with mid-section ducted thrust for producing lift. There was a general discussion on whether a ducted fan could produce the necessary volume and pressures needed to make a suitable demonstrator. Bob has yet to talk with some ducted fan experts in his area, but will be doing so in the near future.

One problem with taking almost all the air away from a ducted fan is that there would be very little left for providing forward thrust. This was another area of concern Bob would need to discuss with his experts.

There were several suggestions on how to configure the model to reduce the amount of airflow bending (swept wing), and also the need to taper the ducts to keep the output pressure constant along the span of the mid-section flap.

Bob then got into how and why he uses his paper airplanes. He commented that he almost always carries the makings around in his brief case, because you never know when you might get a good idea, or you have spare time and need something to do with your hands. All it takes is some duct tape, scissors, and 5X8 index cards.

He got an early start at building paper gliders when he cut one out using a diagram from an old volume of the Book Of Knowledge. Then, when he was stationed in Greenland, he use this skill to provide the base's school children with some gliders for Christmas presents when the resupply plane couldn't get in due to bad weather.

Bob also got involved in paper glider contests, and started experimenting with strakes trying to overcome his propensity to come in second. He feels the strakes help scavenge some of the air and prevent turbulence from forming on the wings. He used his techniques to teach aerodynamics to a local 4-H group, and they evolved from very simple designs to more complex aircraft.

There are some limitations, such as compound curves, and getting some types of weight distributions.

Bob ended by challenging the group to try his techniques to come up with something new that will fly. Only a couple of people had tried the version in last month's newsletter, the biggest problem being encountered was not having enough dihedral. (This month's article on the FinchTip should give some of you ideas on how to configure the tips to make it fly better.)

There was a brief discussion about TWITT members using their imaginations to come up with a flying wing glider that will be competitive with conventional sailplanes.

Bob Fronius showed us an old model of a Horten design he build years ago, and then he went on to discuss some of the airfoil designs the Hortens used to achieve their results. The general theory seemed to be that airfoil thickness had to be further forward than in more conventional wings.

The meeting was adjourned so everyone could get out into the open air and cool down, and try some of the various paper models.

LETTERS TO THE EDITOR

7/3/93

TWITT:

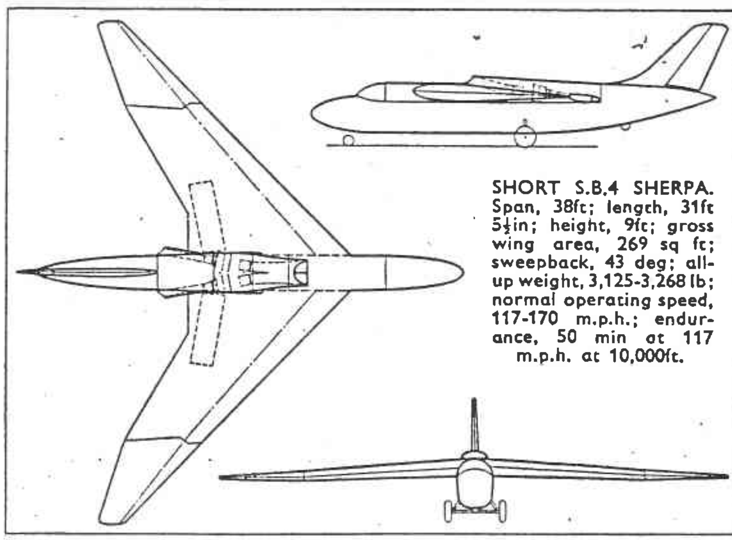
Enclosed are a couple of articles concerning an experimental tailless transport that the Short Brothers aircraft company worked with in the early 1950's. One article is from a 1953 issue of the British magazine Flight And Aircraft Engineering (now called Flight International). The other entry is from the book British Research and Development Aircraft by Ray Sturtivant.

The aircraft was flown both as a glider and as a jet powered research aircraft. It is interesting to note that the entire wingtip moved to provide control (in the same manner as the Hill Pteridactyl).

Enjoy,
Kevin Renshaw

(Ed. Note: The aircraft in these articles is the Short Sherpa (see the 3-view). The articles are a page or less and will be added to the library.

We would like to thank Kevin for his constant contributions to the library and newsletter.



SHORT S.B.4 SHERPA. Span, 38ft; length, 31ft 5¼in; height, 9ft; gross wing area, 269 sq ft; sweepback, 43 deg; all-up weight, 3,125-3,268 lb; normal operating speed, 117-170 m.p.h.; endurance, 50 min at 117 m.p.h. at 10,000ft.

