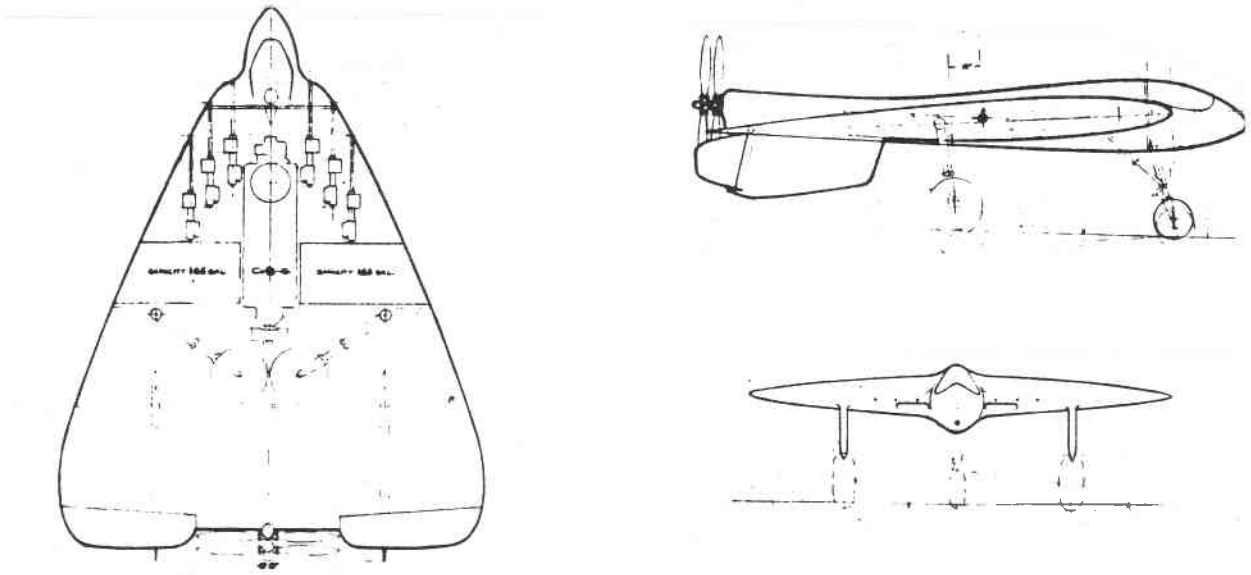
No. 100 OCTOBER 1994

T.W.I.T.T. NEWSLETTER

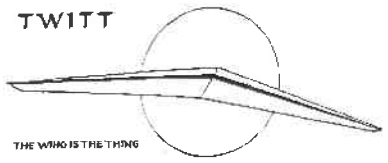


ABOVE: An American delta-planform design by Michael Gluhareff, a Russian exile living in America. This was a wind tunnel demonstration model build by the Ludington-Griswold Company, Saybrook, Connecticut, in the late 1940's. Source: Lippisch P13a & Experimental DM-1, by Hans-Peter Dabrowski, Schiffer Military History, Atglen, PA, 1993, p. 45. (Book donated to TWITT Library by Chris Tuffli.)

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., **9410** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, November 19, 1994, beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, CA (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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Meetings are held on the third Saturday of every other month (beginning with January), 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, this month we have a few pictures of what you missed by not making to the SHA Western Workshop for at least one day this year. The pictures will be scattered throughout the newsletter to help breakup the mass of text material from the September meeting.

There was a Mitchell Wing along with the Mitchell Stealth both of which were flown during the weekend from aero-tows behind an ultralight tug called the Dragonfly. There were a number of SWIFTs, one of which was powered by a 3-cylinder, 2-stroke engine and seemed to perform relatively well once the problems with wiring and propeller damage were overcome.

The hangglider community was out in force with their variations of flying wings and delta gliders. The conditions improved to a point on Sunday that most of them were able to sustain for an hour or more. In one instance it looked like the hangglider was actually out performing the higher priced variety in one thermal over the mountains.

One of the presentations was on the Marske Monarch, with the partially completed airframe on display for everyone to take a look at.

Harald Buettner taped most of the technical sessions *(ed. - when someone wasn't standing in this line of view or cutting off his power source)* and had promised to eventually (time permitting) to get a copy to us. When I find the time, I will try to put the 1993 and 1994 tapes together into some type of logical presentation that will be of value to the membership. Neither Harald or myself make any promises as to when this material will be available for distribution.

Bob Higgins asked about a listing of items in the library (see letters section), which another thing on our wish list. However, we do expect to have an index listing of what has been published in the newsletters over the years before we have a library bibliography. This project is currently underway, but we do not have an expected completion date yet.

I hope all of you have made your plans for winter building projects and will include us in helping in whatever way possible.

Andy.

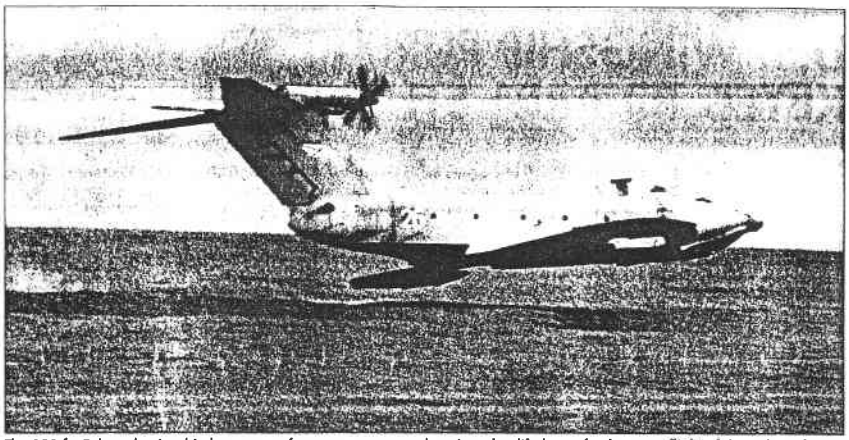
MINUTES OF THE SEPTEMBER 17, 1994 MEETING

Andy opened the meeting by welcoming all our members and guests, and taking care of the usual housekeeping items.

