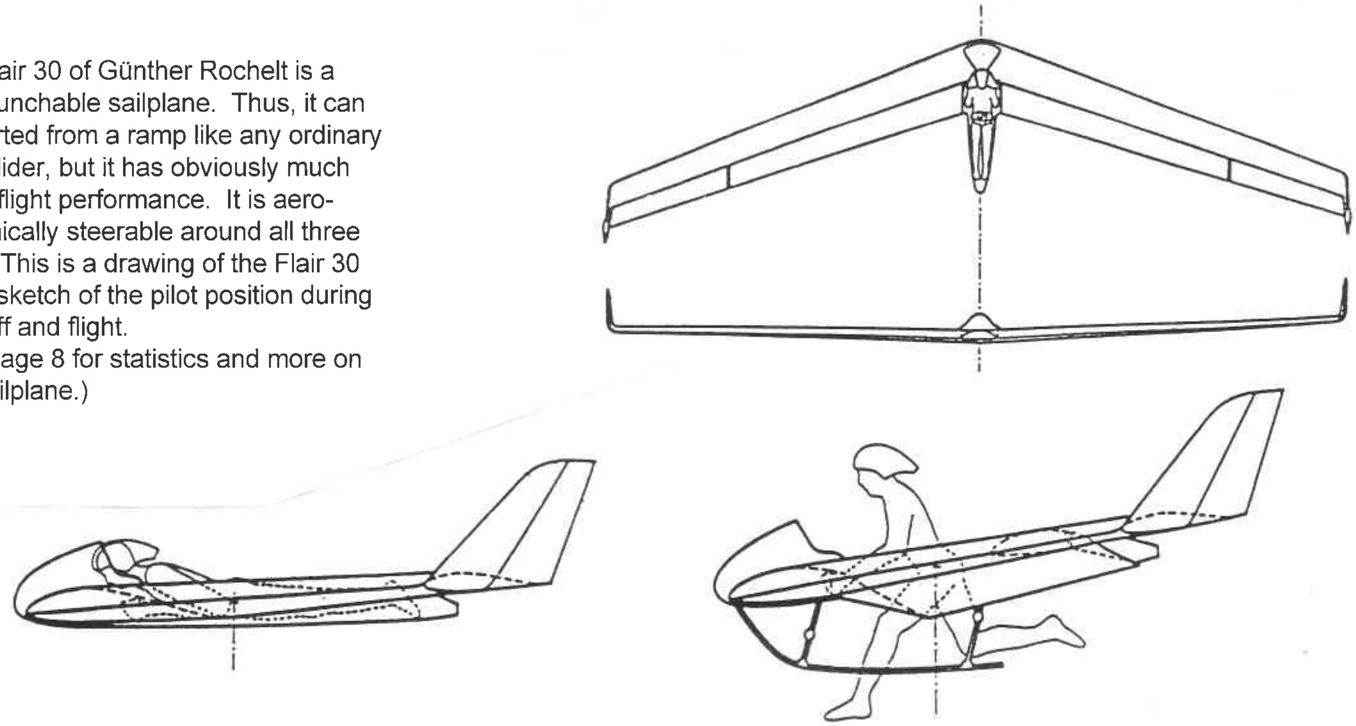
No. 128

FEBRUARY 1997

T.W.I.T.T. NEWSLETTER

The Flair 30 of Günther Rochelt is a foot-launchable sailplane. Thus, it can be started from a ramp like any ordinary hangglider, but it has obviously much better flight performance. It is aero-dynamically steerable around all three axes. This is a drawing of the Flair 30 and a sketch of the pilot position during take-off and flight.
(See page 8 for statistics and more on this sailplane.)



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., **9702** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, March 15, 1997, 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

What a meeting we had in January. Everyone who was there thoroughly enjoyed Gene Larrabee's talk on the oblique wing and some of the off the wall remarks he had about aviation and flying wings in general. You could tell the group was really into it for the day, since the chili kept them warm while they hanger flew for at least a hour after the official meeting was over.

This was one of those occasions where the exchange of information was absolutely astounding. There must have been at least three major groups of enthusiasts sharing information about their respective interests. It was a super sight to behold, since this is what we are all about - getting people together to share their experiences and skills with others so that all are better prepared to tackle the task of designing a better flying wing (or in some cases a more conventional design).

It sure got the new year off to a good start and I hope we will be able to provide this quality of a program again in March. We are exploring several options and will have more in the next newsletter.

I hope our eastern US members are finally starting to dig their way out from under the heavy cover of snow and get back to work on their favorite projects. We here in So. California have been spoiled this year with many warm clear days that allow for gluing and painting and all other things related to building an airplane, so it is hard to imagine what it's like having snow drifts all around.

I have to make my usual pitch for newsletter material. This month there is only one real letter (Al Worsfold's), then Phil Barnes contribution shaped lifting line analysis, and some more material on Zanonia seed type flyers from Al Backstrom. Not really enough to fill the newsletter but all appreciated by the editor. Please drop us a line with what you are doing, any questions you might have about your project, comments on past articles or other things included in the newsletter, or just some tidbit you think everyone would enjoy.

