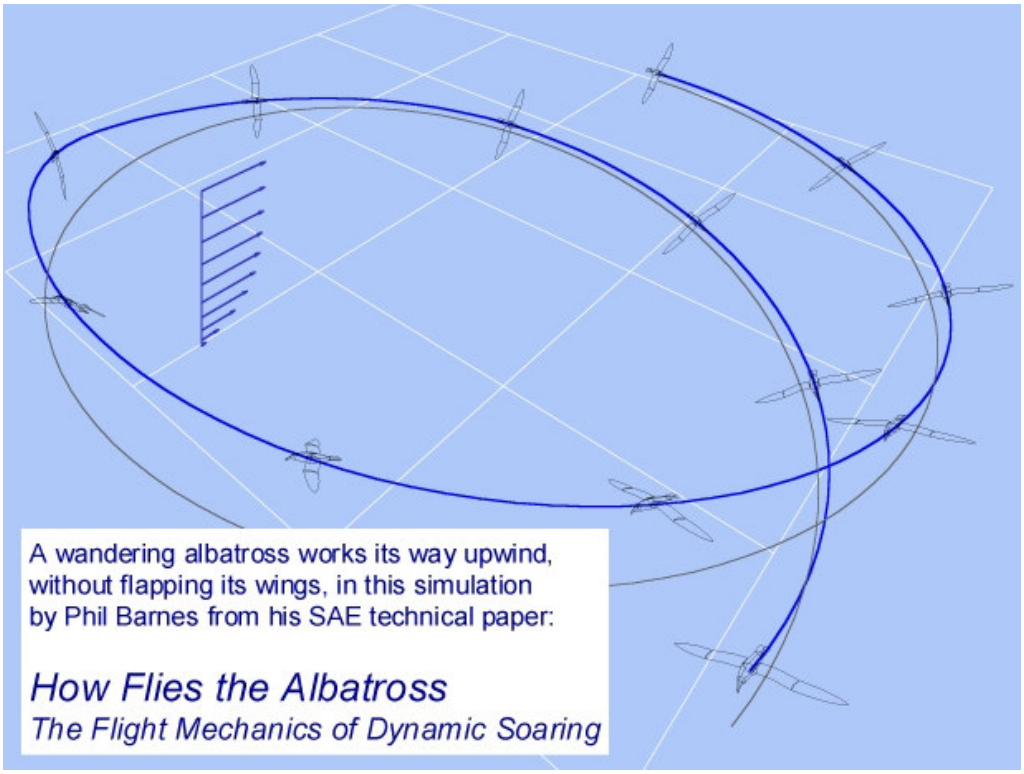
No. 225 MARCH 2005

# T.W.I.T.T. NEWSLETTER

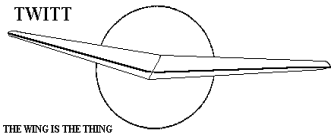
**This is one of the graphics showing the flight of an albatross performing dynamic soaring. See more about Phil Barnes upcoming presentation on page 2 inside.**




**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., **0503** means this is your last issue unless renewed.

**Next TWITT meeting: Saturday, March 19, 2005, 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 (#1720), east side of Gillespie or Skid Row for those flying in).

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## PRESIDENT'S CORNER

This month the newsletter is composed mainly of pieces from the Nurflugel bulletin board since I didn't have very many "real" letters to use. But I have tried to spice them up a little by adding some pictures from the Internet to illustrate specific points being discussed.

I have also included a couple of pictures I took at the recent SSA Convention held in Ontario, CA. You would think that after all these years doing this I would have learned to write down information about each of the shots as I take them, but alas I did not, so the descriptions are less than a full report of the pictures.

However, I did want to make a point about the shot of the Rotax engine and propeller combination. I included it because I think it is important to stay on top of the things from conventional aircraft that are applicable to flying wings. Here is a developed engine package that is finding widespread acceptance in the motorglider world that could be very easily fit into a flying wing. It looks very compact with a minimal amount of associated equipment like a cumbersome reduction drive.

