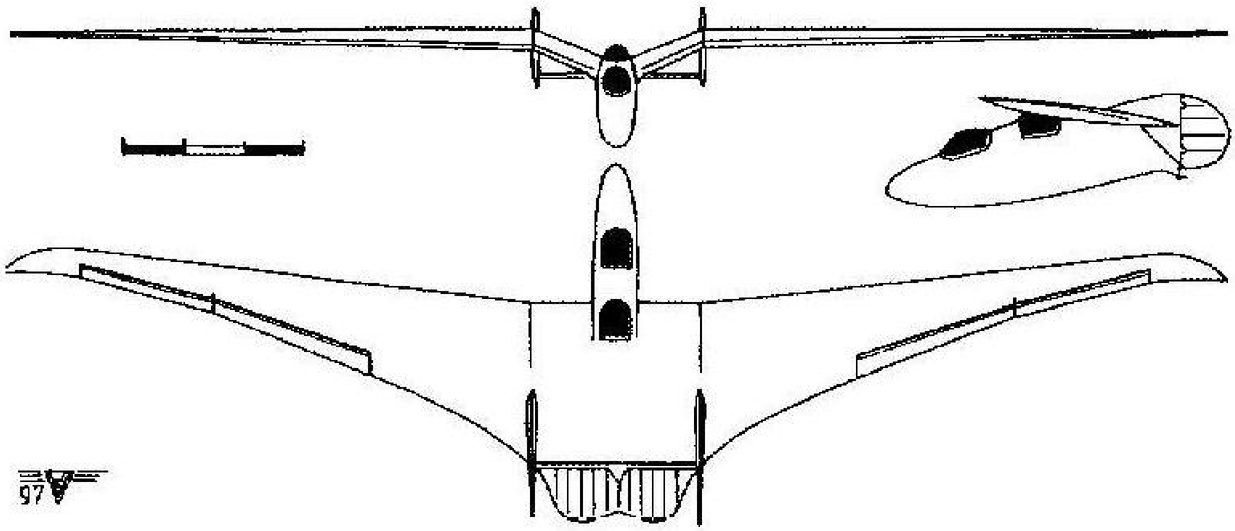
No. 148 OCTOBER 1998

T.W.I.T.T. NEWSLETTER



Philippe Vigneron's drawing of the Russian Experimental glider Belyayev BP-3. (See Letters to the Editor for a little more on this interesting looking flying wing.

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., **9810** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, November 21, 1998, 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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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

The September meeting was just super with Al Bower's giving everyone something to talk about after he passed on his enthusiasm for the Horten Xc to the group. I have already received at least one e-mail wanting more information on who might be interested in taking on building this aircraft, so maybe something will eventually come of Al's research work.

The SHA Western Workshop at Tehachapi over the Labor Day weekend was well attended and the speakers all put on a good show. The highlight of the Saturday night auction was the purchase of a Mitchell Wing that had been donated for the cause by Bob Chase. The flying weather was good, especially during the afternoon sessions and the temperature was nicely moderate for this time of year. Everyone I talked with really enjoyed it. The only thing missing were some flying wings on the flight line.

Access to the new TWITT web site appears to be brisk, although I haven't been able to get statistics from my internet service provider for about a week now. The site was down for about 10 days due to a software problem on their side, but it was back up and running in early September. I have been doing some behind the scenes upgrades to the various pages and will re-publish them in the next week or so. I have received several e-mails from strangers who have found the page and asked for more information or had a specific question about an aircraft or on how to get a hold of someone about a project.

The November meeting is looking like it will be a good one. We will be concentrating on the work of Witold Kasper and I will be putting some of the material we have in the library in next month's newsletter as a primer for the meeting.

Andy

NOVEMBER 21, 1998 PROGRAM

The program for November will feature John Mitchell making a presentation on the work of Witold Kasper. He and his father had some contact with Kasper prior to his death and have acquired some material and video footage we understand will be very interesting.

We will also have one of Kasper's flying wings on display at the meeting and some of the parts from R.W. Long's wing that didn't survive the test flight phases.

There will be more information in next month's newsletter, but make sure to mark your calendar now for November so you don't make other plans and miss what should be another very interesting meeting.

MINUTES OF THE SEPTEMBER 15, 1998 MEETING

Andy opened the meeting by welcoming everyone on what turned out to be a mild day temperature wise in the hanger. This was a blessing since we would have to close the doors for your featured speakers view-graphs.