7/16/93

TWITT:

Enclosed is a cheque for the renewal of my TWITT membership for the next two years.

Our book on "Tailless Aircraft" has been translated in the meantime from German

("Schawanzlose Flugzeuge") into the English language. The translator is Capt. Eric M. Brown. Most probably you have heard of him as England's greatest test pilot. He has test-flown more different type of aircraft than any other pilot in the world. He also wrote 10 books on this subject.

Just in case you are interested to preprint a Section of our book, I enclosed the three pages of Sec. 5.6 Pancaking, Control Inversion of Chapter 5 Flight Characteristics. It describes a phenomenon which is not often mentioned in literature. I wonder what other pilots of "flying planks" have to say about it, especially Jim Marske.

Best regards and many tailless flying hours to all friends of TWITT.

Yours sincerely,
Karl Nickel

(Ed. Note: First off, we owe Karl an apology since the TWITT member who was supposed to help with the translation never finished the job, or at least never got to him in a workable format.

We are pleased to learn that it has finally been translated and hope that once it reaches the U.S. our members will be most anxious to get their copies.

The enclosed section has been reprinted elsewhere in this issue so you can all get an idea of some of the material covered by Karl and his co-author Michael Wohlfahrt. Thanks to both for the insight.)

(Ed. Note: The following is included in this section just in case any of our members in the southeast might be interested in helping with this project. I have sent them a handout flier, a recent newsletter, and a letter explaining a little more about TWITT.)

7/10/93

TWITT:

I am a technology education teacher at South Dade Senior High School in Homestead, Florida, working on an aerospace technology curriculum project. The framework for this project has been adopted by the State of Florida, Department of Education as the aerospace technology curriculum for Florida's public school system. The intent of the program is to provide students with an exciting educational experience using aviation and engineering, and computer applications.

I have developed six text/activity books, with an additional six under development. These text/activity books are being published and distributed by PITSCO, a technology education company in Pittsburg, Kansas, to provide national distribution. The curriculum project is being widely accepted by schools and school systems across the country.

We are currently working on the eighth book in the series which will cover R/C soaring. In reading a recent issue of R/C Soaring Digest we noticed your ad for your organization. Would you kindly send us materials on your products, services and resource materials. We are interested in including a unit on your organization in our text.

If you might consider working with us on this project, or if you need additional information about our development program, you can reach me at school at (305) 247-4244 Ext 285, or at home at (305) 726-3570. I look forward to your reply.

Sincerely,
Steven A. Bachmeyer
1804 Runners Way
N. Lauderdale, FL 33068

(Ed. Note: The following was taken from Rigid-Wing Reader, Volume 1, Issue 3, Second Summer Issue 1993, published by TWITT member Chuck McGill (see ad later in this newsletter).

"**David** Swanson writes: We miss Don so much. This is the beginning of a new era where we will all have better choices. The STEALTH II prototype was not being built from plans, so Tim Morley and Jeff Harlan came to Tehachapi to take photos and measurements of the more complete ship here. STEALTH II LE ribs are 1"/2-lb blue foam on 3" centers, skinned with 1.5mm ply. The ribs from the spar to the TE are 1/4" spruce built-up ribs 18" apart, #1-13 & #0. The TE is 1" spruce covered with graphite. The spoilers will be placed just behind the spar covering 2 rib bays at the CG to increase drag without affecting pitch. Their span/area are different than Don's contest entry - 39.5ft & 144ft^2 plus the stabilators to 156ft^2. Culver-Twist varies from 6° angle of attack at root to 2° at rib #4 (30% span) and 0° at the tip. Sweep 15° at LE, 13° at spar. Weight closer to 75-lbs, L/D about 12 or 22, sink rate about 140 FPM. Dan Armstrong points out that the L/D with a control bar would be about 18/1."

7/24/93

TWITT:

This is to keep you informed on the status of Don Mitchell's work and the availability of his designs. The two primary and current aircraft that Don was working on were the model U-2, with its derivative the "Victory Wing," and the model B-10 with its upgrade the Stealth II.

The Victory Wing was an attempt to build the U-2 for the ultralight category - that is under 254 lbs., as well as improve low speed handling and overall soaring performance. To make a long story short, after I did the initial test flying of the Victory Wing, we were very satisfied with the results obtained.

The ship came out at 250 lbs. and had a stall speed of approximately 26 to 28 mph, without degrading the excellent flying and soaring qualities. We did gain only a slight improvement in sink rate and L/d ratio. We decided to keep the U-2 in its current configuration - that is weighing about 290 lbs. and registered in the experimental category. We do expect the FAR's concerning this type of aircraft to change soon to a new "sportplane" category and we felt that the U-2 would be perfect for that new classification.