Oh by the way, this really is getting to you a week late this month since I had a hard time facing the computer at home after staring at one for 8 hours at the office everyday for the past several weeks. Sorry about that.

Andy

MARCH 15, 1997 PROGRAM

As of publication date we didn't have a confirmed program lined up for March. We have several people working on possibilities, but if you know of someone who would be a good speaker and can provide the group with flying wing relevant information, please give us a call.

The last two programs have been very good because of the efforts of members to make contacts and help in putting together a presentation. Keep up the good work and let's see what we can do for March.

MINUTES OF THE JANUARY 18, 1997 MEETING

Andy called everyone together on what turned out to be a bright, sunny, warm day versus the rain and gloom that was expected. After the usual welcoming and house-keeping items, he asked everyone to introduce themselves since we had some new faces in the crowd (and a crowd it was with at least 38 people showing up at one time or another during the program). One member present was Thomas Bircher from Switzerland (a long way to come for a meeting) who was involved in development of the Diamant and White Knight sailplanes, and Prometheus which is a glider powered by two TurboMecca jest and a long wing that's interchangeable with a short version. Also in attendance was Jack Lambie who indicated he was in the process of telling the Smithsonian what was wrong with their internet exhibit on flight. Two other long distance travelers were Dean Rosenlof and Kim Heidt from Phoenix, Arizona (they are now members after we pressed Dean into speaker service at the last meeting). Kim is a technical writer and is currently working on a story about the Horten gliders and we recommended she get a hold of Phillip Burgers and ask about his experiences when he met Horten in Argentina.

Phil Barnes told us he has just finished writing a new computer program that documents the lift distribution for just about any wing, and he plans on doing it for the Horten wing's bell shaped curve. He has done a test case on a winglet and found it develops thrust if designed properly. He is looking for data on the lift distribution of wings with winglets and joined wings to do some further testing of his new program. If anyone out there has some, drop us a line. (See his two page abstract later in this newsletter.)

Since no one had any further items of interest, Andy introduced Gene Larrabee who would be talking to us about circulation flow on wings how that leads into a logical discussion of the oblique wing.

Gene began by reading a prepared statement defining the essence of TWITT. "An article of the congregation's faith is that if possible flying machines should be reduced to that one essential element, the wing. And further that the boundary layer surrounding the wing be laminar as if the effects of the viscosity were wholly dissipated and can at best be minimized. But I am here to remind you that lift itself is the result of viscosity which aligns the boundary layers with the trailing edge thereby creating down circulation lift. Moreover this lift constantly creates induced drag and finally all of this is described by the circulation theory of lift."

With regard to the TWITT group Gene said he is not a flying wing enthusiast, and in fact thinks of flying wings as "A perennial weed in the garden of applied aerodynamics". However, he has become convinced that the oblique flying wing invented by Robert Thomas Jones is the only aircraft configuration capable of economical supersonic flight. Such an airplane has almost impossible practical engineering problems that must be overcome and he will be talking about these a little later.

(ed. - At this point Gene went through a series of overhead viewgraphs to review the circulation theory of lift. Unfortunately, we didn't get a copy of the slides for inclusion in the newsletter so I will try to summarize the general points he made as he went through them.)

The first slide was of a hydrodynamic vortex that really doesn't exist in the real world, but something like surrounds the tube of a hurricane or a drain in the sink. It has the property that the product of the velocity on every streamline which is circular (velocity is given by circulation gamma divided by the circumference of the streamline). Another old theory is the incompressible flow around a cylinder which has been known for a long time. The flow is symmetrical from top to bottom and front to back and develops neither drag nor lift. This means its not much good.

The next thing to talked about is the real flow about a cylinder. There are alternating vortices behind it the depend on Reynolds numbers and there is some drag. Then there is theoretical flow around a cylinder with circulation. The flow is symmetrical fore and aft about the stream direction but its unsymmetrical from top to bottom and that means the cylinder must be developing lift. Next came the model of circulation around an airfoil versus around a cylinder. The airfoil shape is dependent upon where the center of the cylinder is to be transformed into airfoil section. This was found about 1908 and helped explain why a wing produced lift although most people building and flying airplanes at the time didn't know how they really were working.

There are boundary layers with the upper layer having positive circulation and the bottom layer which has negative circulation. When the flow is aligned pretty much with the trailing edge the difference between the vorticity of the upper and lower boundary layer is almost identical to the circulation formula.

One of the old time, early aerodynamicist found that if you have elliptic span loading then the induced angle of attack would constant across the span and the induced drag of the wing would be at the minimum. This seems to be about the time tip votices were first recognized although pilots thought they were flying through another planes "prop" wash not realizing it was really "wing" wash.