After going over the usual housekeeping items, Andy talked a little more about the new TWITT web site pages that were currently out there for viewing. He explained the rationale for what would be in it for the future which is mainly to contain major items that are not already on someone else's pages. He will be putting out a page of links to other sites so anyone accessing the TWITT site could navigate to other related sites for more information on flying wings. He would also be adding the member's projects page as soon as he is able to purchase a scanner to convert some of the pictures into an electronic format.

Bruce Carmichael was asked to promote his latest booklet Ultralight & Light Self Launching Sailplanes. This was an outgrowth of his research for a speech he gave earlier in the year. Bruce also mentioned he had gone back to Elmira after the SHA Workshop to attend a meeting of the International Sailplane Design Board. He had been asked to give a presentation along with two others from SHA on light and micro-lift sailplanes and where they are going. This is probably the prelude to developing international regulations for these types of aircraft in the future.

Bob Chase had a little historical footnote for us. In his early years he had gotten interested in model airplanes through what he learned in the Book of Knowledge. While at Oshkosh this year he came across a book called Model Airplanes and the American Boy, 1927-1934. It illustrates paper airplanes designed by William B. Stout, who was responsible for the Ford Tri-Motor.

At this time Andy introduced Al Bowers who was going to talk to us today on what has turned out to be his favorite Horten sailplane, the H Xc. Andy mentioned we would be video taping Al so that others can share this experience from afar, and he asked everyone to ask plenty of questions.

(ed. - Due to the length of Al's presentation and the need to get other material into this month's newsletter, the minutes have been broken down into two parts, with the remainder to be published in November. We have also tried to make them as detailed as possible so you can get full affect of Al's work in this area. We will be releasing information on the availability of the video tapes as soon as they have been reproduced in sufficient quantities to meet the anticipated demand.)

As background into what got him started preparing this presentation, Al said it all started when he heard about the 1997 National Soaring Museum Flying Wing Symposium in Elmira, New York. With his fascination of flying wings since his childhood days, he decided to get his foot in the door and sent a letter to Paul Schweizer to see if he could get a slot on the podium. Al had been working for the past couple of years on the blended wing body which is a flying wing design NASA has had some interest in. After consulting with Bruce Carmichael and several others, Paul approved Al's request to put on a presentation on the history of Horten flying wings.

Al began be giving an introductory overview of what would be covered in the next hour or so. This was done in the form of a narrative at each of the bullet points on the slide.

The more he dug in the Horten history the more fascinating it became for several reasons. As a little bit of preliminary history, he commented that in the early 1920's, particularly in Germany, sailplanes were trying to achieve higher and higher aspect ratios. It turns out this has a theoretical basis in spanload history and during this period, after WWI and early 20's, they developed the optimum span load and found out how to calculate what the induced drag was on a wing. Induced drag was sort of a big

Horten Flugzeuge

problem at the time and so spans on sailplanes became larger and larger as they found how to make the limited structures they had at the time work.

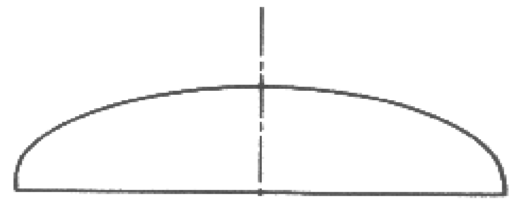
The other half of this occurs in the late 20's the Hortens come along as students in the glider clubs and then in the early 30's as sailplane builders. They came up with a different emphasis on the particular, more classical spanload of the day by coming up with their now famous bell shape spanload distribution theory. More on this later.

The next area to be covered is some history of the Horten's sailplanes over the years. He believed Peter Selinger had identified 43 particular sailplanes the Horten brothers had built and, he felt this had a strong influence on how they ended up where they did when compared with others of the time like Jack Northrop. This history would include the high performance sailplanes, some of the later designs while Reimar was living in Argentina, and in particular, the foot launched Horten H Xc which is the ultimate goal of the presentation.