ABOVE: Don Mitchell sitting in the cockpit mockup of Stealth II.

The U-2 is the flying wing where the pilot sits in the wing and has a bubble canopy on top of the wing. I was the company demonstration pilot for the U-2 at Mitchell Aircraft at Porterville in the early 80's and was totally satisfied with and really enjoyed flying this model. It was very stable, had excellent soaring qualities and performed very well with only 20-25 hp. Don never did complete drawings for the Victory Wing, so this modification to the U-2 is presently unavailable.

The B-10 was Don's other principle design and the pilot sat under the wing in an open frame or a small pilot pod. My own personal ship was the B-10 and like the U-2 it was an outstanding performer - stable, easy to fly and transport, and all on only 20-25 hp. using only 1 to 1 1/2 gallons of fuel per hour. The B-10 was easier to build than the U-2 and both aircraft were basically wood and fabric designs.

Don designed his airplanes to be easy to build, easy to fly, and with excellent handling characteristics coupled with the absolute best performance, over any aircraft in the ultralight category.

The Stealth II was an upgrade to the B-10, sharing the same pilot-under-wing configuration.

The Stealth II was not completed or test flown and there are no complete drawings available for this ship. The aircraft that Don was working on when he passed on is owned by Dave Swanson and is being completed by Les King. The Stealth II should be an improvement over the B-10. It has a different airfoil, it weighs less and has a slightly longer wingspan. Only time will tell regarding the differences between this and the earlier B-10

Both the B-10 and U-2 are truly great Don Mitchell designs - probably the best all wing designs in the history of aviation. Complete blue prints are available for both the B-10 and U-2. They include pictures and building instructions. They will cost $150 per set and would be a very important addition to a flying wing library or to anyone who is contemplating building or designing a flying wing airplane.

There are interested parties that would like to obtain the exclusive rights to the B-10 and U-2 designs. I'm wondering if there would be any TWITT enthusiasts interested in the rights to these aircraft.

If you have any questions or would like to order a set of plans, please contact:

ABOVE: Mitchell U-2. Note pilot enclosed in wing itself like Northrop designs.

Richard Avalon
892 Jenevein Avenue
San Bruno, CA 94066
(415) 583-3665 or (209) 783-8330

(Ed. Note: We would like to thank Richard for the update on the progress of Stealth II and the Victory Wing. We will try to print a couple of the pictures he sent along in either this or a later issue, space permitting.

He also sent along an article from Plane & Pilot titled "1980 Mitchell U-2" by Doug Colby. This is a pilot report on flights conducted in Don's prototype.)

WINGTIP DESIGN

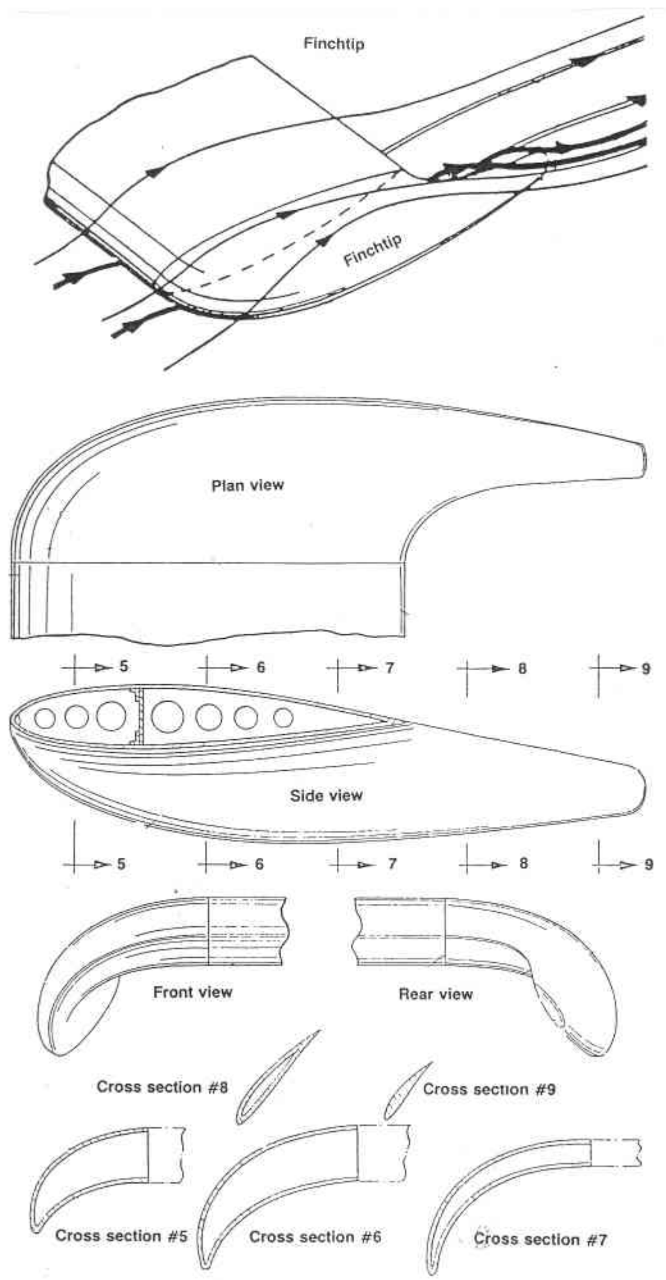
The following material is being reprinted with the permission of its author, Reg Finch. It has been previously published in Sport Aviation, March 1984, pp. 40-41.