At this point Gene introduced the theory of Robert T. Jones who thought the optimum form for a lifting airframe that the had to fly supersonically would be an oblique, elliptically loaded wing which would fly so that the forward tip would form a conical shaped shock wave and the rest of the wing would be inside this shock wave. If you did this then the flow around the wing would be sub-sonic and you could use sub-sonic airfoils and leading edge suction. This would give lift to drag ratios far superior to sharp-edge supersonic airfoil. He started presenting his idea around 1952, but at first it was not received with much enthusiasm.

R.T. Jones went to work for the Nicolas Beesley Aircraft Co. with only a high school education. The company disappeared in the great depression so R.T. headed for Washington D.C. where he became a stock boy in the Library of Congress. While attending classes at the Catholic University he met Dr. Monks Munch who had been a leading engineer hired by NACA to do airfoil testing and was responsible for designing the variable density wind tunnel. Munch taught R.T. lots of clever things about aerodynamics.

Gene went on to say he learned about Jones' oblique wing ideas by reading the public writing of the AIAA members. Jones had the idea that if you had an elliptic wing set at an oblique angle you would have low induced drag at low supersonic mach numbers because of a lot of span, and pretty low weight drag due to lift since it was distributed longitudinally. Gene told his students about this idea and they designed a transonic airliner in 1978. The rationale was that you could have an aircraft traveling at mach 1.1 where the shock wave wouldn't hit the ground and cause the usual big bang.

They started with a business jet version where the wing could be skewed at various angles and area ruled. They thought maybe a rich Arab country might be interested in funding such a project since it would get them to their destination almost twice as fast as other business jets. Also, the plane would have good slow speed characteristics since the wing could be kept in the conventional position for takeoff and landings. The biggest problem was the pivot point since all the electrical and fuel connections had to be developed to move also.

Gene turned the project over the XMI Corp. which was the product of an MIT student who thought he wasn't getting enough mail. The XMI Corp. went on to develop the Crisilis bi-plane man-powered aircraft.

R.T. Jones finally got Burt Rutan interested in building a flying scale model of a transonic airliner that Boeing took some interest in for a while. The Rutan version was flown by a number of people, but it had some funny characteristics when the wing was in the oblique position.

Gene explained a little about the Navy's F-7U which was a tailless, low aspect ratio swept wing airplane with two vertical fins *(ed. - I believe this was the Cutlass)*. It was hated by the Navy pilots for a couple of reasons. One of them was the difference between the inboard and outboard leading edge slats because an end plate was added to the outboard end of the inboard slat that significantly changed the stall characteristics from that of the wing tunnel models. The second reason was the low aspect ratio design made for a very high angle of attack during approach to the carrier and it made it hard for the pilot to see the flight deck.

This lead to development of the F-8U *(Crusader)* which was a conventional jet aircraft with a variable incidence wing to help the pilot see the carrier during approach. This had its draw back during a wave-off since when power was applied the aircraft didn't pop up in a normal manner, but simply started accelerating without climbing which scared the deck crews. This led to the A-7U *(Corsair)* which had the same general planform without the movable wing.

Jones got the idea of building a moveable oblique wing on the fuselage of an F-8U. They studied three different wing sizes and found that it wasn't going to be an easy thing to control. It was found that the best solution was to remove the fuselage and turn it into a flying wing, which is the direction Jones started moving.

This change in direction resulted in a 20' span flying scale model demonstration flying wing. It had two vertical fins on the down swing wing, and was powered by two ducted fan engines since there weren't any jet engines small enough at the time. It would have 24 servos to make all the components work. The model was completed in 1994.

One of the break throughs was that in order fly this thing you align your axis system with the wing instead of rolling and pitching about the flight axis. The flight control system worked by deflecting the trailing edge flaps together to control pitch attitude about a spanwise axis, and spanwise to control roll attitude about a perpendicular spanwise axis. This all required rate gyros and other electronic gismos to make it all work, along with the skilled hands of the radio control operator.

One of the unique aspects was that it had 4-wheel controllable steering. This was necessary since the aircraft took off in the oblique position so traditional tricycle type landing gear would not provide the proper ground handling characteristics. The video showed it worked extremely well since the aircraft could be turned around in less than its own wing span. This type of maneuverability would be necessary in the full size aircraft due to restricted parking areas at most major airports.

Gene then showed the group a short video of the only flight that this model made. It was launched from Moffat Field NAS in San Jose, CA and made several circuits about the runway before being successfully landed. It always flies left wing-tip forward and flight orientation from the ground looked like it must have been extremely difficult for the pilot who is used to having the wing perpendicular to the line of flight. The aircraft appeared to be reasonable stable and at no time did it look like the pilot was having any trouble controlling it in any attitude. The group gave the pilot a round of applause as he made a nearly flawless landing of what looked like a most difficult aircraft to fly.

Gene pointed out that there were deflector vanes on the aft end of the engines nacelles. He explained these were to direct the thrust vector downward so that it pass through the center of gravity of the wing.

Before the actual flight the model was mounted on a gimbal on top of a car and the engines started. The car was then driven at about flight speed to the controls could be activated to determine that they would have control of the airplane once it was in untethered flight. They also did a full checkout of the on-board computers to make sure every parameter being monitored was recording properly.