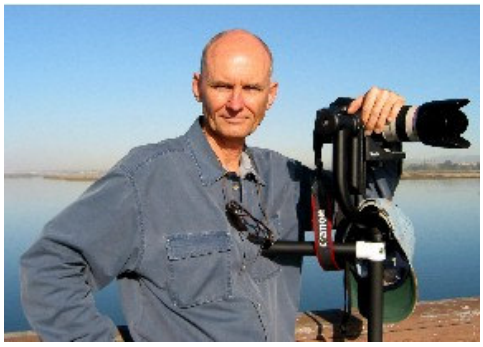
I thought the propeller was especially interesting in that it folded rather than feathered, like most of the other designs on display at the convention. For a flying wing this would mean a trailing propeller on a pusher installation thus eliminating the need for the pilot to determine the props position for optimum performance. It also keeps it out of the way during a power-off landing.

It was interesting that at least half of the aircraft on display at the convention were motorgliders. This appears to be the wave of the future as aero-tow costs continue to rise at the FBOs and pilots begin looking for sailplanes that are a little more flexible in terms of cross country flying. Obviously, flying wings could do this much more economically, but I am not seeing any interest from manufactures to move in that direction.

Andy

## MARCH 19, 2005 PROGRAM

The March program will feature **Phil Barnes**, a long time TWITT member and past speaker, who will enlighten the group on how the albatross flies over the oceans using dynamic soaring. We have heard a lot about this technique over the years, especially through SHA's Western Workshops, but this will be a more technical overview using all the tools Phil has in his kit bag, featuring photography, paleontology, physics, math, and aerospace engineering. The presentation includes real-time simulations of a wandering albatross executing dynamic soaring maneuvers.



Make sure to mark your calendar right now so you don't miss this program.

His presentation will be done with a computer-projected program so the graphics and pictures should be outstanding to view. You won't get the full effect if you wait to see some of them in the newsletter the following month.

## LETTERS TO THE EDITOR

March 1, 2005

TWITT:

RE: Akerman Tailless

I have been going back and reading back issues from #1. I go back every couple of years and read the old issues. I have been trying to find something on the Akerman Tailless for a long time. I first saw it in the Airtrails magazine back in the 1940's. In newsletter issue #147 Sept.1998, page 2, Al Backstrom sent in some materials. Are they still available? Do you know how much it would cost to get the materials?

Thank you for your time and consideration CAVU,

Fred Blanton
<fnjblanton@prodigy.net>

*(ed. – After going through the archives I found the material Al sent to us in 1998. It is composed of: "The John D. Akerman Tailless Airplane (Model I - 1936)", John D. Akerman, Minneapolis, MN, March 31, 1969. pp. 10 + attachments; "Stability of Tailless Gliders", Stan Hall, Ground Skimmer, July 1976, pp. 22-26. These items can be made available to others who might be interested for $5.00 in the US, which includes handling and shipping. If you are overseas, add $2.00 US for the extra postage.)*


*(The following are messages extracted from the Nurflugel bulletin board that I thought were of general interest to those of you who do not have Internet access or do not participate in this group.)*

January 2, 2005
From: "Norman" <nmasters@acsol.net>
Subject: BKB at WoodCrafters

A few months ago I heard that Ken Bates had built a scale BKB-1. Last night I found some pictures from the May '04 Woodcrafters in Muncie, Indiana. http://www.mkrusa.com/WC_04.htm

Enjoy

Norm

January 8, 2005
From: evolbaby@aol.com
Subject: Aircraft, Aeronautics, Space Flight Books for Kids?

Any recommendations for books on the subject to introduce kids 8-12 about the history of flight? I mean the good books and videos that give credit to the people who did the designing and test piloting and troubleshooting.

If there aren't any it would be cool if one of you pros put out a product like it. DVDs too. Since we're a 'flying civilization' it would be best if the kids learned from the best as they'll be the engineers and pilots soon.