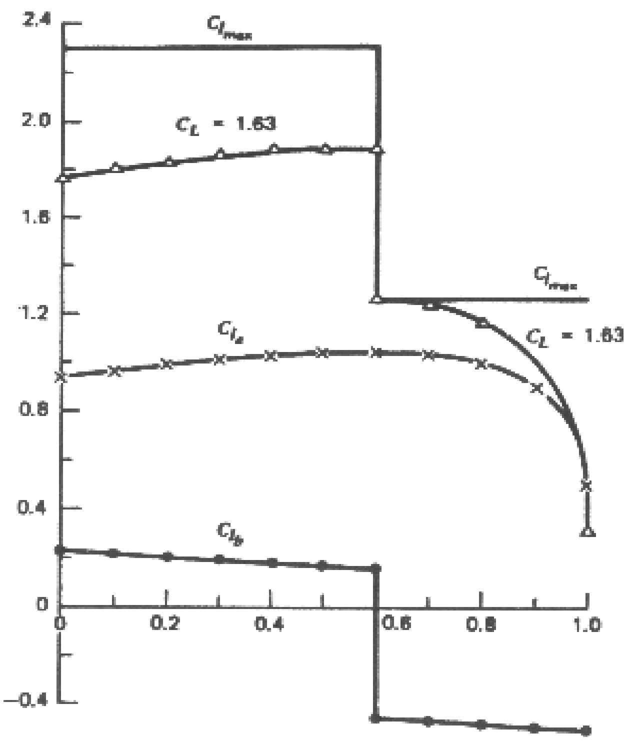
He then began talking about the analytical span load history. The original formulation for this comes from Ludwig Prandtl who came up with a paper published in Germany in 1918 and in an English version by NACA in 1920, called "Applicationds of Modern Hydrodynamics to Aeronautics". In this he explained how to calculate induced drag based on spanload using a lifting line theory which assumes all the lift occurs along a single spanwise line called the Line of Aerodynamic Centers. The way he accomplished this was with a series of chordwise vortices along the wing's span. He mathematically modeled these horseshoe or closed loop vortices going all the way back to where the wing first develops lift which is a starting vortex. If you moved the wing in a perfect fluid without viscosity this vortex would remain there as has been shown in some experiments. However, it is difficult for most people to visualize a wing and think about the flow going backward underneath it, so it is really more of a mathematical concept with some basis in reality.

Max Munk applied calculus to this theory and one of the things he came up with was the optimum span load that minimized the induced drag. The optimum span load turned out to be the elliptical span load distribution. This theory is taught all through aeronautical engineering school as the optimum so everyone is inclined to accept it as the best way to go as long as you are working in an inviscid world. However, there have been some recent developments done by a small group of people at NASA Langley where they have applied viscosity to this theory and it turns out that the optimum is almost, but not quite purely elliptical. So for all practical purposes, modern designers still use the elliptical theory and it works very, very well.

The problem was this is a very mathematically intensive way to try and calculate the spanload in order to get a beautifully elliptical span load that is desired. Oscar Schrenk came up with a very simple method of predict what span load is, but Al warns that this method is what would be called a "Rule of Thumb". It works very well, but there is no firm theoretical basis for the way it works. There is some empirical evidence that it works very well, but it just happens to work out that way. Referring to the Analytical Span Loan History chart, Al described the individual lines representing twist, taper and surface deflections and then that they look like when combined under Schrenk's method. The twist line has a distinct jog in it that is the result of a flap being deployed in the inboard section of the wing which is representing mechanical twist, so this method deals very well with control surface deflections.



elliptical span load



The other primary line on the chart represents the planform of the wing based on the "Rule of Thumb" of an elliptical distribution. It is an average of what you have for a plan-form and the elliptical distribution. The two lines, twist/deflection and plan-form, are then combined yielding the third, more complex representation based on the angle of attack. This particular chart was done to try and find where the wing would stall first and as it turns out it is at the inboard end just before you get to the flap. The chart also shows finite span load at the tip which realistically cannot exist since it is a discontinuity of nature and is one of the problems with Schrenk's approximation method. However, Schrenk's method was used by most people very easily mathematically, this being a relative term, to calculate the span load for their aircraft.

Unfortunately, Schrenk's formula didn't give the full picture since there were some problems with it, and one of the people who came up with a solution for this was Hans

Multhopp. He simplified it mathematically by adding control points in his wing which allowed him to get a product condition. This is were the flow comes off the upper and lower surfaces cleanly and joins the airstream. These control points are simply vortices going the other way and Multhopp put them coincidence with the circulation vortex along the line of aerodynamic center. In 1944, Laska and Weissingger move the control points back to the 75% chord position versus the 25% position of Multhopp's which is where the normal aerodynamic center is assumed to occur, however, this makes the method even more mathematically intensive. Don't forget this is at a time before digital computers which made performing the calculations much harder accomplish with accuracy.