He then announced that he had forgotten to put some very important information in the last newsletter (something about computer problems). Mark and Liz Motley were blessed with our newest TWITT member, Mark Justin, on August 27, joining us at 6½ lbs and 19". Congratulations to the new parents.

We had received a letter from Barney Vincelette of Houston, DE, asking if the library had a copy of Jack Northrop And The Flying Wing: The Real Story Behind The Stealth Bomber, by Theodore Coleman and Robert Wenkam. Since the library doesn't have a copy, Andy asked the group if anyone had one or might know where it could be obtained. Someone mentioned it might be found at Aviation Book Company or Zenith Books. *(ed. - I'm not sure how to contact either of these, but a good aviation magazine or public library may be of assistance.)*

Andy showed a short video of a Russian wing-in-ground-effect (WIG) aircraft that is just now being shown to the western world. Also know as the Ekranoplane, it has some outstanding capabilities that the Russians are trying to develop into a commercial enterprise. According to an article in Aviation Week & Space Technology, August 1994, pp. 55-56, one version, The Lun, is slightly smaller than a Boeing 747, has a maximum takeoff weight of 400 metric tons and can cruise at a speed of about 450 kph. *(ed. - I will see how well the accompanying photo will reproduce to at least give you an idea of what we saw. Thanks to Chris Tuffli for the article.)*



The 190-ft. Orlyonok wingship has two performance-augmented engines that lift the craft. The 1992 flight of the Orlyonok over the Caspian Sea is the only one known to have resulted in a fatality.

Andy passed along that Bill Speer, a long-time resident of skid-row, was killed in his P-51 during practice for the Reno Air Races. Chris Tuffli had a copy of a memoriam by John Dormer, which was distributed for everyone to read.

After the video, Andy introduced **Barnaby Wainfan**, who would tell us all about his FMX-4 experimental lifting-body sport airplane. *(ed. - the following is a transcription of what Barnaby covered during the meeting. Some of the material was technical or he made general comments about experiences or mathmatical formulas which made it difficult to get it all in. For those of you who are interested in this design and Barnaby's theories about why it works, a set of two audio tapes will be available for $4.00 postage paid ($5.00 US for foreign mailings.)*

Barnaby told us the airplane was, hopefully, somewhere between Pecos and El Paso, TX. Its return from Oshkosh had been delayed by weather (its VFR only) and some problems with the propeller. He mentioned that the plane would be on the cover of Sport Aviation in October, and it has been presented in Kit Planes, so there are, or will be, several places to obtain more information if you desire.

The FMX-4 is a lifting body with no curved surfaces anywhere in the airframe. He wanted to make it clear it was not a stealth, the radar cross-section was not a consideration in the design, and it was designed before the F-117 configuration went public.

The real motivation behind the design was to see what could be done with a low aspect ratio configuration and exploit some of the advantages of other airplanes, like the Dike Delta, etc.

He wanted to get the numbers out of the way early, so here they are:

Length	19'6"
Span	15'
Empty Wt.	370 lbs
Gross Wt. Norm.	620 lbs
Gross Wt. Max	680 lbs
Flown at 720 lbs	
Fuel Cap. Norm.	10 gal
Fuel Cap. w/Aux.	19 gal
Structure	6061-T6 Alum tube
Covering	1.6 oz Stits Fab.
Engine	Rotax 503 DC
Max Speed	106 mph
Cruise Speed	90 mph
Stall	None-stable mush
ROC (620#)	750 ft/min
Range (10 gal)	150 miles
Range (19 gal)	300 miles

The numbers change somewhat with the angle of attack, mostly due to the location of the static ports, but the plane has been flown against a calibrated airspeed so Barnaby figures he knows what he is getting. More tests are planned once it gets back to California.

The low speed spectrum is the most

interesting aspect of the flight envelope. As you slow down you find yourself at an absurd angle of attack, looking at the horizon through the windows in the floor. Hard aft stick produces an high-frequency buffet that is very noisy, the nose drops to about 10° above the horizon and then just sits there. The same occurs in a turn except the sink rate increases significantly.

Stall characteristics was one of the objectives of the design, since most Sunday flyer accidents involve stalls during takeoff or landing. The FMX-4's buffet and mushy, but controlled flight, achieves that objective while providing an aircraft with a safety zone around the pilot. Since he sits in the middle of the aircraft, there is a 5' crush zone on all sides, plus the tubing surrounding the pilot.

One of the most asked questions is "What is the lift to drag ratio." Barnaby indicated this was a hard one to answer because he hasn't been able to get an accurate measurement of the thrust being produced by the Rotax and propeller combination. Based on what they know at this point, he thinks it is about 7. The important point here is that it goes 106 mph on 43 hp.

The primary structure of the aircraft weighs 68 lbs. and it is all aluminum, expect for the engine cowling which is fiberglass. It is a short, stiff structure (a space frame) with the heaviest tubing being .035 walled, 1" tube. It works well for the stresses of the fabric and everything else, but then becomes somewhat of a problem where the landing gear enters the fuselage for attachment. This area has been greatly beefed up with intercostal plates to pick up the pilot, gear and engine loads.

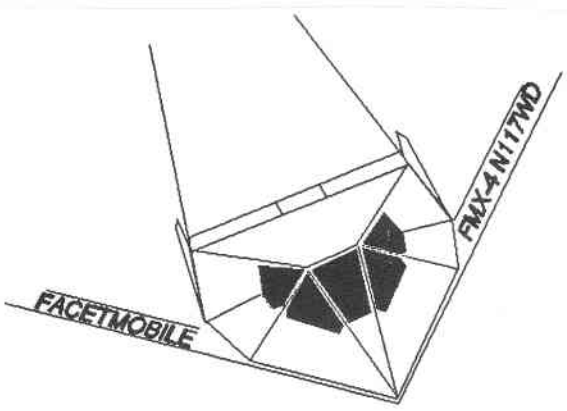
He commented that due to these types of loads he would probably use steel tube for this area (if he were to do it again) since it would be easier to weld in the desired supports.