If you are interested in squeezing the frontier of knowledge a little, as we were, and you see an area that is lagging behind, as we did, and you are suddenly subjected to a flash of insight, you may very well spend the next year on your back in a wind tunnel. The lagging frontier is wingtip design. Paradoxically, this is an area where a lot is happening, aerodynamically speaking. Why has it been neglected for so long? Ask NASA, Boeing or any of the biggies in aerodynamic research. You will get rather vague answers similar to which you are accustomed to hearing from a politician. Hoerner's books on lift and drag provide some insight into what is happening out there at the end of the wing.

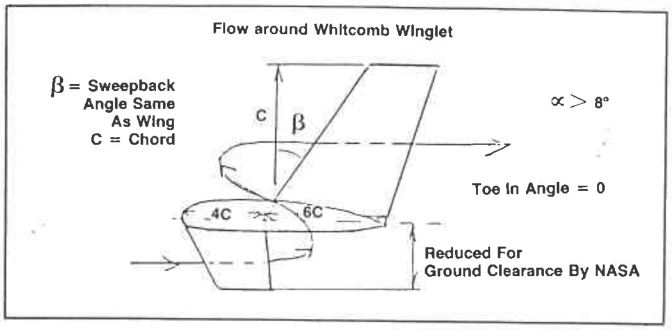
The culmination of our research resulted in a technique for tailoring a wingtip to a particular aircraft. This wingtip works by reducing the induced (vortex) drag to a bare minimum. It extracts lift out of the remaining weakened vortex and using the gentle persuasion of pressures, pushes the vortex outboard, thereby increasing the effective span. In aircraft design it is effective span we care about, folks, not geometric span. Effective span is measured from the center of one wingtip vortex to the center of the other. L/D is the bottom line for efficiency of any vehicle. These wingtips, known for obvious reasons as the Finchtips, will improve the L/D (Lift/Drag) and consequently save money on fuel (as much as 10%).

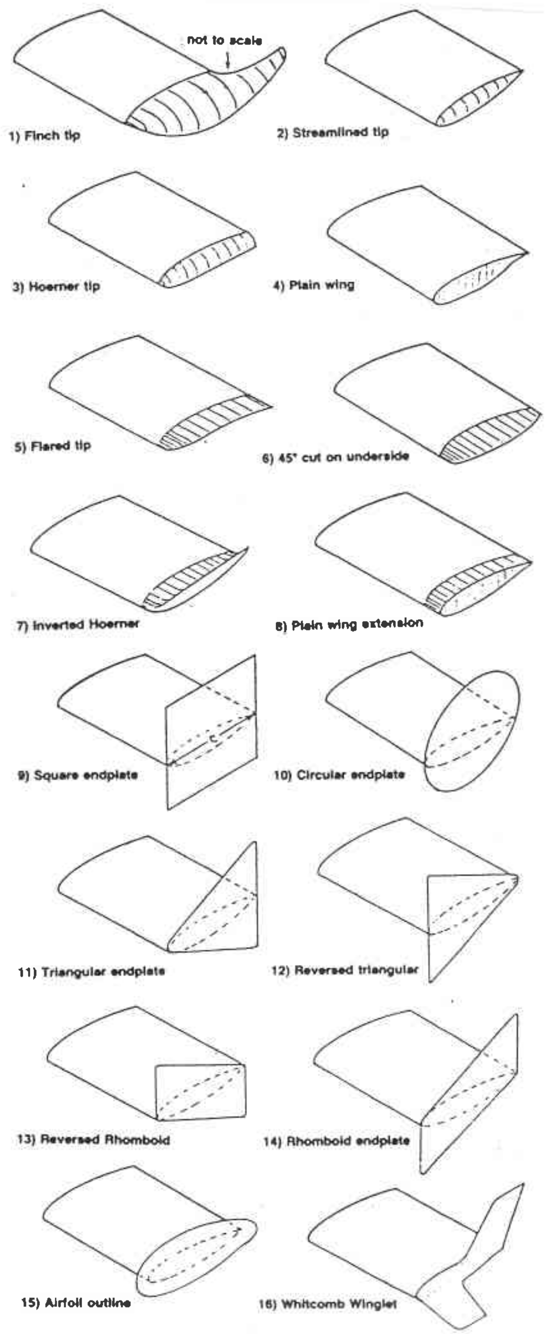
This type of tip works best on low aspect ratio, rectangular, thick, heavily loaded wings. They would be ideal as a retrofit on F-4, F-16, etc., to improve turning capability, or on the Space Shuttle to improve L/D and cross-range. So those of you who are building your won space shuttle, this is for you. However, any aircraft can benefit from this type of a wingtip, with sailplanes benefiting the least. Their high aspect ratio tapered wings are already pretty efficient.