Gene had one more overhead for us. *(ed. - I will try to get it all just like he wrote it.)* Oblique flying wing:

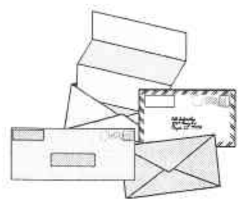
- Large wing chord where people can stand up.
- Eight foot thick leads to a 50' chord.
- Large wing span to reduce induced drag, 50' chord leads to 500' span.
- Large wing span leads to oblique take-off and landing. Present runway widths are about 300'.
- Control necessary around spanwise pitch axis, center of pressure due to narrow trailing edge flaps is surprising near the 50% chord point. This is due to the pressure peak over the narrow trailing edge and also one over the leading edge.
- You would want a more aft CG because the center of the airfoil is near 45% chord; never mind that it is unstable but it is just hard to get much pitching moment out of trailing edge flaps with the CG that far back.
- Zero pitching moment due to thrust required of under wing slung engines, perhaps included in thrust vectoring.
- One minute evacuation required after landing gear failure on airfield. Solution - emergency doors in the leading edge.
- Perhaps split trailing edge flaps near the tips would provide better control than the vertical fins near the down-turned wing tip.
- Then which way should the pilot be oriented - chordwise with an optically generated picture of the direction of flight??
- A retractable landing gear with 4-wheel steering during ground handling and also allowing pitch rotation.
- Finally, is a cruising L/D of about 15 at a mach number of 1.5 worth all this trouble? A mach of 1.1 would be boomless. Theory and experience seem to indicate with some certainty that it is impossible to build a supersonic airplane with an L/D of more than 10 at a mach number of 2 and perhaps 7 at mach 3.

According to Gene, the oblique flying wing is the only economical supersonic airliner and it is not very economical. It is questionable there will be anything to displace the Boeing 777, that has an L/D of almost 20 and cruises at .8 mach, in the Airbus competition.

There was a short question and answer period. It was pointed out that some theories had the aircraft flying in the normal mode when sub-sonic and gradually moving to the oblique attitude as the mach number was increased to take advantage of the oblique shock wave characteristics. It should be noted that the model shown in the video did everything in the oblique mode.

After an excellent presentation by Gene, Andy had the group break for refreshments provided by Chris and Connie Tuffli. Today's feast was hot chili with cheese and onion toppings along with chips. It sure hit the spot and the crock pot was very empty by the time the raffle started. The first winner was Bill Lambie (Jack Lambie's brother) who took home a nice socket set in a metal carrying case. The second winner was Donald Bloom who took away a package of electric extension cords and multi plug adapter, then our third winner, Victor Millman, selected a package of workshop rags. Andy then decided to go for one more winner who turned out to be Alex Kozloff who took a small hand-launch glider just for the fun of it.

With the raffle out of the way, Andy formally adjourned the meeting, but you would have hardly noticed. The crowd broke into several discussion groups while finishing up their bowls of chili and then just kept going and going (and the Eveready bunny wasn't even anywhere in sight). It seems that everyone had something they needed to know from someone else and they were all at the right place and the right time to exchange vital information.



LETTERS TO THE EDITOR

1/14/97

TWITT:

The mention of the Kasperwing in the minutes of the November 16, 1996 meeting caught my attention. I am a hangglider pilot and once had thoughts of owning a Kasperwing for its soaring capabilities.

I reviewed some of my old magazines and found the article "Flying The Vertical Mush" by Jan W. Steenblik in the June 1983 issue of Glider Rider magazine (copy enclosed).

The September 1980 issue had an article about Oshkosh '80 where in it told how Steve Grossruck was grounded for making a "parachute" - almost vertical - descent in his Kasperwing. Despite his claim that he was doing what his craft was designed to do. He was denied permission to fly in the main airshow. Mitchell aircraft flew instead.

The April 1988 issue of Ultralight Flying has an article titled "Kasper The Friendly Wing" by Dan Johnson. He lauds controllability at near and even "below" stall.

I came across part two of an interesting article "Mitchell Wing Legacy" in the March 1985 Whole Air magazine. It mentioned a hangglider pilot Norm Castegnato who flew Howard Longs' Sky Ski. The Sky Ski is a Mitchell B-10 where the pilot sits supine up inside the wing with his head protruding into a lexan bubble canopy. Both Norm and Howard found it to be extremely pitch sensitive and to yaw excessively and land like a jet. Howard suggested that Norm install Kaper wing tips. Norm did so with the help of Art Siorda. The claim was that the tips reduced sensitivity 50%, stall speed by 4 mph and stabilized yaw and roll. This is a foot launch version of the B-10.

I enjoyed my review of the old magazines and hope to spend more time going back over them. Another article in the May 1985 Whole Air magazine was about Henry Cherry's Hang Plane - it shows three views of his FED 858 (enclosed with landing wheel) flying wing and the FED 859 (with external control bar) flying wing. Henry had high hopes for it but to my knowledge he was never able to market it.