"Why is the airplane faceted." The answer is simple, it is easier to build straight sticks than curved sticks. This is the only reason. The key here is to keep the junction angles somewhere around 30-35° so there will be little to no boundary layer separation. He showed us a chart that demonstrated a relationship between the sweep angle of a break line between surfaces and the actual break angle across the surface for separation. The more you sweep it, the steeper you can break it along the break line.

The reason for the FMX-4 designation is that FMX-3, a developmental, radio-controlled model turned out to be a disaster. It was supposed to be the definitive answer based on what had been learned from the earlier models. However, he found they had gone beyond the angle limitations and the aircraft would barely fly. Further flow testing showed where the problems were, and the results obviously fly very well.

The aircraft resulted from a lot of thinking about what kind of flying the average pilot does in his 25-50 hours per year. The primary point was to provide an aircraft that would not come up and bite this type of pilot, and yet provide an easy to build, inexpensive airframe for the homebuilder. Plus it is nice to have the weirdest airplane on the airport, and it has a lot of internal volume for all kinds of stuff.

The project started with a small, radio controlled model to explore some of the concepts found in an old free-flight model called The Thing. At first it was not intended to research the possibility of a manned aircraft until one of the other engineers asked the question. *(ed. - this next part will take a little imagination.)*



ABOVE: Project logo.

The test model was being flown with the flat side up similar to what we have traditionally seen in the NASA lifting bodies. Of course, this made it difficult to convert the faceted aircraft into a man carrier since the landing gear would have to very long and it would be hard to see out of at high angles of attack. Then someone thought about turning it over so the flat side was down which provided the natural lines of the aircraft for a cockpit and shortened the landing gear. The model also flew better with the flat side down, so the project was continued.

The next generation model was then built replacing the centerline break line with a flattened area to act as a windshield. The results got them enthusiastic about continuing with development of a manned aircraft.

The size of the aircraft was driven by the height of the pilot and the need to keep the break angle down to about 32° for flow control. This gave them a 42" depth at the canopy break and a root chord of 18' (19.5' with elevons). An interim model found that shortening the chord caused the canopy break angle to reach 37° which gave it the bad flying qualities. Fortunately, they tried it in model form before starting actual construction of the full size aircraft *(ed. - something we have been saying for years as a means of saving time and money on a project)*.

The results of quarter-scale model tests confirmed the design concept and construction began on the real thing in October of 1989. It took about 2½ years of work until rollout at the Chino Airport for flight tests. There

was about a 10 week delay trying to get the Rotax to run reliably. Unfortunately, the engine had a defective ignition system it took time to detect and correct.

Dave Morss began the taxiing tests and they found there were some landing gear problems. The first gear was too soft, and after a series of other gear legs they finally found a combination that would retain its configuration during takeoffs and landings.

ABOVE: Hanger flying prior to the meeting. Left to right: Maurice Brockington, Harald Buettner, Barnaby Wainfan (back to camera) Alex Kozloff, Ed Lockhart, and Dominique Veillard.

The first real flight was in April of 1993. Peter Lert made this flight which proved to be both elating and disappointing, all at the same time. First, it flew so the concept was proven and he got down in one piece. However, they found the climb rate was only about 300 fpm and the top speed was only about 65 mph in level flight, and it had some weird control forces.

They began to research why this was happening by backing into the performance envelope by calculating what they thought the thrust should be based on Rotax's estimate of horsepower. The drag factor was then subtracted and they found they had a L/D of 3:1 which was impossible based on the earlier model tests. At this point Baranby got Gene Larabie to help in determining the propeller's performance and they found the engine was only producing only about 32 hp versus the advertised 55 hp. This was finally corrected by Rotax, and the aircraft's climb and cruise performance began to come up to expectations.

The control force problem was that the stick force gradient with airspeed was reversed. The faster they went the more pull force it took to trim the airplane. This occurred at about 75 mph, where more pull force had to be added since the trim had reached its limits. Barnaby clarified that the trim mechanism for the FMX-4 is a separate surface located on the trailing edge between the two elevons, rather than tabs on the elevons.

Their research found that neither the aircraft or the control surfaces were unstable, but they did think maybe there was an aeroelastic problem with the fabric. They did add a couple of ribs to solve this problem, but it turned out not to be the key. Barnaby started flying the airplane and now knew first-hand what the plane was doing.

The only thing left to look at was the elevon hinge moments. The aircraft has large elevons that are very powerful, have no aerodynamic balance, and the airplane has a very low aspect ratio. It was this combination causing the problem. The first part of the puzzle was that the lift curve is very low which means to change the lift coefficient a given amount takes a big change in the angle of attack. The second part is that the elevons are out of balance which means they float free with the airstream, i.e., if you let go of the stick the elevons will streamline with the airflow.