How does the Finchtip compare with the Whitcomb Winglet? If you like Winglets, you'll love the Finchtip. They both work, but for different reasons. The Whitcomb Winglet can be improved upon by laying it flat, i.e., just extending the wingspan an equivalent amount. At least now the lift force will be in an upward direction rather than horizontal. The bending moments on the wing will be about the same as before, but the induced drag will be less. Some of the leading aerodynamic research laboratories subscribe to this. The advantage of the Whitcomb Winglet lies in its secondary rudders (VariEze) or on 15 meter sailplanes where the span is limited to 15 meters.



Finchtip views (not to scale)





So now that you are thoroughly convinced, we have included excerpts from a paper I have written. It shows a comparison of 16 wingtips we ran in the wind tunnel at San Diego State University (see chart on page 8) as well as some drawings of what a Finchtip looks like. The Finchtip is patented internationally but I have no objection to an individual builder putting them on his aircraft. I would actually encourage it for the sake of progress and efficiency, not to mention good looks!

If you would like some theory, graphs and some insight as to how to build them, the paper is available for $19 *(price may have changed since 1984, ed.)* from R.V. Finch, P.O. Box 180934, Coronado, CA 92178.

Preprint from the book *__TAILLESS AIRCRAFT__*
by Karl Nickel and Michael Wohlfahrt
(translation by Capt. Eric M. Brown)

Chapter 5 **FLIGHT CHARACTERISTICS**

Section 5.6 **PANCAKING, CONTROL INVERSION**

THE PHENOMENON: With remote-controlled flying-plank models one can observe the following behavior. The air the flying model obeys the control commands in a seemingly completely normal manner. This changes, however, near the ground. Suppose the model flies a few centimeters above the ground and the pilot pulls the stick full back. Then the model "pancakes" and sits in the grass.

IMPORTANT: What the pilot expects does **not** happen, namely, that the model reacts to the up-elevator command and that is rises again.

EXPLANATION:

The reason for this behavior is easy to explain: because of the elevator action a control surface at the trailing edge produces **down-lift,** hence the model pancakes and touches the ground. At higher altitude this pancaking would not be observed nor would it have any effect. Some fractions of a second later the flying model would flare out because of the changed pitching moment, and so it would reach a higher angle of attack, get more lift and would climb.

It is easy to test this explanation by giving the opposite control command: let the model fly horizontally close to the ground and give down elevator. Then the model will **jump up** some decimeters, i.e. it does **not** fly downward immediately, as one expects. Afterwards the model inclines around the pitch axis and then "shoots" down (careful - danger of crash!).

Pilots who are not familiar with this phenomenon sometimes speak of a "control inversion." They forget that the "normal effectiveness" of the elevator is **not** to produce a rising or sinking of the aircraft, but to turn the machine around the pitch axis.

