No. 202 APRIL 2003

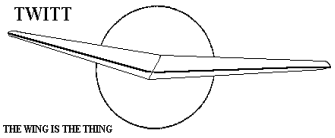
T.W.I.T.T. NEWSLETTER

While everyone was sitting in a stuffy hanger, I was taking pictures of some natural flight off the deck of the cruise ship somewhere off the California coast. These give you some idea of the complexity in wing shapes a seagull uses in soaring flight. It is no wonder Bob Hoey and his group have difficulty in trying to duplicate this in an R/C model. (Andy)

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

The number after your name indicates the ending year and month of your current subscription, i.e., **0304** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, May 17, 2003, beginning at 1:30 pm at hanger A-4, Gillespie Field, El Cajon, CA (first hanger row on Joe Crosson Drive - Southeast 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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Wt/#Issues	FRG	AUSTRALIA	AFRICA
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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 (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

Well, I sure picked a really good meeting to miss, but my wife and I had a lot of fun on the cruise and, we enjoyed visiting with the family (all 20 of them). I have looked at the video and Paul put on a very good presentation about flying wings and other assorted items relating to energy efficient vehicles.

I would like to thank Gavin for taking over and getting everything organized and the meeting started. He had his hands full with such a large group.

I would also like to thank Doug Fronius for diverting people from Torrey Pines, where the weather wasn't cooperating for flying, out to the meeting. I am sure that helped bolster overall attendance with people who were down in San Diego for the Vintage Regatta. I understand that Sunday was much better with sustaining conditions along the famous cliffs. It is a shame that not everyone in town on Saturday could witness such a sight.

We all need to thank a non-TWITT member, Ken Hoffmann of North Hollywood, who has contributed several boxes of aviation related material to our archives. Since we haven't had a chance to go through it all yet, I will tell what he said was in the boxes. "For many years I was in love with flying wings. At one time I had the opportunity to visit the Northrop Aviation Library and copied whole sections re: wings. I still have most of it and if you're interested I'll donate it to you. I also have a large box of EAA magazines and instructional manuals. Several cover such flying wings as Fauvel and Hoffman, in depth."

Bob Chase was kind enough to get together with Ken and arrange a time and place for picking up all this material. Bob then brought it down to the meeting and we are now going through it. We will keep you informed of our results.

Andy

MAY 17, 2003 PROGRAM

As usual, we don't have a program locked down for May yet, but we are still looking at a number of options.

If you know of someone you think would make a good presenter and, that person lives in the Southern California area where travel would be easy, please let us know. If you provide the name and contact number, we will see what can be worked out.

MARCH 15, 2003 MEETING RECAP

In Andy's absence Gavin called everyone together and introduced Dr. Paul MacCready who was going to cover the subject of flying wings from the small to the extra large. The hanger was full from front to back with at least 55 people who filled out the sign-in sheet that was passed around. This has to be a record for a TWITT meeting. Thomas Bircher was there from Switzerland and Norm Masters from Colorado, so we had some long distance attraction this month.

(ed. – Just in case you didn't read my column, I would like to thank Gavin for taking over and conducting the meeting, while also covering the video camera and audio tape so I would have something to work from for the newsletter.)

Paul opened by explaining the presentation would be about the various unusual aircraft he has been associated with over the years. They are not in any particular order, but would be focused on ones that were tailless, along with some birds and insects that demonstrate theories related to tailless flight. Over the years he has found that tailless aircraft work just as well, or better, than conventional aircraft especially when used in some specific applications.

He referenced some of the past talks at TWITT, including those by Bob Hoey on his bird model experiments, Bruce Carmichael's reviews of historical flying wing projects and, Al Bowers' coverage of the Horten designs. He went on to talk a little about the Horten lift distribution theories, but didn't elaborate since this had been covered extensively by prior speakers.

One of the recent things he says has made the smaller model aircraft much more capable is the improvements in battery life that is allowing much longer flight times. He gave the example of the Pointer reconnaissance drone (9-ft. span, 9-lb. hand launched) that now has up to a 4-hour duration versus its previous 1.5-hour capability on older type batteries. This is for an aircraft without an optimized airframe and Paul felt even greater duration could be achieved with an improved airframe. This is a very durable drone that is designed for forward battlefield deployment and can be landed similar to the de-thermalling devices used in some free-flight models.

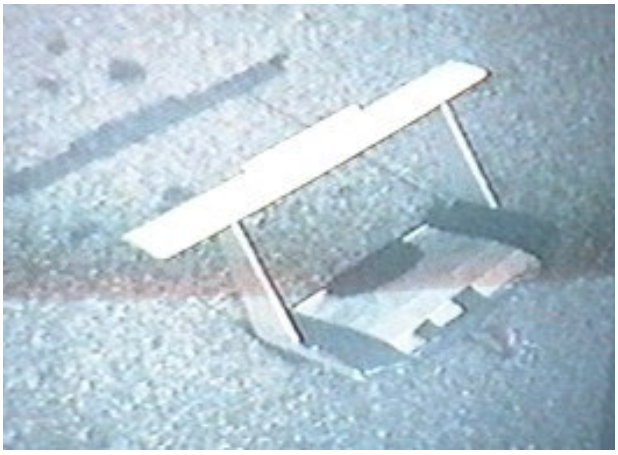
One of the videos Paul showed was "Doing More With Much Less" that shows some of the energy efficient cars, planes, bicycles, etc. that Aerovironment had developed over the years.