Multhopp's "simplified" theory came out in 1938 and the Horten brothers saw it as a big jump forward in being able to understand the span loads of their airplanes. You can understand why when you start thinking about the bell shaped span load. The bell shaped span load by definition goes to zero at the tip, so Schrenk's method which has a finite value for span load at the tip is very difficult to deal with. This made Multhopp's method a big break through for the Hortens and all their designs since 1938 used his theories in the design method.

In talking about bell versus elliptical span loading, elliptical is the optimum since it gives you the minimum induced drag and for sailplane designers this is a big deal. The Hortens thought that may be there are times you don't want the optimum for one thing, but a sub-optimal solution for many things will solve more problems so they came up with the bell shaped span load. Al referred to the Bell vs. Elliptical Span Loads slide to illustrate this point. Both the elliptical and bell shaped curves come to a finite point at the tips which is very important. Once you have these span load distributions, the fascinating piece is that you calculate the induced drag for each of the little vertical areas on the chart as you progress across the span.

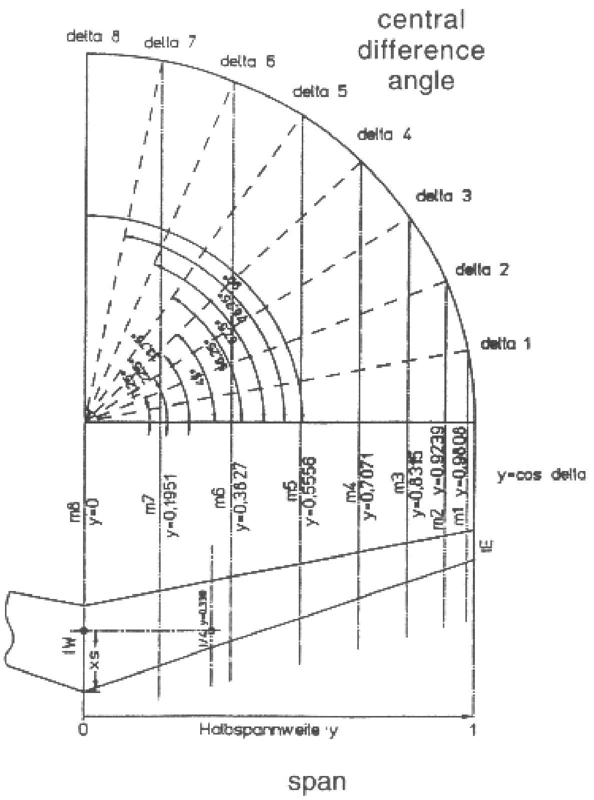
On the elliptical curve the induced drag continues to build all the way across the span always represented by a negative value, which is drag. On the bell shaped curve you notice there is a positive area out near the tip that has become what could be called induced thrust versus being drag. This allows you to do things like proverse yaw with the roll command, which is based on the amount of lift that is generated. By making more lift at a tip then the value of the induced thrust will increase at that tip. Phil Burgers noted that this induced thrust condition is why birds fly in the "V" formation. The birds at the tips of the "V" are actually achieving forward thrust, whereas the lead bird is not but does benefit from the significant upwash from the others. So, in 1938 the Hortens are using this induced thrust at the tips, but we don't see it again until the 1950's when Dick Whitcomb came up with the winglet designs. Phil Burger pointed out that the wing tips on Horten's aircraft are similar to "flat winglets", which Al agreed with.

The one thing that Multhopp's method cannot account for is the sweep angle, so there is a residual value out there that the Hortens called "mitteleffekt". This is purely an artifact of their calculation method and it doesn't really exist since it involves a problem in the analysis technique, but not in physical reality. As you sweep the wings back on any type of wing upwash from the center influences the tips differently so there is a small increased load at the tips and a decreased load at the center line. In Multhopp's technique the upwash for sweep is unaccounted for and the next slide showed what this looked like. If you took a Horten wing and un-swept it the results would be shown as the solid line on the chart which has a fairly low lift value at the tip but a much higher value near the middle relative to the swept case and this is the mitteleffekt. Bruce Carmichael commented that Irv Culver's approach to fixing this problem was to increase the angle of attack of the center section, whereas, the Hortens fixed it by increasing the chord at the root section. So, mitteleffekt is not the sag in lift distribution at the middle, but it is the unanticipated sag in the lift distribution in the middle, just to clarify the point.