Exactly the described flight behavior arose

Table 1 Windtunnel wingtip comparison at =2° & 10°

WINGTIP V in mph	C_L =2° V=128	C_L =10° V=76	C_D =2° V=128	C_D =10° V=76	L/D =2° V=128	L/D =10° V=76	Geo Aspect Ratio	REMARKS
Plain Wing GAW-1 airfoil	.428	.950	.031	.089	13.70	10.01	1.18	Inboard vortex (of tip)
Plain Wing Extension	.433	1.012	.027	.084	15.09	12.0	1.41	Inboard vortex (of tip)
Finch Tip	.468	1.036	.027	.083	17.24	12.54	1.47	High Eff. Aspect ratio. Weak vortex outboard of tip.
Hoerner Tip	.439	.956	.027	.082	16.06	11.70	1.35	Vortex at tip
Flared Tip as seen on several light A/C	.496	1.095	.030	.102	16.37	10.78	1.41	Used on Beech A24R
Inverted Hoerner	.459	1.011	.027	.095	16.78	11.30	1.35	Inboard vortex (of tip)
Streamlined tip	.410	.890	.029	.086	14.07	10.33	1.40	Inboard vortex (of tip)
45° Cut on underside	.455	1.023	.028	.088	16.0	11.66	1.44	Inboard vortex (of tip)
Whitcomb Winglet	.547	1.115	.022	.095	24.81	11.76	1.528	Large sideforce, vortex outboard.
Rhomboid end plate	.563	1.142	.032	.096	17.39	11.92	1.18	Large sideforce, vortex outboard.
Reversed Rhomboid	.507	1.148	.032	.084	15.70	13.70	1.18	Large sideforce, vortex outboard.
Triangular end plates	.550	1.170	.032	.095	17.11	12.33	1.18	Large sideforce, vortex outboard.
Reversed Triangular	.518	1.123	.034	.087	15.27	12.95	1.18	Large sideforce, vortex outboard.
Square end plate	.609	1.287	.038	.091	15.90	14.07	1.18	Vortex outboard (of tip)
Circular endplate	.596	1.266	.034	.089	17.31	14.20	1.18	Vortex outboard (of tip)
Airfoil outline endplate	.493	1.075	.032	.091	15.30	11.78	1.18	Low sideforce, vortex inboard (of tip)

Table 2 Flight Test Results Finchtip on Beech A24R Sierra.

	Power	Fuel Flow	Flight tests report Flared Tip mph Beech Tip		mph FINCH TIP		
RPM	H G in	GPM	IAS	TAS	IAS	TAS	REMARKS
2200	21.8	7.5	120	133	132	142	5,500' 14°c
2400	19.2	7.5	112	122	124	135	5,500' 14°c
2500	23.0	8	132	143	137	150	5,500' 14°c
2200	24.5	8	126	135	130	139	3,500' 18°c
2300	24	9	130	139	134	143	3,500' 18°c
2400	24	9.5	135	144	139	148	3,500' 18°c
2500	24	10.5	137	146	140	149	3,500' 18°c

with the most famous tailless flying plank, namely the Fauvel AV 36. Many pilots told us (unfortunately we never could fly this machine) that this sailplane behaves completely "normal" high up. But any beginner is clearly instructed before the first flight that the landing is problematic. Under no circumstances are abrupt elevator movements to be made, otherwise the aircraft will display a tendency to skip on the skid. At take-off things are not as dramatic, because the plane is normally very quickly high above the ground, where the difficulties disappear.

The Horten brother observed the same phenomenon with their first design, the Horten H I. The H I was a Delta glider with relatively high aspect ratio (around 7) and an elevator in the wing center. Even though it was not a flying plank its flight characteristics were very similar. Since the Horten brothers at that time (understandably enough) did not know of this flight behavior they spoke of "control inversion" ("Wirkungs-umkehr" in German).

THE PREJUDICE

Many "experts" claim that this pancaking is typical for all tailless aircraft. One can hear these "well-known facts" in particular from those people who never piloted a flying wing or tailless model. In the year of 1943 or 1944, I (Karl Nickel) heard for the first time this "expert knowledge." Because I hadn't noticed this alleged "fact" before, I made some flight tests and asked my friends to duplicate them. For my tests I used both the tailless sailplane Horten H III f, and the motorglider H III d.

With the motorglider I could fly steady at very low altitude with the engine throttled back over the airfield of Gottingen. By pulling up hard the aircraft always climbed immediately. No pancaking ever occurred whereby the rear wheel would have touched the ground.

Now I have to admit that it is difficult to estimate of the flying altitude is perhaps 10 or 30 cm. This is true in particular if one cannot see the rear wheel. It could have been that the plane really did pancake slightly (say 10 or 15 cm) but that I could not find this out by "flying too high" (say 20 cm above ground). Because of this uncertainty, I examined the behavior further with the H III f. With the prone position and the large "windows" at the bottom of the center section, I could observe exactly what happened so close to my face. It is true that I could not see the rear skid, but I could observe quite clearly the (retractable) front skid and its distance from the turf. It was no problem to fly with excess velocity very close to the ground so that the front skid remained just a hand's breadth above the ground. The rear skid cannot have been much higher. After pulling up quite hard I could then always observe quite clearly that the front skid moved swiftly away from the grass. In no case did the rear skid touch the ground in these experiments. My friends also reported the same behavior.