ABOVE: Dr. Paul MacCready addressing the group. To his right are some of the "toys" he brought along for demonstration of what works or doesn't work.

Environmental issues are one of Paul's major emphasis' and he related that he found Charles Lindbergh made many contributions in this area in his later years. To put this into perspective, he said that if we had been visited by aliens over a 5,000 year period, they would have seen vertebrates populating about 1/10 of the earth on their first visit. They would have seen very little change over the ensuing 5,000 years until about the last 1,000 years. Now they would see vertebrates (man, pets and livestock) populated 98% of the earth, with nature taking up the remaining 2%. So the question becomes one of how do we achieve the proper balance between man and nature so that both do not become extinct.

After the video, Paul covered some of the small models he and his son Tyler had been experimenting with to answer questions. As he noted, even if something doesn't work right, you always learn something that can be used for the next design. *(ed – The pictures scattered throughout the recap were taken from the video so the quality is not the best, but hopefully you can get the general idea of what they*

were "playing" with.) None of these flew well and what they found was a simple 6-inch square with a single motor worked the best. No elevator was necessary, but they did need several rudders for adequate control. To meet the customer's need they finally settled on a 12-inch span, 6-inch chord aircraft with an electric motor and video camera.



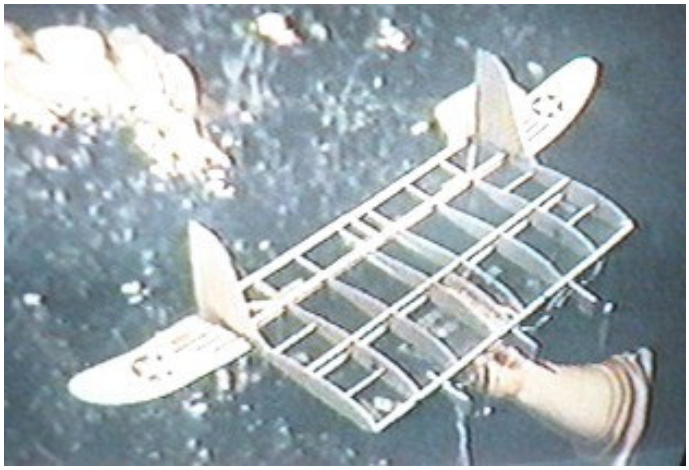
There were a couple of shots of Tyler's walk along glider that can be flown off your forehead once you get proficient with it. He then showed a slide of their flying telephone pole. Not only was the shape unique, but it also used internal electric motors to drive fans that sucked air in from an opening along the span and pushed it out the trailing edge for propulsion. It sort of looks like an oblique wing without any engines.

The next item he covered was Aerovironment's participation in the Smithsonian's Pterodactyl replica program that we have covered in past programs.

ABOVE: Here is a shot of part of the large crowd gathered to hear what Paul has to say about the latest trends in flying wings and, other things of interest.

Paul then went through a series of slides covering the evolution of flying vertebrates since the Pterodactyl up through what we observe as birds today. It sort of went back to his overall theme of how nature has adapted to the changes in the environment, as man became the dominant species.

The next slide showed Bob Hoey and a couple of his bird models, the Seagull and Raven. Bob and his team are continuing their studies as we have seen from his presentations at past meetings. He also had a slide of a turkey vulture in flight with its wing tip feathers spread out for a turn. He noted that the vultures could often been seen soaring over the tree tops in high winds for hours at a time without flapping, indicating their overall flight efficiency.



Paul then went through a series of short videos covering some of the topics he had covered in the slides. He also included the German animation of an albatross taking off and soaring over the ocean waves. This then transitions into a sailplane showing how dynamic soaring would be accomplished.

With the end of the video, Paul moved on to show some of the models he brought along. Some of them were just basic wings that only flew reasonably well. He also showed the group the commercial versions of the walk along glider, including an electric powered bi-plane version that is radio controlled. If you are interested in playing with them, you can probably find them at most large hobby shops or toy stores.

At this point Paul opened the program to questions from the floor. The first one was asked by Bruce Carmichael and it was directed at Paul's thoughts on lightweight, powered personal aircraft. Paul responded with a short discussion on the possibilities of building an aircraft with a 1 foot per minute or less sink rate that could utilize atmospheric turbulence to stay aloft at almost any time of the day. The LightHawk

shown at Tehachapi has gotten pretty close to this criteria. He also went through how you could use such an aircraft for dynamic soaring

One of the things he pointed out was the overall improvements in batteries that are allowing for longer durations than in the past. This could be applied to these light aircraft in place of fossil fuel engines, at least for self-launching. One thing he mentioned was the possibility of using the propeller to put energy back into the batteries during extended glides. So with a combination of thermals and batteries, the cross-country distance could be improved.

A question was asked about the glide ratio of Helios and whether or not it was structurally stressed for something like dynamic soaring or flight in the jet stream. Paul commented that the Helios only had about a 30:1 glide ratio so wasn't necessarily suited for high altitude, long distance record flights. But he did comment on the fact that attempts are being made to get sailplanes up to the 90:1 range through boundary layer control and other devices, that could make it to the jet stream and set distance records.