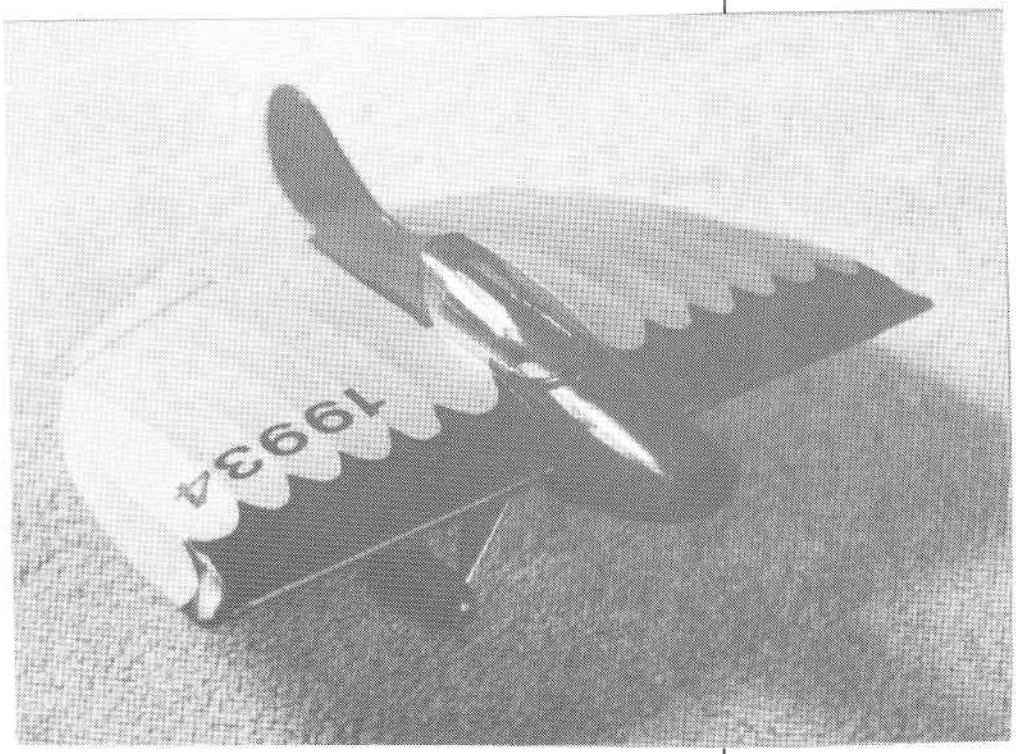
These elevons are so powerful that it only takes 1° of deflection to create a 1½° change in trimmed angle of attack. It was this ½° difference that was causing the high stick forces which the trim surface was not capable of overcoming.

The solution was two fold. First, fixed taps were added to the elevons to make them want to float up more. This would trim the aircraft to the bottom end of the speed scale so you would be pushing against the force of the tabs to make the aircraft go faster. This almost fixed the entire problem, but they went one step further and put a down spring into the system, which is a classical solution for a reverse force problem. It now will trim up for hands off flight.

Barnaby then went on to talk about the flying qualities of the aircraft. It flys very conventionally, with the exception of the high angle of attack and the higher than normal stick forces. This later element appears to be a good thing in that it prevents some rapid movement of the powerful surfaces which could cause inadvertent pilot induced oscillations.

The pitch forces are very nice, but they found there was a noticeable trim change going in and out of ground effect. They found that you have to trim the airplane for neutral control forces at the liftoff angle of attack, and then when the power is applied the nosewheel can almost immediately be pulled off the runway and the takeoff pitch angle attained. This is good since the three point

attitude is at a negative angle and produces very high drag. The elevons get sufficient airflow from the propeller for this pitch up, and Barnaby said you could feel the airplane accelerate once the noseup attitude was reached.



ABOVE: Larry Watson's model of a modernized version of the Flying Pancake.

During the takeoff run there is a little push required to maintain attitude until reaching takeoff speed. The pressure is then released and it rotates to seek its own angle of attack. At about 15-20' it requires about 3-5 lbs of pull to maintain the same attitude, this being the point of leaving ground effect. The forces are then trimmed out and everything continues in a normal manner.

All of the trim and stick force changes make it an easy airplane to land since it basically flares itself. They did scrape the tail fins a few times until they found the right combination of attitudes and power settings to achieve the perfect touch downs.

The next goal was to get the aircraft to Oshkosh. Barnaby was resolved that he would not take it there any other way except by flying it in and out. It took 9 days and about 26 air hours at a block speed of about 88 mph. The Rotax burned about 5 gallons an hour being a fuel cooled engine. The highest altitude it reached was 7500', and he was able to takeoff from West Texas with a density altitude of 4000' on a 90° day and still achieve a 400 fpm rate of climb. *(ed. - who says it has to look fast and sleek to perform well).*

Barnaby was asked if the high drag was typically induced drag from the low aspect ratio. He responded that he didn't have high drag even though he had a low L/D. He continued by asking the group how many Rotax 503 airplanes there were that could do over 100 mph (not many)? Since the others are of more conventional design, the FMX-4's drag can't be all that bad.

Responding further, he commented that although people quote maximum L/D for airplanes, that is not the point at which most flight is conducted. Low aspect planes achieve their max L/D at very low lift coefficients, therefore, the FMX-4 has a narrower range between its cruise speed and best L/D speed. He compared it to something like a Cessna 150 which might have an L/D of 10, but due to this speed range spread they are both cruising at an L/D of about 6. So from the pure raw drag per unit of weight standpoint, the FMX-4 is doing just about as well as the 150.

He feels the real number that should be looked at is the payload to drag ratio since there is no virtue in efficiently transporting dead weight from one place to another. This is one of the reasons why a low aspect ratio works. Fifty percent of his takeoff weight is useful load due to the smaller structural weight. The trade off is between the structural weight of the aircraft and its aerodynamic efficiency. If you go back into the formulas and take the power required to fly and recast it in terms of payload/gross weight, instead of weight, you find that the power to fly a pound of payload is inversely proportional to the product of the L/D times the payload/gross weight ratio. (If you add so much dead weight to the airplane, how much increase in L/D is needed to break even?)

Barnaby went on to say that in order to get high aspect ratio aircraft to the higher payload capabilities it would be necessary to increase the wing loading to unacceptably higher levels. Therefore long wings and high aspect ratios don't necessarily solve all the problems, as some of the high speed, glass fiber "rocket" homebuilt owners might think.

The wing/body type aircraft also has a lot of wetted area that you can't make go away. There are a lot of intersections to cause drag and no matter how well you try to minimize their effect they are still there. When you get into the lower aspect ratios the wing sort of absorbs all these areas and the detractions of the intersections go away. You end up blending the structure to the point that the structural weight per unit of area goes way down.