This review was fun for me and I thought it might be of some interest to you or those working on the upcoming flying wing exhibit at the National Soaring Museum.

Al Worsfold

(ed. - Thanks for the interesting letter. We haven't heard much about the Kasper gliders for some reason. The material you enclosed was a little too dark to reproduce well for inclusion in the newsletter, but we will put the article in the library in case someone would like a copy- which may be possible.

This is the type of stuff I was commenting about in my column. People like Serge Krauss might be very interested in adding some of these references to his bibliography and others might be interested in the modified Mitchell wing. You just never know.)

PATHFINDER GROWS INTO CENTURION

The February 3, 1997 issue of Aviation Week & Space Technology, page 59, contains an article on a recent NASA grant of $2.5 million to design and build a larger version of the AeroVironment Pathfinder solar-powered drone (see page 9 of TWITT Newsletter, Dec '96).

AeroVironment (the company founded by Paul MacCready) is now working on a proof of concept version of what will be called the "Centurion" whose first flight is planned for this fall. This prototype flying wing could reach altitudes above 80,000' with the installation of solar panels, and the full size craft could reach 100,000'.

A quarter scale model of Centurion will have a span of 62.5' with a 2' chord and be powered by 12 electric motors. The model needs to fly as slow as 8 kts for the proper ratio of inner/outer wingtip speeds in a turn, forcing ultralight construction to keep the weight at the 20 lb goal. The 2" diameter spar is made from graphite and Kevlar, and the covering is microfilm like used on indoor model aircraft. This model is just waiting for the right weather conditions in the California high-desert so it can be flown.

Pathfinder is not finished yet. It will be taken to Hawaii for high-altitude flights to the 60-70,000' level which will exceed its current altitude record of 50,500'.

Also in the February 3, 1997 issue of Aviation Week & Space Technology, was a classified ad for AeroVironment. They are looking for Aeronautical, Mechanical and Electronic Engineers & Technicians who enjoy developing innovative airplanes, and would appreciate the unique and challenging work at AeroVironment.

Their Design Development Center is located in Simi Valley, California, about 1-hour from downtown Los Angeles.

If you are interested the ad says to send a resume to:

HR/DDC-AW-2
222 E. Huntington Drive
Monrovia, CA 91016
Fax: (818) 359-9628
AVHR@aerovironment.com

PHIL BARNES' SHAPED LIFTING LINE VECTOR ANALYSIS

Phil Barnes is preparing a technical paper on lifting line aerodynamics and has provided a copy of his abstract for the TWITT Newsletter. The full paper is being prepared for the 1997 World Aviation Congress. The paper will have a strong emphasis on the aerodynamic design of tailless aircraft.

Bypassing, if necessary, the technical portions of the abstract, readers may find the supplementary discussion and attached graphic interesting in regard to the effect of winglets.

TWITT members are encouraged to contact Phil at (310) 833-8083 if they have any questions or comments about the abstract and/or to share, if available, any wind-tunnel data representing spanwise lift distribution, particularly for winglets or joined wings.

(ed. - The next two pages contain the information provided to TWITT by Phil. It is printed exactly as he gave it to us, so if you see anything that seems out of place he probably should be contacted and informed of it. As you can see from our classified section, this is one of at least three projects Phil has been working on over the past year or so, so if you have something to contribute, please contact him.)

Abstract

Shaped Lifting Line Vector Analysis for the Lift, Pitching Moment, and Induced Drag of 3D Wings

J. Philip Barnes
Sr. Technical Specialist
Northrop Grumman Corporation

A well-known tool for preliminary aerodynamic design, the lifting line method, is enhanced for more accurate treatment of planar wings and extended for the treatment of winglets, joined wings, and other non-planar configurations. Test data and supporting theory are used to show that the lifting and downwash lines, traditionally located at 1/4 and 3/4 chord respectively, should be shifted to account for aspect ratio and airfoil properties and re-shaped to account for root effects in swept wings and tip effects in all wings. Characterizing the geometric and aerodynamic properties in non-dimensional form, three-dimensional vector analyses and matrix methods are applied to solve for the spanwise lift distribution (normal to the spar). Then, the net lift, lift distribution, and pitching moment predictions of the proposed "shaped lifting line" method are compared to test data for wings with various arrangements of planform, twist, camber, and flaps. Elliptical wings are included. Finally, an "apparent downwash" method for calculating induced drag is introduced, whereby the total induced drag agrees well with that predicted by Munk's Stagger Theorem, but the spanwise variation of induced drag loading more closely matches test data.

Attachment

For those reviewing the abstract, the attachment and following supplementary discussion are provided, whereby the "shaped lifting line" and "apparent downwash" methods have been applied to analyze the characteristics of a non-planar wing at a selected angle of attack.