Someone asked about the airfoils on Pathfinder and Helios and whether or not they were applicable to personal aircraft. Paul commented that the airfoils were designed in theory and then wind tunnel tested to verify performance, but he didn't have the airfoil value. They are designed for a slight positive pitching moment to work in conjunction with the small elevon on the trailing edge.

After a little more discussion on the composition of the jet stream, Paul concluded his program. The crowd helped with picking up all the chairs (and we used just about everyone we had) and moving Doug's airplane back into the hanger out of the rain. The Rigid Midget, all wood sailplane, was also on a trailer outside and was returned to its hanger spot.

LETTERS TO THE EDITOR

March 20, 2003

TWITT:

Enclosed is my check for a one-year renewal of the TWITT membership and newsletter. It's a great newsletter and ranks right there with the Sailplane Builder. Taking nothing away from the great job Janice Armstrong and previous SHA editors have done, I know you will bring a fresh approach to that newsletter as well. Keep up the good work. You are well appreciated.

Regards,

Tom Kitchell
Ozark, AL

(ed. – Thanks for the renewal. I am glad you are enjoying the newsletter and hope you continue too in the future. Over the past several months we have had just about everyone coming due renew their memberships, which is gratifying. My first issue of Sailplane Builder has hit the streets and I feel like it came out rather well. It was missing the usual membership roster included in the first issue of the year, but it will be included with the second quarter issue. It was an interesting first experience and, I have enjoyed working with everyone from SHA that helped me put it together.

April 6, 2003

TWITT:

As a student of industrial design at University of Applied Sciences Schwaebisch Gmuend (www.hfg-gmuend.de) my final topic will be dealing with a concept of a flying wing.

My goal is to develop a concept of a foot launched and motorized glider. At the moment I am analyzing existing systems like the Swift, the Horten IV/VI, Horten Ho X c "Peirnifero 3", the mosquito and so on.

As an Industrial Designer one is developing new ideas and concepts, of future products, especially by analyzing human/machine connections and further market chances

Within the technical range however we need support. For this reason I am looking for persons and institutions which have experience in the building and in the construction of tailless aircrafts.

I hope you can help me. Any information would help. I remain,

Yours sincerely

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(ed. – This came in at the last minute via e-mail and I wanted to get it out to you in case there is anyone who would like to help these students. I don't know of anything we can do directly from the archives that would provide them the assistance they are looking for.)

March 19, 2003

TWITT:

With my new subscription I am sending some pictures of an aircraft that is on display at the Tulsa Air and Space Museum. I am a new volunteer so I know very little about this one. I do not know if it is considered a tailless airplane or not, but I enjoy it every time I see it.

It was built in 1981 at the Jenks Riverside Airport by Tom and Dan Diehl and Ernest Koppe. Take off is 27 mph on

land and 30 mph on water. It weighs 300 lbs. and is claimed to be the first ultralight that is amphibious.

This is the prototype with a motorcycle 650cc engine. The production version is said to be wider and powered by a Rotax engine. Its official name is XTC.

I look forward to the next issues.

Thank you,

Larry Routson
Tulsa, OK

(ed. – I am not an expert, but I would say it is a tailless canard, so I guess it is alright to include it in this newsletter. As I look at the photos [a couple included below], it seems like there is not enough depth in the fuselage to keep the pilot dry when in the water. Perhaps the chine keeps it away from him during takeoff. Also, I couldn't tell if the entire canard is movable as a elevator or whether it is just trimmed and the trailing edge section used at the elevator.

I hope you enjoy the coming issues.)

IRV CULVER ON THE KASPER WING (BKB)

(ed. – Last month we published Irv Culver's thoughts on flying wings in general. This month we will a series of letters initiated by A.T. "Lu" Lundgren after a short discussion with Irv at the 1984 Sailplane Homebuilders Association Western Workshop.

Please don't forget that although Irv and Lu continually refer to the original sailplane as the Kasper Wing, it was really the BKB-1, which was designed in Canada by Stefan Brochocki, with assistance by Fred Bodek and, Witold Kasper helping in the construction, and who eventually bought out the other two and moved the aircraft to the Seattle area while he worked at Boeing. The Bekas was Kasper's attempt to duplicate the BKB-1 with some "improvements" and the Ultralight was Kasper's plan sold to Cascade for production.)