Reynolds numbers now begin to work for you. If you look at the skin friction of a flat

plate, as the reynolds numbers increases the parasite (skin friction) drag goes down. When you get to a low aspect ratio wing the reynolds numbers go up because you have a large chord. The FMX-4 has a mean-chord of 14½' and cruises at 100 mph at a reynolds number of 14.5 million. This means he is getting about a third of his wetted area for free. This then becomes the basis for his rationale for building a low aspect ratio aircraft.

ABOVE: Mitchell Wing getting ready for an aerotow at Tehachapi. (Photo by Floyd Fronius)

When asked about lift coefficient and best L/D again, Barnaby indicated the best L/D should be at about 60 mph at a 40° angle of attack, with a coefficient of about 1 to 1.5. This obviously wouldn't be very good for landing and the angle of attack is not a comfortable one for most pilots. This would result in a minimum speed of about 25 mph, although the aircraft touches down at about 18° angle of attack and 50 mph.

The next question concerned the vortices created by the unusual shape. The sharp leading edge is specifically designed to control the behavior of the vortices. One of the purposes is to make the vortex break clean at the leading edge when they happen to prevent them from rolling inboard and reducing the effective span of the aircraft. This is in deference to rounded leading edges where the vortices can break at a number of different places based on angle of attack.

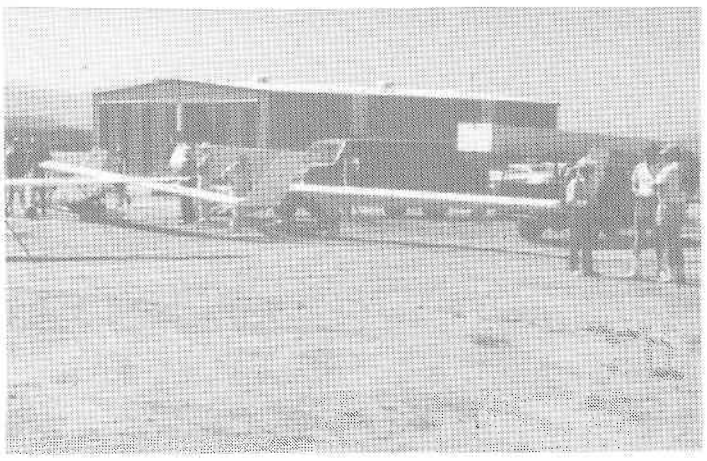
The other trick that Barnaby is playing with related back to delta wing designs and is now starting to reemerge. It is a vortex flap for delta wings, which means if you can get the vortex to roll up on a forward facing surface then the low pressure in the vortex core has a forward component. He says this is not a perpetual motion machine, since it cost you energy to wind the vortex up, but you will get most of the energy back and you get back to a net force value that is similar to the attached flow of a rounded leading edge. The FMX-4 takes advantage of this in its pyramid style shape.

He wanted to make it clear that this concept is not overwhelming superior to a conventional configuration, but it is doing as well, if not slightly better, and buying him things in other places. If he went back and did a Smoothmobile (rounding off the corners and smoothing out the lines somewhat) instead of a Facetmobile he would have something even better.

The next question concerned the location of the CG, which is at the first planform break (the peak right behind the cockpit canopy). That is the forward edge of an estimated 15" CG range based on the computations. However, one neat thing that occurred is the 14½' aerodynamic chord and that 10% of the chord is a long way. On his trip to Oshkosh he stuck 15 lbs of oil 6' behind the CG in the tail, and an auxiliary tank with 60 lbs of fuel 3' behind the CG and he couldn't tell the difference in the flying qualities of the aircraft.

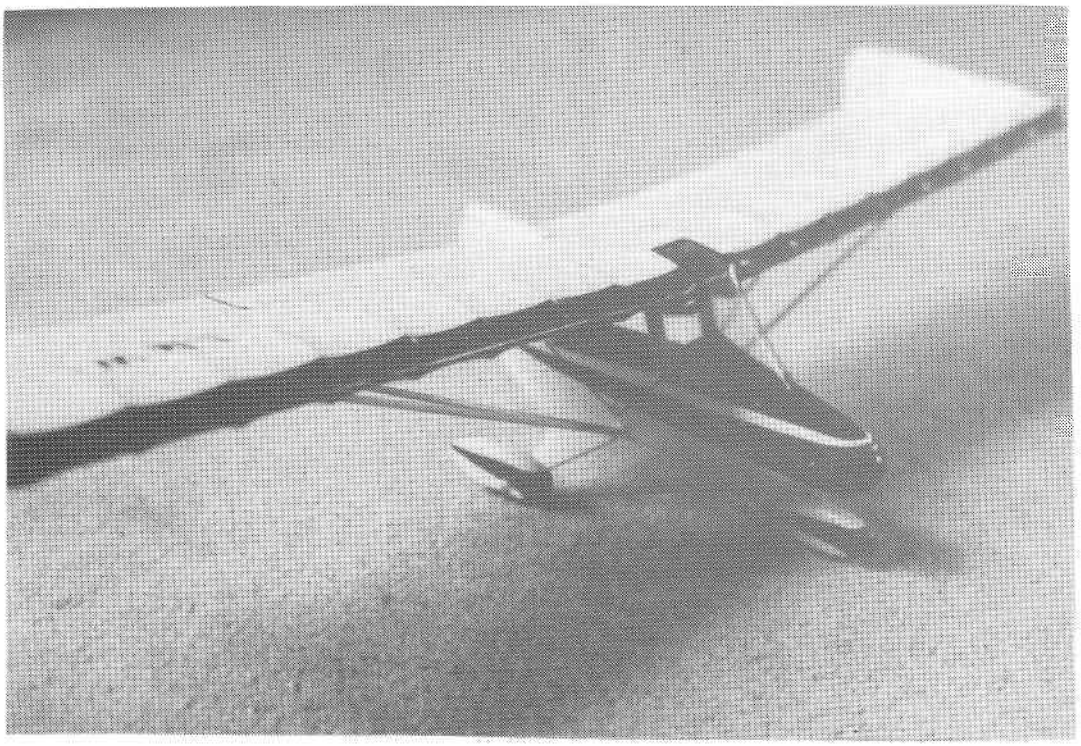
The aircraft is performing about as predicted by the computed and wind tunnel estimates. The aircraft has not been tuft tested due to problems with attaching the tufts to the surface since upper surface reaches so far from the edges. He did mention that the pressure patterns evident on the fabric covering has given them some indications about flow control.