There is one other piece of the puzzle in the calculation method used by Multhopp. Al had seen it in many of the Horten papers, but it wasn't explained very well. Then he ran across some unpublished papers by Dr. Edward Udens in Germany, who has a lot of information on the Horten designs. The Calculation Method (Multhopp) slide shows the analysis derived by Dr. Uden's (see next page for an illustration of this technique). It maps the wing out using a uni-circle arc that begin with a value of zero at the root and rotates around to a value of one at the tip. This 90 degree segment is then divided up into equal angles and then the arc intersection points are mapped down through the wing's chord. These give you the spanwise locations that are called control points for analysis and are labeled as the central difference angle. These sometimes showed up in the Horten papers as a delta. What Horten found was that when you raise the power of the transcendental (sine) function for the value of 'n', you get closer to a bell shaped lift distribution curve. If you make the 'n' value 1 then you end up with an elliptical distribution and, when you raise it to 2 it becomes bell shaped but you still don't have induced thrust at the tips. As you get to a value of 2.5 there is a cross-over from adverse yaw to proverse yaw and, as 'n' increases towards 3 you get increases in induced drag which is the penalty for this method. So you want the minimum value of 'n' you can get away with and for the Hortens most of the time in their designs this value was 3, which is near optimum.

At the bottom of this slide is a span versus twist graphic which represents a correction for the chord length. The graphic is the twist distribution for the Horten H Xc and was provided by Reinhold Stadler in Germany who has a program for calculating it quickly and easily. The fascinating thing about all this to Al is that there is washin for about the first 20 percent of the wing, so the wing is twisting the wrong way. Then it goes out to about 10 degrees of washout at the tips, but overall it has a twist range of about 11.7 degrees due to the washin area.

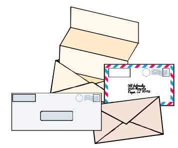
Udens took this analysis technique and using a value of 3 for 'n' and calculated the span loads for a number of different configurations (represented in the Udens' Results slide) including the induced drag. Then he found if you had a control surface deflection for those particular span loads you could determine the yawing moment for the designs.



Multhopp's Calculation Method

He did this analysis for eleven different designs and looked at the affects of elevon configurations. He found that even with a bell shape curve and a deflection of an inboard elevon would cause adverse yaw as represented by the negative numbers in the results chart. The positive numbers represent proverse yaw. Al offered a caveat at this point that was brought up during the SHA session; proverse yaw is not always desirable. When you look at the Military Standards (Mil Std) used throughout the government for handling qualities for the same level of adverse and proverse yaw, pilots find the proverse yaw more objectionable. So, just because you can get proverse yaw it is not necessarily a good thing, and getting any degree of proverse yaw is hard. Adverse yaw is usually the norm as can be attested by many sailplane pilots who have run out of rudder authority when using full ailerons.

After Al completed his presentation, the meeting was adjourned for donuts and drinks, and a lot of hanger flying with a never ending stream of questions for Al to field before going home.



LETTERS TO THE EDITOR

9/6/98

TWITT:

Enclosed is $36 for 2 year renewal to your organization. I always enjoy your articles on flying wings. Living in Arizona doesn't allow me to attend your meetings. I have actively looked at building a PUL-10, but am waiting until it is a more flight tested product.

Last January I started an EAA Chapter here at Scottsdale Airport. We are now up to 70 members so I know how hard it is to have meetings, find speakers, as well as, produce a newsletter. My hat's off to you guys. Your speaker list is great & your newsletter is first rate.

I have added a Breezy to my collection this year, what a riot. It shares hanger space with my Cessna 140, Piper J3 and Thurston Teal Flying Boat. We have all bases covered, but a flying wing of some type is on the horizon. In my travels as an airline pilot I am always looking for interesting aircraft. The only new flying wing I have seen lately is the inflatable glider (looked like a cross between and Swift and wonderbra) at Oshkosh this year.

Keep up the good work & if any TWITTs get out our way, stop by Scottsdale Airport or call.

Curtis Clark
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(602) 953-2571

(ed. - Thanks for the nice letter on your activities and collection of aircraft. You should be commended for taking on the task of starting a new EAA chapter, and you're right about the amount of work it takes. It seems like the work is never done and now with the web page another aspect has been added that requires continual attention.

The one thing you didn't mention was when your chapter has it's meetings. Next time you have a second drop us another line and we will let everyone know.)

9/26/98

TWITT:

Sorry I haven't submitted anything in a while, but I have been busy traveling (mostly work) and trying to get a sailplane recovered and repainted (my trusty old 1-26 is just about airworthy again!).