October 16, 1984

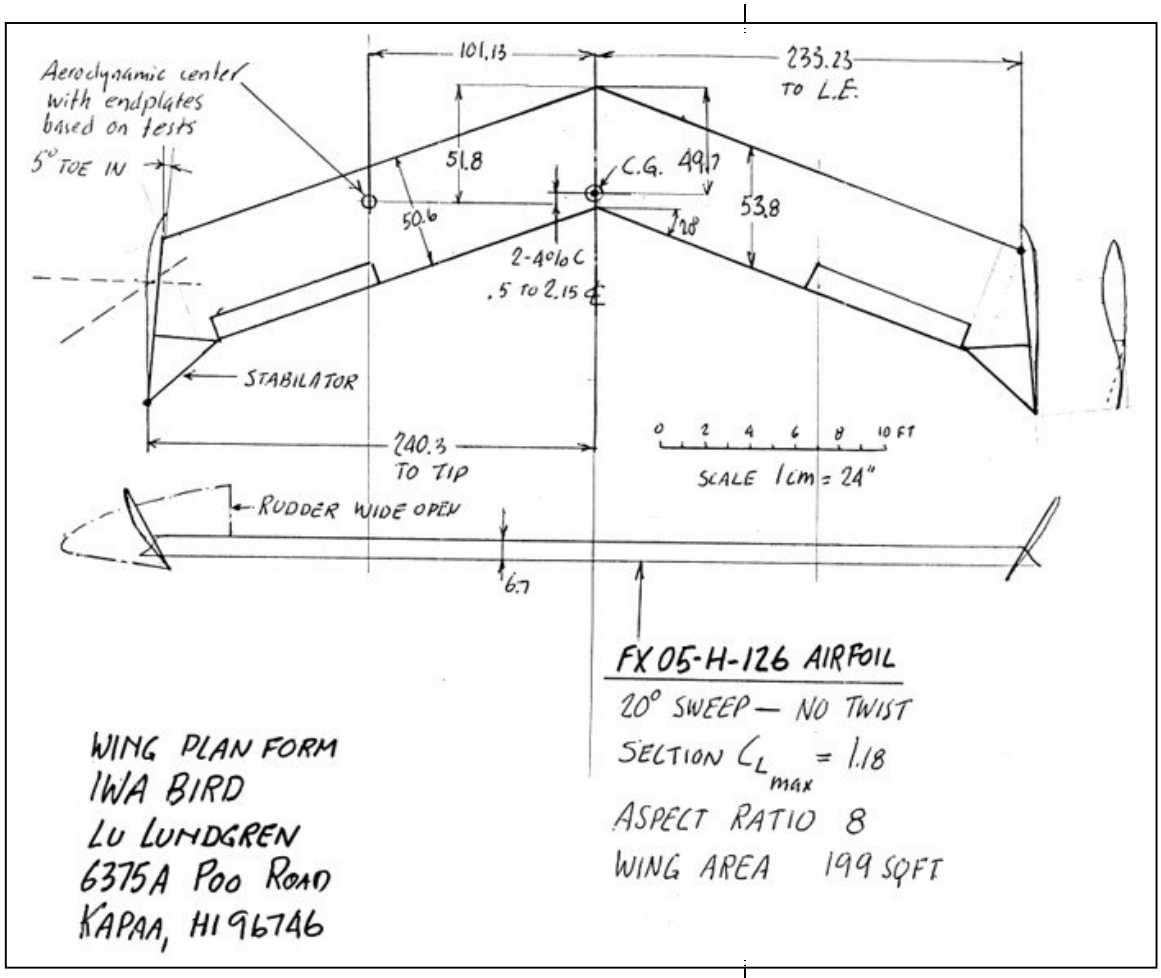
From: A.T. "Lu" Lundgren, Kappa, Kauai, Hawaii
To: Irv Culver

It was a great pleasure to be to meet you in person at Tehachapi. Herman Stiglmeir often refers to you as the Bible, but it seems to me that there could have been more intimate personal contacts between Lockheed Burbank and Lockheed-Vega, later Lockheed Plant A at the Burbank terminal. I don't suppose there was too much contact between the Burbank Skunkworks and Stan Hall's Sunnyvale Skunkworks either.

Here I sit on a rock in the Pacific Ocean and have only Herman der Feltwebel to argue with and, that gets monotonous. Therefore, I will take advantage of your offer to criticize my IWA Bird Wing design and, the Kasper theory in principle.

I hope to obtain another copy of the book "The Kasper Wing", which I helped Kasper to write and edit after 10-years of arguments, discussions, reviewing of 8 mm films of his glider tests, etc., culminating in the design and building of my own version of an Ultralight Kasper wing, which I hope we will fly in another month or so.

When I get the book I will send it; in the meantime I enclose my wing planform, assumed lift distributions and, two sheets covering the data on the Wortmann FX-05-126 airfoil that we are using. *(ed. – These are shown on the following pages.)*



I am looking forward to your serious comments, but only want to point out the following design features.

1. Rectangular planform – Reason: Pitch control affected by changing spanwise lift distribution. Lift necessary at elevon locations at tip. Wing tip stabilizers help to obtain elliptical lift distribution.

2. Tip elevons when moved up or down, change the lift distribution so as to cause a considerable shift of the CP inboard or outboard, and due to sweep back, forward or rearward.

3. Reflexed wing profile. No airbrakes, spoilers or flaps to cause an unpredictable change in lift distribution with resulting random pitch response.

4. Endplates and tip rudders with 5 degrees toe in and inclined 30 degrees insure high roll stability independent of the angle of attack. Dihedral which changes with angle of attack on a swept wing, is not needed.

5. Elevons used as ELEVATORS near the tips cause a variable washout from the start of the elevators to the tips. The washout increases at high angles of attack and decreases at low angles of attack. This eliminates the need of built-in geometric washout.

6. When pulling out at low angles of attack (high speed) the forces in the down direction created by the elevators at the wing tips are changing the almost elliptical lift distribution into a triangular one (see sketch), which greatly decreases the bending moment of the wing.