It is not difficult to understand this flight characteristic and to understand the error of the "experts." Let's first examine a **canard** aircraft. If the pilot wants to climb, the lift of the front wing is increased. This increases on the one hand the overall lift which raises the aircraft. On the other hand it produces a pitching moment, whereby the aircraft is turned around the lateral axis. This generates a greater angle of attack and again a higher lift. The plane then climbs for both these reasons.

With tailed aircraft and with sweptback flying wings the matter is a little more complicated:

> **On the one hand** the elevator deflection produces a down-lift at the elevator surfaces. This **diminishes** the overall lift of the aircraft
>
> **On the other hand** the down-lift far back behind the CG on a large level arm generates a nose-up pitching moment. Hence, the aircraft is turned around the lateral axis which produces a greater angle of attack. By this the overall lift of the aircraft is **increased**.

The two changes in lift counteract each other. Which one is predominant depends upon the balance of the different forces and turning moments, in particular upon the moment of inertia around the pitch axis and the pitching moment.

It is true that for tailless sweptback aircraft the pitching moment produced by the elevator deflection is **smaller** than that for corresponding tailed aircraft, but their moment of inertia around the pitch axis is **also smaller** (and normally quite considerably). Hence the turning around the lateral axis is at least as fast for the flying wing as for the tailed aircraft. Whether there results pancaking due to lift loss or climbing because of the lift gain depends only upon the balance of the said forces and moments. It can easily be computed for any tailed aircraft. According to our own observations and computations it looks as if there is no existing tailless **sweptback** aircraft which pancakes. The flying planks (and the "Delta" with inside elevator) really seem to constitute an "isolated" and "singular" case.

POSSIBLE ADDITION TO TWITT LIBRARY

Karl Sanders has done it again. He has sent us an abstract of an SAE paper he will attempt to obtain through his contacts at Northrop. Karl has been a constant source of material for the library, and for that we are most grateful. In his letter he noted that Torenbeek also wrote the excellent "bible" "Synthesis of Subsonic Aircraft Design."

AIAA Accession No. A91-52947 Aerodynamic performance of wing-body configurations and the flying wing. E. Torenbeek (Delft University of Technology, Netherlands). Society of Automotive Engineers (Dept. 2719, 400 Commonwealth Dr., Warrendale, PA 15095-0001) General, Corporate and Regional Aviation Meeting and Exposition, Wichita, KS, Apr 9-11, 1991, SAE Paper 911019, 8p., 7 refs.

The elementary analysis has been made of generic wing-body configurations with variable volume allotment in wing and body, for constant total useful volume, including the all-wing configuration. These aircraft were compared on the basis of the L/D ratio, for specified flight conditions. In addition the parameter ML/D for constant corrected thrust has been optimized, resulting in certain combinations of altitude and speed for maximum specific range (if corrected TSFC=constant). Finally, the effect of volume allotment on L/D for given engine size was studied. It has been found that in many cases optimum volume allotments indicate that wing-body combinations are to be favored. Only in the case of relatively low Mach numbers and high-altitude flight the flying wing out-performs conventional aircraft, but it will generally require larger engines.

AVAILABLE PLANS & REFERENCE MATERIAL

Tailless Aircraft Bibliography

by Serge Krauss

3rd Edition: An extensive collection of books, articles and other items related to the development of flying wing (tailless) aircraft design and construction.

Cost: $20
Order from: Serge Krauss
3114 Edgehill Road
Cleveland Hts., OH 44118

Tailless Tale, by Dr. Ing. Ferdinando Gale'

Consists of 268 pages filled with line drawings, tables and a corresponding English text. It is directed towards modelers, but contains information suitable for amateur full size builders.

Published by B^2 Streamlines, P.O. Box 976, Olalla, WA 98359-0976, or (206) 857-7249 after 4pm Pacific Time. Price is $38, postage and handling included (also applies to Canada and Mexico). Orders shipped elsewhere will be sent surface mail unless an additional $10 is included to cover air mail postage. Washington residents must add 7.5% sales tax.