Best,

Greg

January 8, 2005
From: Henry Matthews <hm0062000@yahoo.com>
Subject: Re: Aircraft, Aeronautics, etc.

Hello Greg and all,

I know of no such books (or DVD) on the market, but
years ago, I planned an aerospace educational series for children, with the following titles:

- The first pilots
- Bridging the continents
- The first jet pilots
- The first rocket pilots
- The first supersonic pilots
- The first swing-wings
- The first ramjet aircraft
- First across Mach 2
- First across Mach 3
- First across Mach 6
- The first Space Suits
- The Space Animals
- The First Spaceships
- The First Space Planes
- Flying without Wings
- Invisible Aircraft
- First space walkers
- First Women in Space
- First on the Moon
- The first Space Stations
- The Shuttle
- Flying Wings
- Teacher in Space
- Journalist in Space
- Doctor in Space
- Flying Bedsteads
- First Rocket Fighters
- Balloon spacemen
- ... (the titles are almost endless)

Each title would have been a colorful easy to read booklet, beginning with a simplified explanation of the concept (i.e. ramjet, swing-wing) followed by a historical narrative with pictures of the planes and the pilots, sketches and, at the end of the booklet, a quiz and an invitation to each young reader to write an essay or make a drawing about aerospace exploration. The essays and the drawings would have been later published in a special edition. Supplements (coloring books with X-planes and spaceship drawings to color) were also planned.

This initiative did not proceed because of the usual financial difficulties. Color printing, hard cover binding and deluxe production were (and still are) beyond my means. And I was not sure I can get this series promoted successfully.

Regards

Henry Matthews

January 8, 2005
From: Norman Masters <nmasters@acsol.net>
Subject: Re: Aircraft, Aeronautics, etc.

"Orville Wright, How We Invented The Airplane" ISBN: 0-486-25662-6

"The Wright Flyer, An Engineering Perspective" ISBN: 0-87474-979-4

"Early Flight, From Balloons to Biplanes" ISBN: 1-55521-227-1

"Milestones of Aviation" ISBN:0-88363-316-7

"Milestones of Manned Flight" ISBN: 0-8317-6050-0

"The Air Racer": ISBN 0-933424-01-9

"Soviet X-Planes" ISBN: 0-87938-498-0

"Taub, Dove of War" ISBN: 0-911852-82-4

"Gee Bee, The Real Story of the Granville Brothers and Their Marvelous Airplanes" ISBN:0-934575-04-5

"Operation Pinball" ISBN: 0-87938-472-7

"Unconventional Aircraft": 0-8306-2384-1

"A History of Aircraft piston engines" ISBN 0-89745-079-5

"Winged Wonders, the true story of the flying wings" ISBN: 0-87474-966-2

Norm

Henry Matthews replied with: These are not books for kids.

To which Norm responded:

If they had been available to me when I was 12 I would have read them. Most of them are not very technical and, except for "The Wright Flyer, An Engineering Perspective" and "A History of Aircraft piston engines", none of them are beyond a bright 6th grader. But I suppose that depends on the quality of the school district you live in.

Henry responded with: I still say these are not books for kids in general. Of course some kids, with an adult's aptitude, and a passion for aerospace will read them eagerly, but, in general, a book for kids should be in simple language, colorful and well-illustrated.

And then the following came in:

January 9, 2005
From: "Andrea" <brownar@eircom.net>
Subject: Re: Aircraft, Aeronautics, etc.

Hello Henry,

If you don't mind I would like to say I both agree and disagree with you.

I sometimes assist in teaching teenagers who cannot attend school for various reasons.

I have found that having books that are full of illustrations and diagrams and books that are technical as a mixture for the kids is best. The reason I say this is that the books with the bright pictures, easy diagrams etc, can be used to stimulate interest and then if they are further interested the technical books can be read by them until they reach the limit of their understanding, which I have found to be the best way to teach teenagers, in my experience.