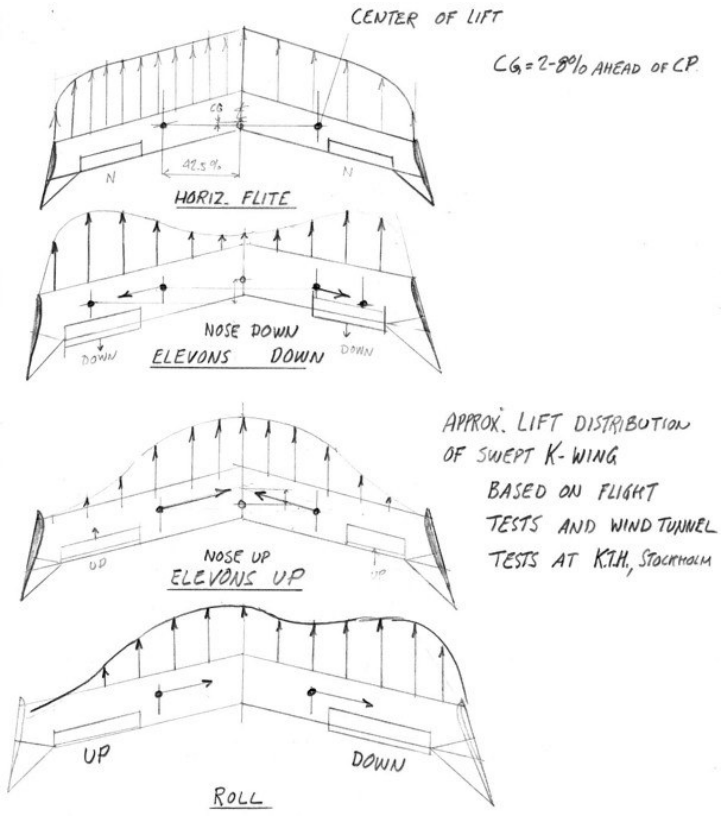
Irv, we only touched upon the subject twist versus no twist when you suggested that I send a drawing or sketch of my wing. Obviously we cannot cover the entire subject of tailless airplanes and flying wings in one brief meeting or on two pages of correspondence.

I just do not know to what extent you have studied the Kasper theories on tailless airplanes, or his papers on vortex flow, etc. I do not see how you could possibly have avoided reading some articles in EAA's Sport Aviation or other magazines.

Man is by nature conservative and, it takes time for new ideas to germinate and to become accepted, especially since commercial, financial and special interests enter the formula.

Stan Hall (and many others) have asked me, "If this Kasper theory is so good, why has not some entrepreneur company grabbed it?" That is a valid question and, I have some good answers having been in the business, as well as, the engineering and manufacturing end. That is beyond the subject of our discussion, however, but if you are interested I can give you the answer.

The facts and thinking behind all this, however, is based on the test results from two prototype sailplanes built in 1950 and 1963, performances at many air shows in Washington state, thousands of feet of 8 mm films, about 300 hang gliders and ultralights built by Cascade Ultralights in Issaquah, and one built from my design in Honolulu in 1980. The Cascade ultralights use the same airfoil, but are single surface.



I am looking forward to hear from you in due time and, if you have any further interest in the Kasper theory I will be glad to furnish more complete data.

I designed and built my first glider in 1929, retired in 1966 and moved here then. It is a hobby now and it keeps my brain exercised, although it gets me into the damndist arguments with Herman der Feldwebel.

I hope to hear from you.

November 9, 1984

From: A.T. "Lu" Lundgren
To: Irv Culver

I realize that you are a very busy man, albeit retired, but I should greatly appreciate a word with you in response to my October 16th letter to you.

As of today I have not been able to obtain another copy of Kasper's book, but if you are interested I am sure that I can obtain one.

I recently found a photographic history of practically all the unusual airplanes built since the 20's including European. It covered several successful tailless aircraft, VTOL, all Northrops, Lippisch, Armstrong Whitworths, etc., including Ryan and Convair's vertical raising airplanes and, Waldo Waterman's excellent "Flying Auto", which I used to watch flying at Santa Monica in 1935. (next page)

FX 05 H 126 WORTMANN AIRFOIL

DATA FROM ZEITSCHRIFT FÜR FLUGWISS., HEFT 8, 1957

SUMMARY: 25% Drag reduction with 25% increase of the low drag range compared with NACA 8H12 profile.

CP % FROM LEADING EDGE

COL 1	2	3	4	5	SECTION DRAG COEFFICIENT C_d			
	RN = 1.500.000				REYNOLDS NR × 10⁶			
α°	C_L	$C_{m\,1/4}$	$\frac{C_{m\,1/4}}{C_L}$	.25 minus COL. 4	.7	1	1.5	1.8
-4	-.10	-.05	-.5	.30	.015	.014	.011	.009
-2	-.12	0	0	.25	.012	.011	.009	.008
0	.33	-.010	-.03	.28	.010	.009	.008	.007
+2	.56	-.0157	-.028	.278	.009	.007	.006	.006
4	.77	.0214	-.028	.278	.009	.008	.006	.006
6	1.00	0282	-.028	.278	.009	.008	.006	.006
8	1.14	-.035	-.031	.281	.010	.009	.009	.009
10	1.16	.039	-.034	.284	.010	.010	.010	.010
12	1.18	-.043	-.036	.286	.010	.011	.011	.012
14	1.18	-.050	-.042	.292	.010	.011	.011	.012
16	1.18	-.057	.048	.298	.010	.011	.011	.012