The upper half of the attachment shows four views of a swept, tapered, and twisted wing with winglets which are canted outboard and set back from the leading edge. The leading and trailing edge lines are shown in each view. As seen in the plan view, the lifting line is shifted aft at the wing root. The chordwise relative position of the downwash line reflects the empirical lift slope of the selected airfoil. In the front view, the distance, "projected" in the y-z plane, along the wing spar from the centerline to any spanwise position, is designated (p). The halfspan is designated (h).

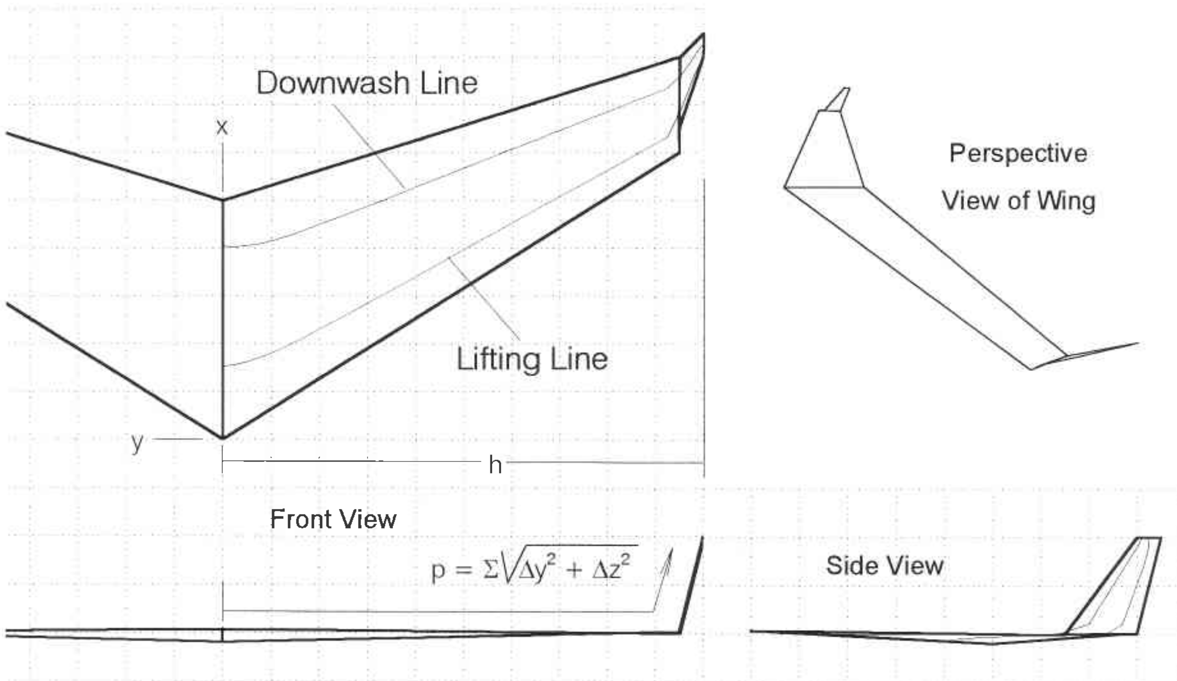
For the purposes of calculating lift and induced drag (but not profile drag), the cambered airfoil is everywhere replaced by a thin, symmetrical airfoil which has the incidence of the cambered airfoil, plus the incidence of the airfoil zero-lift line, less the airfoil washout. The planar portion of the wing incorporates 4 degrees of washout, varying linearly. The winglet leading edge is "toed out" by 2 degrees at the base, with zero washout at its tip. The airfoil zero lift line has an incidence of 3 degrees. This, together with the twist, is seen in the front and side views.