They did do some flow tests on the models to determine if there was any separation. To do this, they would get the model started and ready for takeoff, place a 50% mixture of poster paint and water in a line perpendicular to the airflow to be checked and then launched the plane. The model would be put in the flight position they wanted to check and held there for about a minute or two and then landed. Photos would be taken of the resulting patterns on the skin's surface (its good to have contrasting colors) and then the paint cleaned off with water for the next flight. According to the pictures in Barnaby's album it looked to be very affective.



ABOVE: Two SWIFTs in the takeoff line at Tehachapi. (Photo by Floyd Fronius)

This fluid mixture could also be used for full size aircraft using a system of small tubing and a squeeze bulb full of paint. Once at the desired flight condition you could release the paint onto the area be evaluated, hold the attitude for a couple of minutes then land and photograph the area. The paint is still slightly moist so washes off easily and the aircraft is ready for the next test.



ABOVE: Larry Watson's static display model of his current design now under construction.

One area of the aircraft that needs more refinement is the high sweep angle yielding too much dihedral effect. This is a problem on final when you are trying to slip the plane with the heavy control pressures. Turbulence response is another area affected by the dihedral effect in that it produces a roll input that is controllable but very annoying. However, it is nice in cruise mode since you can trim the aircraft up and just fly it with your feet. He intends to solve some of this by changing the angles of the vertical surfaces and remove some of the ventral effect below the aircraft.

The configuration of the canopy and entrance area were briefly discussed. Barnaby said he wouldn't consider putting a bubble canopy in for a better view since it would have some affect on the airflow. Besides some slight modifications to the angles along the side windows will solve part of the sideways visibility problems. He definitely would not get rid of the floor windows since they are a primary navigation tool.

The cockpit entrance is through the bottom, just in front of the seat. This is somewhat awkward, but due to the shape *(ed. - that silly shape thing seems to be always getting in the way)* there is no place on the upper surface to put a door that would be useful. Also, the door would need some extra latching mechanisms since it is a pressure surface and could easily be sucked open. Since the aircraft is so light, if you stepped on the edge to climb into the centerline cockpit it would probably tip it on its side.

When asked what his future plans were, Barnaby said he really didn't know. There was some interest from EAA members seeing the airplane at Oshkosh, but he wasn't sure if it was just curiosity or a true desire to build something very unusual. He indicated if he were to build the next generation it would be at least a two seater (and probably a 3 seater due to pressure from his daughter for a family airplane) with an O-200 or 320 engine. This would yield performance equivalent to flying a Cessna 150 and getting an extra passenger free.

An interesting derivative would be a flying Winnebago due to the incredible volumes of interior space. It would cost a fortune to build but would be ideal for going to Oshkosh.

He figures he will get a lot of response from the EAA fraternity after next month's issue of Kit Planes which will include an article on the FMX-4.

One purpose of the airplane is to shake up everyones thinking and get things moving into new areas of development. It would also offer the typical Sunday flyer the opportunity to get into something unusual, but with the capabilities that they normally use for their average flying needs (short trips or just general local area flying).

If he ever decided to produce the aircraft as a kit, he had some ideas of how it could be done in such way to make it easy for the average kit builder. Basically it could be a bolt together unit with whatever welded parts done by the manufacturer. However, at the present time he does not have the resources to even think about perusing this option at this time, unless someone wanted to put up the necessary financing and there appeared to be a consumer demand for the product.

Barnaby went over some of the difficulties they encountered with the Rotax engine during the initial development, and what they went through with the propeller to achieve the desired results needed to make the aircraft perform properly.

Despite the lower horsepower being provided by the engine, Barnaby said he is pleased with

the performance of the aircraft and believes it is exceeding some of the original design parameters. If they could get an engine to produce the rated horsepower, he feels the plane would perform much better when coupled with the propeller suitable matched to the peak rpm limits.

After a little more question and answer period with Barnaby, Andy conducted the raffle which was won by Ed Lochart (a beautiful historical aviation stamp collection and associated book which is available from your local post office).

After the raffle Andy introduced **Paul Stahlhuth** to tell us about his models shown in last month's newsletter. Paul began by explaining his rationale for the basic shapes which was his interest in forward swept wings originating during his years in college. After learning to fly radio control models he regenerated his interest and produced the MANX.

The design is basically his own unique configuration. He put the vertical tails on mainly for directional control and ended up using them to frame the elevator. The center section is a lifting body which aided the flight capabilities as well as giving him a good place for the radio equipment. The CG came out at about the leading edge of the center section. It is a two channel system, elevator and rudder, with differential rudders to correct for any adverse yaw characteristics.

The first slope flight was a success and he didn't have to make any changes, other than fix the usual dings you get from landing on the back side of a slope site.

The second version had more vertical surface which he figured would make it more aerobatic. However, it became so aerobatic that it was almost unflyable in that it would go into a spiral dive every time he made much of a turn.

He then went on to the inverted V-tail version to experiment with the elevon concept of control so married it to his forward swept planform. His wings have no twist (washout) in the wings, but does have a little up trim in the elevator on the MANX. He uses an eyeballed Clark Y airfoil for the outer panels and a semi-symmetrical airfoil for the center section.