α = Angle of attack (from ZERO LIFTLINE)

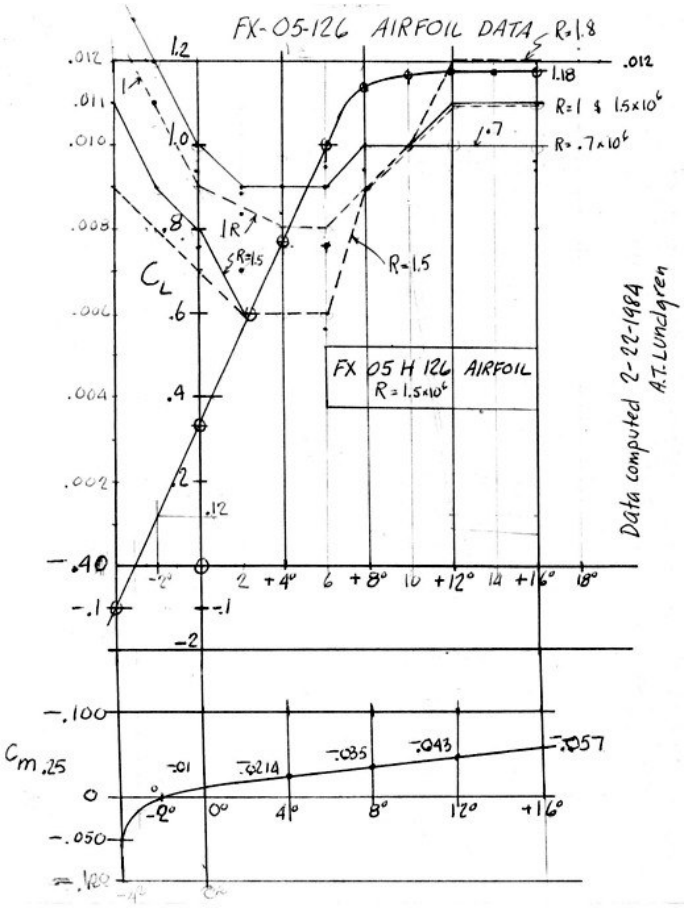
C_L = Section Lift Coefficient

Angle of zero lift -3°

Slope of lift curve $\frac{d\,C_L}{d\,\alpha} = \frac{1}{9.14} = .1094$ per degree

C_{M_0} = MOM. COEFF at ZERO LIFT

$CP = .25 - COL.4 = .25 - \frac{C_{m\,1/4}}{C_L} = .28$ CHORD



The photos were very interesting and revealed to me what was basically wrong with the tailless designs and, in my opinion, Waterman's was technically the best.

What have you done about solving the high-pitched noise of the Cuyuna engine on the Wind Rose?

Please drop me at least a brief note.

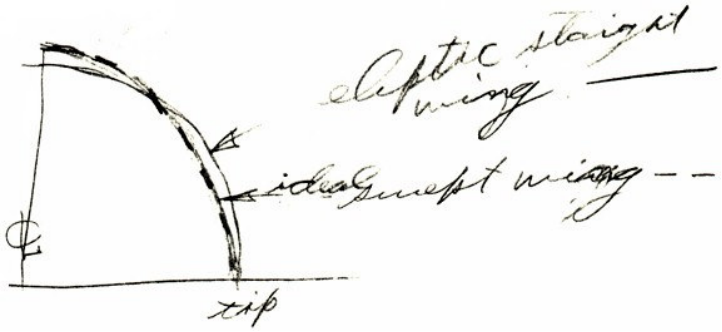
November 18, 1984

From: Irv Culver
To: Lu Lundgren

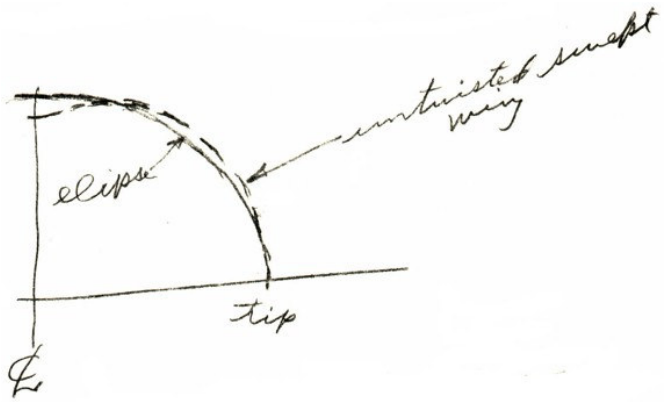
Please pardon me for not writing sooner. I've been busy finishing up the Wind Rose, as well as, other projects.

When I talked to you at the SHA meeting I did not mean to imply that tailless gliders would not fly. What I did mean to say is that I have not seen a tailless glider that tried to minimize the induced drag. Minimizing the induced drag on a swept wing is accomplished by making the wake several span lengths behind the wing (including the Betz role up) look like the wake from a straight un-swept wing of the same span with elliptical loading.