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(614) 389-6055

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P.O. Box 9078
Champaign, IL 61826-9078
1-800-637-4989 or (217) 398-3636
Shipping: $5.75

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A newsletter dedicated to providing a united voice in further developing the rigid-wing industry, a certification program, and satisfying the self-regulation imperative.

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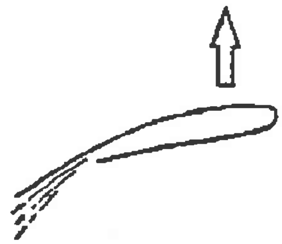
Mercer Island, WA 98040

FOR SALE - Consolidated booklet of the 3-views and specifications for all the SHA Design Contest aircraft. This is a nicely done newsletter style publication that gives you all the information in one place. Bob will also be including one issue of the TWITT Newsletter. (If you are a TWITT member, you might want to specify which issue of the newsletter you would like to avoid duplications.)

Cost: $4.00 US, Postage Prepaid

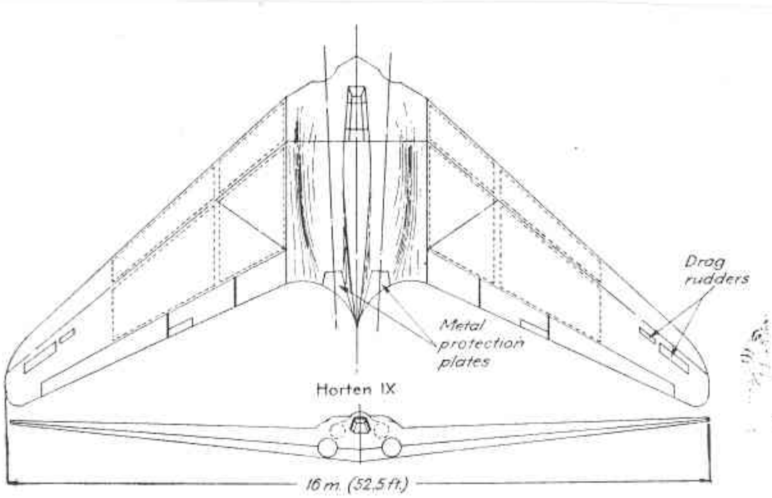
Contact: Bob Fronius
P.O. Box 20430
El Cajon, CA 92021

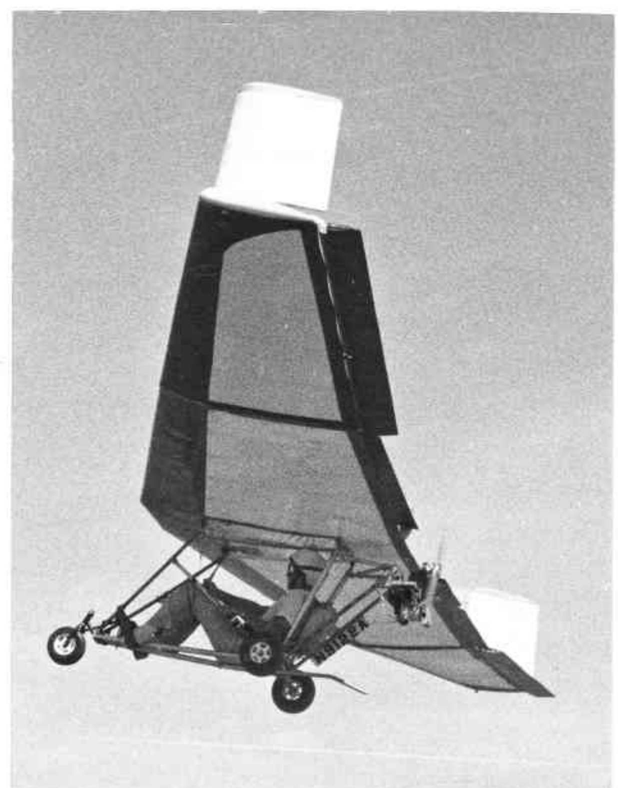


THE HIAM AIRPLANE
NEEDS YOUR HELP

For those interested in assisting Budd Love with the future development of his High Internal Air Mass (HIAM) project, he would be glad to hear from you. This concept has changed in recent months to include both a conventional aircraft and design of a Horten type flying wing utilizing HIAM technology. (See Dec '92 newsletter, page 4.)

Contact: AIRLOVE, LTD.
6423 Campina Place
La Jolla CA 92037
(619) 459-1489





ABOVE: Three-view of the Horten IX illustrated in AVIATION, August, 1946, p. 68.

LEFT: A Mitchell B-10 flying wing in flight. Note the ailerons are aft and below the trailing edge of the wing.