He hasn't had any problem with the MAX or LAMBDA stalling or spinning and has found them pleasant to fly. He has made drawings of the designs, and will make them available if someone is interested. He doesn't have any plans to make kits so any building would have to be from scratch, which seems to be becoming a lost art in the current modelling world.

Since there were no more questions on Paul's interesting aircraft, Andy adjourned the meeting and everyone went into the hanger flying mode.

LETTERS TO THE EDITOR

9/2/94

TWITT:

I thought I would send you some recent photos of some of my projects (flying wings). I've really been busy the last few months working on them.

The July issue had an article about a flying wing hangglider another fellow and I were supposed to be building. Well, the money didn't come, but I managed to build the fuselage up to the point you see in the picture.

So, instead of going on with another project, I modified the frame of another ultralight project. It's gone so fast I have the fuselage 90% complete and part of it painted. The whole thing only weighs about 25 lbs, wheels and all, with tricycle gear. Now I have two planes with no wings.

I'm going to stop work on the experimental version and go ahead and finish the ultralight first. I will send pictures and story line as soon as I can get everything together.

Also enclosed are pictures of some small static display model I built of my flying wing and also a modernized version of the ARUP Flying Pancake! Plans are available for a .40 size model from Flying Models, October 1989.

Larry Watson
Caryville, TN

(ed. - Thanks for the update on all of your projects. I will try to publish some of the pictures, but I am not sure how they will come out. At least it will give everyone an idea of what it is you are doing. We will look forward to your next story line.)

TWITT:

Do you now have, or do you plan in the future to make available, a listing of th contents of the TWITT library. I am sure that you have information that would be both interesting and usable for research of future projects.

I very much enjoy your newsletter and look forward to reading it each month! Please find the enclosed check for next year's dues.

Thanks you,
Robert Higgins

(ed. - The answer to your question is that we do plan to have the information available some time in the future. Unfortunately, we cannot say exactly when that will be. Compiling the information is going to be both time consuming

and labor intensive, both of which we are in short supply of in the local area at this time.

We are always looking for volunteers who could help with this. They would not necessarily need a computer, since the most difficult task is going to be getting everything in alphabetical and/or chronilogical order. Once the information is placed in some type of input format, the actual time to get it into the computer for final sorting and printing would not be too bad.

If there is anyone out there in the San Diego and Los Angeles areas that would be willing to take on a small portion of the library for initial organization and cataloging, please contact us and we will be more than happy to get you going.)

R/C Soaring Digest Update

Special Notice To All Third Class Subscribers In The USA.

Effective October 1, 1994

We will no longer offer 3rd class bulk mail delivery in the USA. All subscriptions and renewals will be by 1st class service only.

Why Change?

Because you asked for it, some directly, and most indirectly. We should have listened more carefully, sooner!

We have long been sensitive to the fact that each, or at least most of you, subscribe to RCSD because you want it. Many of you can't wait for it to arrive, and some of you even keep track of when it is delivered each month. When you go to a club meeting, the flying field, or your friend calls to talk about an article, you realize that your copy has not arrived and you ask us, "Why?"

Well, we are as frustrated as many of you. Trying to explain 3rd class delivery service vs 1st class service is becoming a daily frustration, for many of you as well as us. Frankly, we have difficulty understanding it, ourselves, sometimes because it can vary so significantly by state, area, and location. So this way, you get your copies within a few days after delivery to the post office, and the information will be current. We believe that this is a beneficial change for all of you, as well as for us.

YOU CAN HELP!

If you wish to help, you may convert your subscription any time. Just let us know. Because of the cost, some of you may elect to share a copy with a friend. We will certainly understand!

We hope to combine the phase out by late 1995, when the number of 3rd class subscriptions is no longer sufficient to meet postal requirements.

THANKS FOR YOUR SUPPORT!

The primary purpose of this significant change, that will affect so many of you, is because we need to improve delivery time. But, no, we still haven't figured out how to get it you "yesterday"! Sorry!!

Jerry & Judy Slates

AVAILABLE PLANS & REFERENCE MATERIAL

Tailless Aircraft Bibliography

by Serge Krauss

4th Edition: An extensive collection of about 2600 tailless and over 750 related-interest listings. Over 15 pages of tailless design dates, listing works of over 250 creators of tailless aircraft, and the location of thousands of works and technical drawings for the Ho 229 (IX), Me 163, & Me 262.

Cost: $23 (Domestic)
$32 (European destinations)
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Order from: Serge Krauss
3114 Edgehill Road
Cleveland Hts., OH 44118

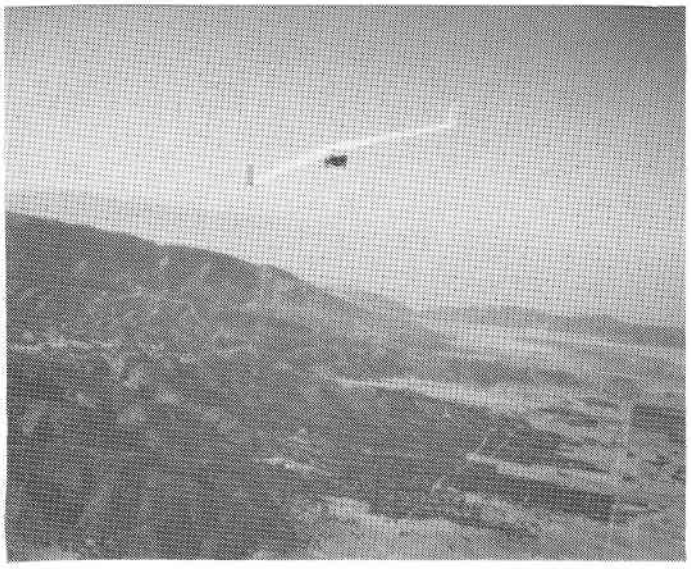
Tailless Tale, by Dr. Ing. Ferdinando Gale'

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. Price is $38, postage and handling included (also applies to Canada and Mexico).