The above does not mean that the span loading is elliptical for the swept wing. If one looks at the six dimensional pressure fields of flow fields of a swept wing, we find that the down wash angle at the trailing edge of the center part of the wing is pushed up as it flows back due to the induced pressure field of the outer part of the wing. So the lift distribution on the swept wing should depart from elliptical thusly.



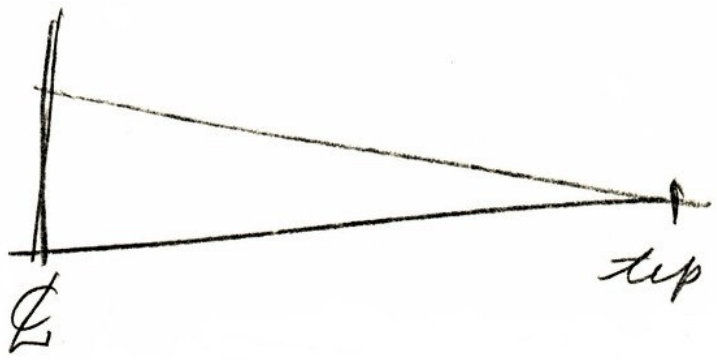
Further the basic untwisted swept wing tends to have a dip at the CL so the best (lowest induced drag on a swept wing) is obtained by non-linear twist, thusly.



The twist I've seen on tailless gliders looks like this (for tapered wings with straight element lines), no break.

If you have noticed the twist distribution on jet transports with swept wings, they look like this.

This is the best they can do with a single break in the loft lines. Fortunately, an un-tapered wing simply twisted looks like this.



This is considerably better than the tapered, simply twisted wing.

January 14, 1985

From: Lu Lundgren
To: Irv Culver

Thanks for returning the Kasper book, but it was my intention that you should keep it and give me an unbiased opinion on the merits of Kasper's aerodynamic arguments and the vortex theories for which the Jones gang is, as usual, trying to take the credit. I suppose, however, since you ducked

some of my questions, that you are either fed up on other people's ideas, especially since you have such a long and creditable career in the field of aerodynamics and design yourself.

During my 63 years since obtaining my M.E. degree, I spent 5-years in industrial engineering, built my first glider in 1927, a 50' span sailplane in '30 and went to work for Douglas in Santa Monica until 1937. In the fall I went to Sweden to take the job of works manager for the newly formed SAAB airplane, engine and prop factory, where I organized the airplane section, ordered all production facilities tools, trained people and served as the liaison between SAAB, the Swedish Air Force and Junkers in Germany. When the war broke out we returned to California Christmas 1939. The SAAB factory that I organized was consolidated with another company in Linköping in 1945 where they today build the SAAB-Fairchild 340 and other planes. The other factory, where I worked, now builds the SAAB automobile.

I met Kasper in January 1974 and got sold on his ideas, primarily because the Boeing people thought a lot of Kasper and Bob Lamson, sailplane pilot and builder/designer of the high altitude Strato Glider, formerly Chief Engineering Test Pilot at Boeing for years since the 707 prototype, swore by Kasper's ability as a designer, part of the 707 test crew and former Polish glider champion 4 times, etc.

I only quote this to convince you that I am not a backyard home builder only, but my engineering studies and experience were interrupted during the war years when I went into manufacturing, shop management and eventually into financing. A checkered route for sure, perhaps inconsistent, but engineering and building has continued to be my hobby during the retirement years. I only bore you with this synopsis in order to get you to know me a bit better and, to make you help a simple country boy to understand a few aerodynamic problems better.

There is no substitute for good judgment and experience and, paper merits mean nothing by themselves – they are only tools of the trade. This is why I respect your opinions and ask you to bear with me. Since both of us are retired, I expect that we can both pick each others brain a bit as members of SSA and SHA. If you disagree, I will understand and accept it, but I sure would appreciate it if you could put your finger on any serious flaws in Kasper's theory.

People, including Stan Hall, have said if Kasper's idea is no good, why has not some big aircraft company bought a license for this patents and gong into the business. I know the answer to this and it is purely economical, hardboiled reasons. Why risk cancellations of fat long-term contracts for conventional commercial or military aircraft while the going is good for the profits. In business profit is the bottom line – no arguments. Jack Northrop, a few year before his death, visited Kasper and told him, "If I had known you when I designed flying wings, my airplanes would have been the success of the century, instead of a failure". So much for that.

About 600 single surfaced Kasper ultralights have been built by Cascade Ultralights in Seattle. It was awarded first prize at Oshkosh in 1981 and, in 1982 it got permission to demonstrate its ability to make almost vertical mush landings due to vortex action, at Oshkosh, startling a lot of people. Kasper has nothing to do with Cascade any more, since they gypped him out of agreed to royalties on his patents and, are now practically broke and out of business.

I designed and built my IWA Bird in order to prove to myself that all Kasper's ideas are sound, although I have seen thousands of feet of films of the performances in the Seattle area of his earlier prototypes, have talked to responsible Boeing and other people who have actually witnessed Kasper's astonishing performances with his BEKAS prototype. These include recovery from forward and backward tumbling, vertical landings with no forward speed. His BKB-1 is the ONLY aircraft in the USA that has been licensed for unrestricted acrobatics including tumbling.