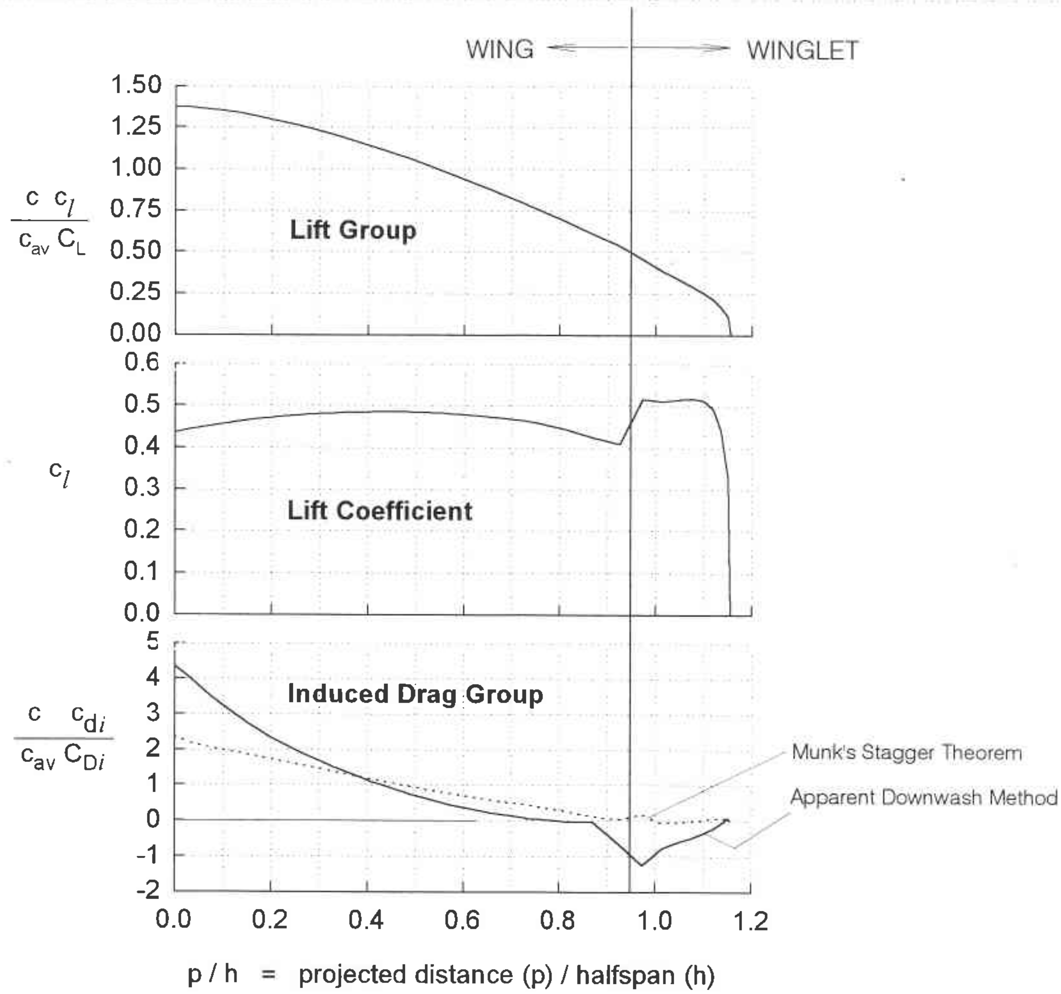
The lower half of the attachment shows the spanwise distribution of aerodynamic loads at 5 degrees angle of attack. As required by the vortex laws, the strength of the bound vortex must be continuous from the wing root to the winglet tip. The lift group, which is proportional to the bound vortex strength, exhibits the required continuous distribution. Owing to the discontinuity in wing chord at the base of the winglet, a sudden change in lift coefficient is observed at 95 % halfspan. Nevertheless, almost the entire wing is operating near 0.5 lift coefficient.

Perhaps most interesting is the negative induced drag, or "thrust," developed by the winglet. Although the spanwise (chord-weighted) integration of induced drag matches the total drag predicted by Munk's Stagger Theorem, only the "apparent downwash" method reveals the negative winglet drag.

WING DESIGN STUDY

Application of Shaped Lifting Line and Apparent Downwash Methods





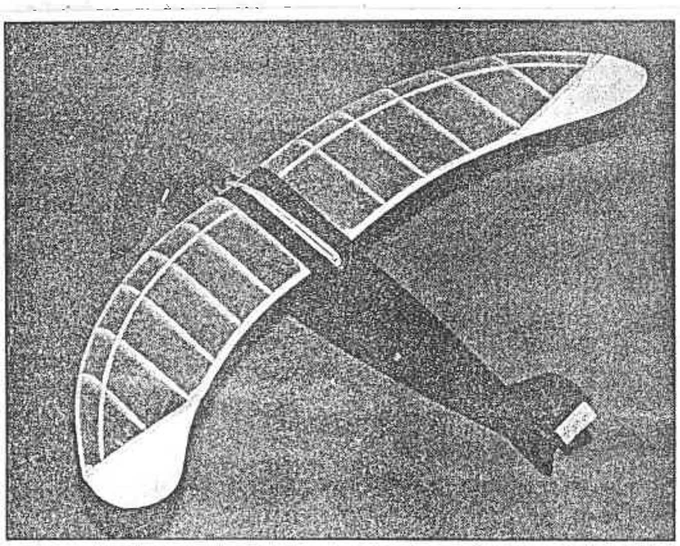
TWITT LIBRARY ADDITION

The following material was sent to us by Ed Lockhart and are good quality reproductions of the original pages. Unfortunately, the name, publisher and other statistics of the publication from which they came was not included. Perhaps Ed can pass this along. What we do have is:

Chapter 6 - "Flying Wings and Things". Seven pages of text and photos of aircraft such as the Westland Dreadnought, and several versions of Geoffrey Hill's Pterodactyls

Chapter 15 - "Tailless Aircraft Research". Eight pages of text and photos of aircraft such as the Handley Page Manx, General Aircraft GAL.56 and GAL.61, and the De Havillands 108 Swallow.

The Zanonia seed concept still lives on. Here is some material forwarded to us by Al Backstrom, including his own design of an 18" tailless aircraft, PERSEY, with a wing based on the seed. The article that describes the tiny aircraft also includes a set of plan that could be used to build one. It seems Al experimented with it over a number of years and finally found the right combinations to make it fly "beautifully".