You might also want to purchase his new book **Structural Dimensioning of Radioguided Aeromodels**, priced at $18.00.

On The Wing...the book, by Bill and Bunny Kuhlman (B^2) is a compilation of their monthly column that appears in RCSD. Many of the areas have been expanded and it includes coding for several computer programs to determine twist and stability. Priced at US$28.00.

All these are available from B^2 Streamlines, P.O. Box 976, Olalla, WA 98359-0976, or (206) 857-7249 after 4pm Pacific Time. 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.

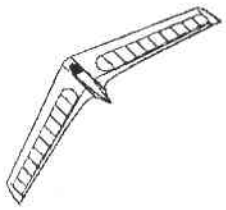


ABOVE: A SWIFT high above the Tehachapi Valley floor captured by Floyd Fronius flying the Tempest ultralight glider in the same thermal.

VHS VIDEOS AND AUDIO TAPES

VHS tape containing First Flights "Flying Wings," Discovery Channel's The Wing Will Fly, and ME-163, SWIFT flight footage, Paragliding, and other miscellaneous items (approximately 3½+ hours of material).
Priced at: $8.00 (postage paid)

An Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Metting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio tape of Alex's presentation explaining the material.
Priced at: $5.00 (postage paid)
$6.50 foreign (postage paid)



FLYING WING SALES

The A-10/T-10 Mitchell Wing motor gliders are well-proven designs, ready to fly, with an aluminum clad wing giving aerodynamic cleanliness. These are fully trailerable, with flight instruction provided in a T-10 by a C.F.I. Major components are available for the homebuilder.

Information pack for $10.
For more information contact:

Higher Planes Inc.
Box 4
Dover, KS 66420
(913) 256-6029

SAILPLANE HOMEBUILDERS ASSOCIATION

The purpose of SHA is to foster progress in sailplane design and construction which will produce the highest return in performance and safety for a given investment by the builder. They encourage innovation and builder cooperation as a means of achieving their goal.

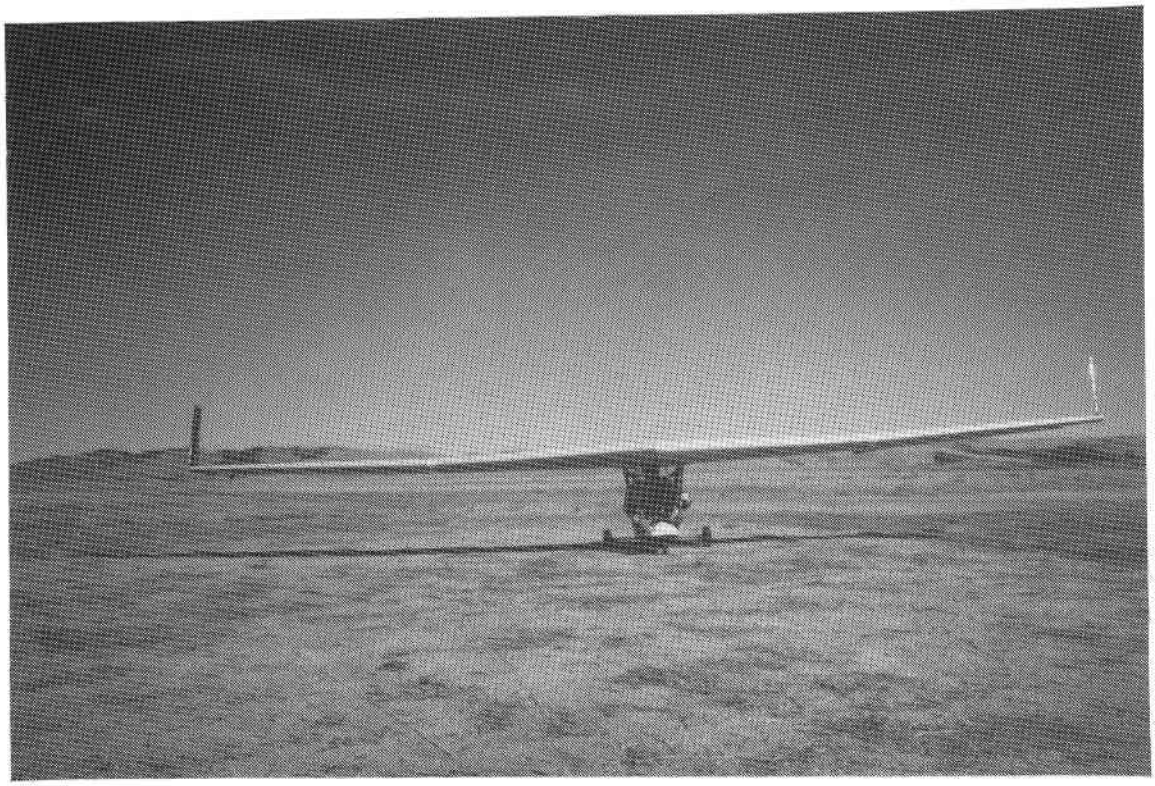
Membership Dues: (payable in U.S. currency)

United States	$21 /yr
Canada	$26 /yr
So/Cntrl Amer.	$36 /yr
Europe	$41 /yr
Pacific Rim	$46 /yr
U.S. Students	$15 /yr

(includes 12 issues of SAILPLANE BUILDER)

Make checks payable to: Sailplane Homebuilders Association, & mail to Secretary-Treasurer, 21100 Angel Street, Tehachapi, CA 93561.

BELOW: The Mitchell Stealth of Les King and Dan Armstrong in its flight test configuration, readying for an aerotow at Tehachapi. (Photo by Floyd Fronius)



BELOW: Closer look at a SWIFT glider on left and powered SWIFT on right being readied for takeoff at Tehachapi. (Photo by Floyd Fronius)