I am convinced that after Kasper is gone (he is 77 now and ailing) and his patents run out, SOMEBODY will pick up his ideas and develop them further, at great profit to themselves and Kasper will die a pauper. I am too old to do any more for him, but my interest and belief in Kasper's ideas remain and intrigue me.

I would not be surprised to see brother Jones try to grab some crumbs from Kasper's table, in his usual style. If you tell him he will probably sue me for libel.

So, my question is, did you scan the book or did you lay it aside as just another diatribe written by another asshole calling himself an expert on homebuilt airplanes? I think that you are too intelligent to do that, so what is your verdict, judgment?

I agree with Kasper that if it had not been for WWI, which cause designers to put the engines in the nose and add a cross tail for strictly military purposes, although it ruins the airflow and increases the drag by 25% or more, the development of the airplanes could have gone in the direction of tailless airplanes instead.

I appreciate all your comments about the need of twist on a wing. Since my short discussion with you at Tehachapi only concerned my Kasper type, swept and untapered with enplates and tip stabilator, I interpret your comments "Fortunately an un-tapered wing, simply twisted looks like this.

This is considerably better than the tapered simply twisted wing. That is just what we have. Sold American.

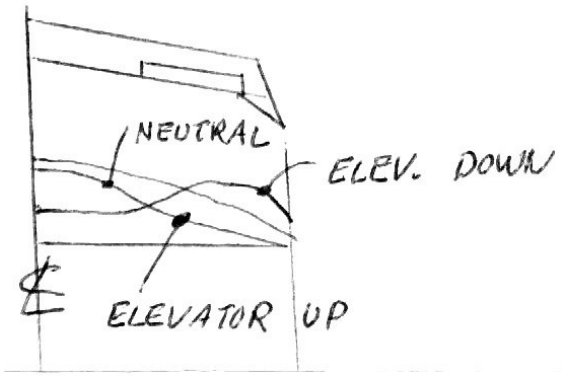
All these arguments are in the Kasper book, but I do not know from your notes if you read it or not, and I am not going to bore you by repeating what is says.

You say, however, that Kasper does not treat the subject of optimum twist distribution. He talks about "variable wash out" or twist. Perhaps a matter of semantics.

One can boil it down to this, in my humble opinion. If we consider the K-configuration (shown in the sketches that I sent to you originally) which are:

1. Moderate sweep back, 13 to 20 degrees depending upon vertical CG location.
2. Un-tapered wing.
3. Tilted and toed-in tip rudders with aerodynamic balance portions acting as spoilers, replacing the ailerons.

4. Tip plates, increase lift coefficient; decreasing the drag (induced); increasing the effective aspect ratio; increasing yaw and roll stability.
5. Wingtip horizontal stabilizers which accelerates the airflow at the tip and cancels the wake which produces the tip vortex. It also increases the pitch stability at low speeds and can be used for pitch and roll trim.
6. The elevons are used as elevators and in addition provide a variable washout or twist which increases with increasing angle of attack. At high speed, when not needed, the washout becomes zero or even negative. This action eliminates the need for geometric washout or twist.
7. The elevator up or down movement forces a change in lift distribution from rectangular to triangular and permits the shift of the center of lift back and forward providing a pitch controlling force which is INDEPENDENT OF FORWARD SPEED AND INCREASES THE STATIC STABILITY AT LOW SPEEDS.



8. Moderate sweepback increases the directional stability and increases the effectiveness of the horizontal tip stabilizers and the elevons by providing greater moment are for the forces generated by them.
9. The reflexed FX 05H126 airfoil with a stable center of pressure and used with sweepback and controlled by the elevon, permits the shift of center of pressure back and forth assuring the change of angle of attach up to 90 degrees, which allows the formation of the vortex on the upper surface at angles of attack from 35 to 40 degrees.

May I hear from you? And, do you want the book back to keep?

With highest regards and friendship,

Lu

January 18, 1985

From: Irv Culver
To: Lu Lundgren

I retired from Lockheed as technical advisor to the corporation in 1966 due to the overwork; 7-days a week was too much and 20-hours a day is also time consuming.

I currently act as technical advisor to several aircraft companies, one helicopter company and, one instrument company. So you see my retirement was a reduction in workload to a more average 6-days a week, 10-hours a day.

I read the Kasper book you sent. I did not find anything in it that is unusual or that I did not already know. I was startled by one statement that indicated that pitch tumbling was pleasant form of recreation. Quite a few people have been killed in tailless aircraft due to pitch tumbling. I question whether these people would consider the maneuver as fun, trapped in their own vortex. The last major project to be cancelled due to pitch tumbling was the Northrop flying wing.

My memory of the first time I read the work of Kutta and also Jakowsky on circulation theory (vorticity) was about 1920. I am sure the paper was written some time before this date. The subject was span wise load distribution and trailing vorticity. Later Betz wrote on the role up of the tip vortices. These papers assumed that the vorticity was of the simple form VR=C where V is the tangential velocity, R is the distance from the core or CL and C is a constant for any particular vortex strength T. I am sending some AIAA papers on the subject.

P.S. I don't know who first discovered vorticity, the ancient Chinese or the ancient Greeks.

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