I have noted several folks asking about Kasper Wings, so I dug through my files and found an old brochure and several articles that analyzed the aerodynamics of the Kasper vortex lift airfoils. I have included them for the library or possible use in the newsletter. While digging through old issues of Soaring magazine, I came across several articles from the early 1970s about various flying wings, mostly from Jim Marske. I have also included them in this package.

Regards,

Kevin Renshaw
Fort Worth, TX

(ed. - As usual Kevin comes through again with some very good material. I have listed what he sent below. Included was an article on the Komet, but I don't believe we have ever seen a write-up on what the final outcome of the project was and what Kevin has done with any prototype that may have been built. Perhaps his next communication will relate this experience.

"A Wind Tunnel Investigation of the Kasper Vortex Concept", by Edward W. Kruppa, University of Washington, Seattle, WA 98195, AIAA, Inc., 1977, pp 10. Includes text, charts, graphs, illustrations and a references section.

"A Brief Wind Tunnel Test of the Kasper Airfoil", by Daniel Walton, Soaring, November 1974, pp. 26-27. Text, pictures and graphs.

"Some Ideas of Vortex Lift", by Witold A. Kasper, Engineering Consultant, SAE, Inc., Warrendale, PA, pp. 12. Line drawings, charts, graphs and text material, including some handwritten notes of unknown origin. Photocopy quality in some areas is poor.

"The Monarch", by Jim Marske, Soaring, (issue unknown), p. 28. A brief article on the thoughts behind the Monarch and some on the construction and flying.

"Flying the Pioneer II", by Rick Apgar with commentary by Paul Bikle, Soaring, July, 1974, pp. 22-25. Nice article on the finishing and flying of a Pioneer flying wing.

"Renshaw Komet", (author/source unknown), pp. 282-286. Concept article on the initial development ideas for the Komet, including model picture, 3-view and statistics.

Date: Fri, 25 Sep 1998
From: vigneron@naseej.com
To: twitt@home.com

HELP NEEDED, Please

New kid on the web (E-mail is now available here in Saudi Arabia and full Internet services are promised for next year).

Following Alain Pelletier's letter published in the August newsletter, I must confess that I am also writing a book (in French) on the history of the tailless aircraft (from the first patents up to today's projects). This book covers only the historical aspect of the tailless and flying wing aircraft, not at all the technical aspect (I am 100% incompetent in that field).

The book is nearly finished (around 300 pages, 350+ photographs and 400+ 3V drawings (cf newsletter N° 111 (Pa49), n°.118 (Arup's). I have also sent you some more pictures (Dehn RingWing, Debreyer "Pelican"), but I think that my letters are still jammed in some remote Saudi post offices). I "just" now have to find an French editor interested by the subject (The most difficult task, I fear).

I have already contacted by snail-mail some members who very kindly sent me documentation and photographs (THANK YOU Bob, Barney, Larry, Lewis, Alain, Curzio, Fernandino, Rudolph, Reinhold, Al and above all Serge).

I will like now to obtain some more photographs of general aviation tailless aircraft designed after WW2 (homebuilt aircraft, gliders, and especially ultra-lights - Catto, Kiceniuk, UFM, Manta, etc...) because my collection is still quite poor on that field.

Any help will be the most welcome.

Yours faithfully,

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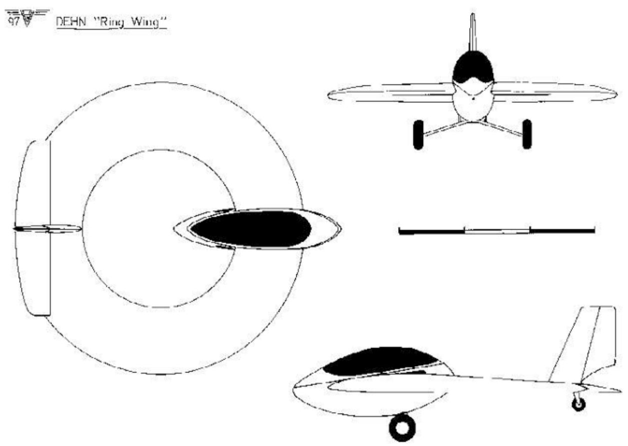
P.S. Attached a file with my drawing of the Russian experimental glider *(this month's cover picture)* Belyayev BP-3 (BP for Beskhvostyi Planer: tailless glider, also referenced as TsAGI-3), designed by Victor Belyayev and tested in 1936. Her wing platform looks like the one of the "Genesis I" (Slight forward swept, separate horizontal rudder). More to come.