Accompanying the Persey article were two letters from the Royal Botanic Gardens, Kew, Richmond, Surrey UK on the Zanonia seed. The core of the letters were:

November 15, 1996 - "Zanonia and Alsomitra are genera in the Cucurbitaceae (cucumber family). They are woody climbers which grow among trees, but are not themselves trees. One of the most noticeable features of their biology is their production of large winged seeds. The gliding flight of these seeds is said to have inspired early pioneers of aircraft flight, and seeds of Zanonia can be twelve centimeters across (including the membranous wing). Plants of these genera are native to the Indomalaysian region."

December 12, 1996 - "Some years ago I obtained a few seeds of Alsomitra/Zanonia and enclose a spare example. This is slightly smaller than some I have seen and one description mentioned seeds with their wings up the 12cm across. You will see that these things do glide beautifully - although they are somewhat fragile."

Al included the following comment: "I remember Gus Raspet having one (a seed) at Mississippi State at one time. He wrote a brief article about it, but I don't have a copy. It had a performance curve based on the only point it would fly at."

Also include in Al's package was a copy of a short article from an issue of Aeromodeller (date unknown) with some interesting facts about the Zanonia seed and its capabilities. *(ed. - I will include it in a future newsletter so you can see some of the amazing feats this seed has performed in free-flight. Just goes to show that the flying wing is still the best type of aircraft.)*

ROCHELT FLAIR 30

COVER: This was sent to us by Al Backstrom who indicated it came from Tailless Aircraft; Theory & Practice. The following data was provided:

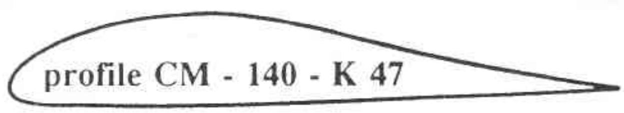
Span	12 m
Wing Area	11 m²
Aspect Ratio	13.1
Washout	5° linear
Empty Weight	Approx 40 kp
Opt. Glide Ratio	30
Opt. Sink Speed	Approx 0.5 m/s
Glide Ratio (braking flaps at 45°)	5
Profile	CM-140-K47
	c_{mo} = -0.048

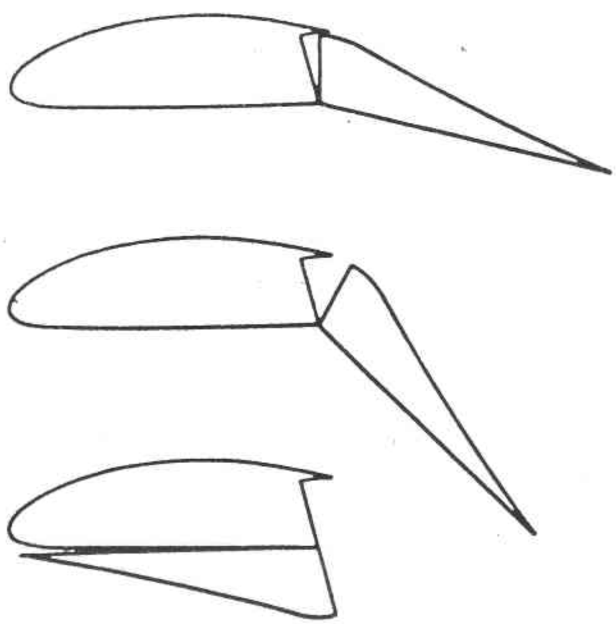
The profile has no fixed centre of pressure
Land on retractable skid (pilot in prone position)
Take-off on foot, or skid with winch/engine pwr.

The following basic ideas have been used in the design of the Flair 30: on the one hand the machine is conceived for hangglider pilots, hence it has to be foot-launchable. On the other hand it should be interesting also for sailplane pilots who want to take-off alone without ourside assistance. For these pilots the best flight performance was desirable. Hence the wing has not been built from aluminium tubes, wire, bolts and nylon (or mylar covering) - as is the case with hanggliders. Rather a modern rigid sandwich configuration was used. This gives a very smooth surface and so produces an extremely low drag coefficient such as is known only with modern sailplanes.

To reduce drag further the pilot is (mostly) integrated in the wing and does not hang freely in the airflow as is the case with today's hanggliders. With this (fixed) pilot position, control by weight-shifting is not possible any more. Hence the Flair 30 has got a compete aerodynamic control system consisting of elevators, ailerons and winglet rudders. There was also an inflight picture included in the article so it has actually flown.

The Flair 30 also has pitch moment free landing flaps. At 15° deflection angle a minimum flight speed is attained. A deflection of 45° is used for the landing. They have a strong braking effect while the flight speed still remains quite low. Günther Rochelt chose a relative chord length of more than 40% for these flaps. Moreover, he move the axis of rotation to the lowest point. With this trick it is possible to tilt the flaps over by 180° which reduces the package measurements for easier transportation (see below).





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