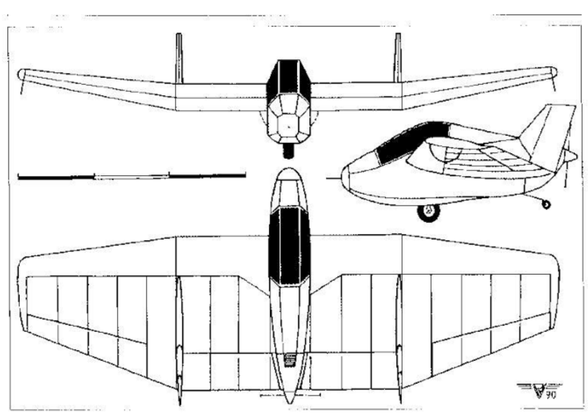
(ed. - After receiving this e-mail I wrote back and asked Philippe for more information on the Ring Wing and Pelican, which he quickly did by return message. This method of communicating is just super, since he was able to send the 3-views that had apparently gotten lost in the regular mail. The descriptions and drawings are included below.)

Dehn "Ring Wing": This aircraft was designed by German born designer Karl DEHN, in Australia. Flying tests were conducted in 1982 by Ben Buckley, but were stopped after Dehn's death, at the age of 67. Project of a motorized version not carried out. No spec available here. This glider is now preserved by the Airworld Museum of Warangatta. (*-Photo Allan Bell/Airworld Museum).



Debreyer "Pelican». This aircraft has been designed by Jean Claude DEBREYER and is now manufactured and marketed in kit form by the company AIR EST SERVICES, Marly, France. (3V drawing of the prototype JCD-02), (*-pictures of the production aircraft JCD-03/ Photo Air Est Services).

Specifications JCD-03: Span : 7.20m, Length : 3.10m, Area : 12m2, Main chord : 2m, Thickness : 17%, Empty Weight : 80/85kg, Max. Weight : 175kg, Engine : One Solo 210cc (15hp), Pusher propeller 0.75m Dia, Cruise speed : 75km/h, Landing speed : 45km/h, Take-off run : 150/200m, Autonomy : 3 hours. Fuel consumption : 3 l/h, Structure : Wings : Foam and Dacron, Fuselage : (Prototype : wood), Production aircraft : Composite materials (Molded fiberglass shells).



‘It Ain’t Got No Tail”

(ed. - This is the second part of Lloyd Watson’s recount of his experiences in test flying his Pioneer IId flying wing. The first part was printed in the September ‘98 newsletter.)

(At the end of last month we read:

“I chose the runway into the 3 knot wind. Clear blue and as I strapped on the parachute it hit me. I going to test fly this wing. For most of my life I have had a obsession with wings. In John Sealy Hospital at age 6 or 7 I remember my father bringing me a Cutlass Jet model because he could not find a flying wing I saw in popular science magazine. I built RC flying wings with the help of friends in Virginia and even stopped in Chino and saw the N9M. In my youth I saw a flying wing plank test flown in the valley of Texas and it just been a part of my dream. Now the dream was at hand.” *And now we pick up the story.)*

I stepped in the cockpit and for some reason felt calm and warm. Everything slowed down. Even with all the activity around the world got quiet. My spirit was calm and I proceeded with the check list step by step. Radio check, Release check, Control check, seatbelt check, thumbs up from my brother on the wing and the radio crackled, N86TX on runway 17 New Braunfels for glider tow and test flight. With that the rope pulled and we rolled down the open runway. My self was focused on deciding the first 200' if it was going to be stable. Then the noise of the skid stopped. Calm, quiet, and peaceful.

Jim Marske, designer and Mike Hostage, builder/owner of a Pioneer IId gave me all the words of confidence and support but this was the true test. Lift off and in ground effect. The cub pulled to 70 mph and we started to climb. The airport has three runways in a triangle so we turned left to always have a landing source if needed. 300' calm and the wing is just beginning to relax. What about me. The wing just says cool it, I been waiting years as you built me to get here, shut up and lets enjoy this. OK. Check roll carefully, OK, check airspeed 70mph now at 1000'. I had decided to go to 2000' on the first tow is all is well to give me a 1000' to just fly smooth. The air is dead calm and very smooth.

One circle of airport and we are now at 2000' north east of airport. I reach to pull the release and everything stopped for a second. It the movie version of slow motion. I had dozen of ground tows but we are at 2000'. Nice calm voice said ' I want to be free " so with a smile and a prayer, I pulled the release. For the next 20 -30 seconds we flew without a single input. Slowed to about 55-60 and just flew. I said to myself, self this is what it all about. Slowly I turned to the left to over fly the airport to go south. It was like the wing was stretching its wings after a long, long sleep. No surprises and just very smooth. Did some slow turns 45s then 90 at about 10 degrees and no more. Always talking on unicom to insure ground and chase knew my intentions.

Down to 1500 feet. Decide to slow down and she just said OK! Now at this height my mind turned to pattern and landing. Tow plane down and chase plane clear and advising traffic of test flight. Turning down wind found myself at 1200 feet for 17 so without even thinking full spoilers. The wing said OK! Now at this point my toes starting to hurt and I realized I was trying to push the rudder pedals out the front of the plane. RELAX said the wing, we've done this before. Down we came but going cross wind I was at 600' so continued full spoilers after making turn. Turning to base and still at 400' so remained at full spoilers and had plenty of room. Keep the speed up Lloyd! Small voice said just watch this squeaking clean touch down. OK I said and she just rolled to a stop about 300' from the numbers down the runway. Wing touched the ground and Lloyd had about a minute to thank the great designer of life for everything and then tell my wing thank you.

The next tows were each to 4000' and we found a mush rate of decent (stall) to be at 40 knots but we still have some nose weight to remove.

First 4000' tow was quiet and peaceful. Did some 90 degree turns at 45 then 75 degrees good response. Wing has a slow tendency to lift the left wing. Will adjust later. Did some stability test on pitch. Increaded speed to 85 mph and then released and did two cycles of pitch until wing stabilized at 60 maybe 58 in level flight. Tried several 360 left and right. Wing want to turn right better but will see after adjustment. Did some more approaches to stall and no tendency to fall off. Wing is heavy with nose weight and parachute and overweight pilot. Landing was nice and very conformable. Crew and family came over to tell me how good it looked.

Last flight to 4000' was uneventful for tow. Did some slack rope tests for yaw with rudder and it did well. Touched spoilers in tow to see effect and was controllable but noisy. Very rough now from 150' to 2700' wind has picked up to 12-15 from radio call from ground. My radio has failed so with pre-test rule if no radio from glider occurs, the ground unit calls all heading and approaches for traffic. At 4000' off of tow decided to try 360 at 80-90 degrees and worked well spiraled down to 3500 did some mild approaches to stall at turns to see if any tip stall occurs. None yet. Hit rough air at 2700' and get bounced. Interesting that at 2500' into wind the wing now is climbing at 150' per minute. Stay here for about 5 minutes at 2500. I go lower, but into wind climb back up. Decided to turn down wind and then penetrate upwind. In downwind turn I dropped about 150' with no warning. Hand held radio floats by and I grab it. Now wing what the (&()^&@#$^ are your doing or is it you Lloyd. I stabilize and fly back into wing. Go right back up to 2500'. Wing did well, pilot is sucking air. Calm Voice says just set back and watch. I notice that I am getting a wind gradient shift at about 2500' so I am doing the pelican bounce for lift or maybe found a small low level rotor. I turned down wind just at the shift and fell out of the sky until I regained airspeed. Don't want that close to the ground. I looked at the wind sock and it was almost straight out. Boy did the wind come up. OK now high approach but I am still at 2000'. I do several S turns and long shallow turns to get down to 1000 for downwind. Close spoilers and I am trucking downwind at 900' at midway down wind. FULL spoilers and I decide to hit final at 500 instead of 300. Turn cross wind at 600 close spoilers and turn final about ¼ mile from numbers at 550. Point nose to numbers and go to 70mph and full spoilers. Wing tell me this is fun. Got some news for wing. Use full spoiler until ground effect and then level at 65 and let headwind slow to 45 and touch spoilers to make a soft touchdown. Then it occurs that I have landed on numbers and am 100' from crew and just taxi over to them using spoilers and brakes.

We load the wing and go home and have a beer and wine. Wing safely in trailer and pilot safely in hammock. I give my wife a big hug and tell her how much I love her and Thank You.

Thanks Marske, Irwin, Hostage, Ralph, Rayford, Herk and my Dad and my Brother for all the hard work. Thank you Honey for all the patience and putting up with this nut that wanted to fly a wing!

Yes, wings do fly!

ABOVE: This is one of Allan Morse's creations he sent us not to long ago. It sounds like he has had good and bad experiences with some of his models, but obviously he doesn't quit trying to get the best out of a flying wing.