I don't go by my own childhood experience, as everyone's experience is different. I find that if a child is given information at a level they can understand they will learn and want to know more. Every child is different. Some have bothered to understand the most basic diagram on one subject but excel in another whereas some are capable of teaching adults some items of information after only a short time learning about a subject.

My advice on this is to give the children a good mixture from very basic right up to extremely technical so as to allow each child to learn to the best of there ability.

Kind regards

Andrea

Henry responded with:

Hello Andrea,

You are right. I agree with every word you wrote.

Every child is different. The series that I wanted to publish, with bright colored pictures, easy diagrams and simple text would have been a stepping-stone, to stimulate interest in the more advanced books. In fact even my (published) books, which are basically historical but contain a technical descriptive element, have resulted in queries by readers wanting more technical material.

You are absolutely right. The mixture option is the best.

Regards

Henry


**ABOVE:** This was the only flying wing type aircraft at the annual SSA convention that was held in February at the Ontario, CA convention center. I got busy taking the pictures and didn't get the details, but it was one of the typical hang glider with associate equipment.

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January 10, 2005
From: "Koen Van de Kerckhove" <nestofdragons@hotmail.com>
Subject: Junkers flap variant idea.

Am I right when I say the following:

If you use a Junkers flap on a flying plank design, you don't have an auto-stable wing. OK, the stall might be later, but ... it still is there. Now, can you create a auto-stable effect if you make the thickness of the flap larger?

If you say "Huh???", let me explain. I sketch my flaps as inverted airfoils. Just imagine a Clark Y airfoil upside down. Now, give it a large thickness. At some point the thickness will lead to a stall of the flap. If you can make sure that the flap will stall BEFORE the main wing, it should lead to an auto-stable wing, isn't it?

Am I right here?

Another thought. By making the flap thicker, do you create a larger venturi effect between the main wing and the flap? If yes, does it create more stall-delay on the main wing?

Last thought. If the thicker flap stalls it will have a air separation effect on the underside of the flap. Normally the flap is a reason for a delayed stall of the main wing. I feared at first that the main wing would stall at the same time. But ... there is still an "undisturbed" venturi-effect between the flap and the main wing. Remember, the air-separation is on the UNDERSIDE of the flap.

OK, a lot of thinking. It all hangs on each other. If I am right, the BULM in Junkers flap configuration is getting more and more for beginner pilots. I cross my fingers.

Keep that brain spawning wings,

Koen

PS. I bit of Swiss air is good for inspiration. Or ... it might be that hard fall I had at the beginning of the ski-week. ;^)

January 30, 2005
From: Mark Hills <markhills@clara.co.uk>
Subject: tip losses

Is it better to have the ailerons extended out to the wing tip or finishing before the tip, (300 mm for example)? I want to look at things purely from a drag point of view. If the aileron ended before the tip there would be the flow disturbance formed at the end of the aileron and another flow disturbance formed at the wing tip. Conversely, if the aileron ended at the wing tip there would be only one.

Thanks

Mark

January 30, 2005
From: Dennis Mingear <dennismingear@yahoo.com>
Subject: Re: tip losses

What about "Mitchell type" elevons as employed on the B-10 and U-2, any comments?

Denny ...

January 30, 2005
From: Norman Masters <nmasters@acsol.net>

Subject: Re: tip losses

Hi Mark--

I lurk on the Allegro-Lite mailing list. This has been discussed there. Dr. Drela suggests running ailerons clear to the tip for a small decrease in drag and increase in effectiveness. The tradeoff is that the aileron is vulnerable in the event of a ground loop.

Norm

January 31, 2005
From: "Serge Krauss" <skrauss@ameritech.net>
Subject: tip losses

Regarding the extension of hinged control surfaces to the tip, perhaps you should also consider control effectiveness. Perhaps one of them will respond, but it seems to me that I read that Al Backstrom and Jim Marske each encountered reduced control effectiveness with elevons extended to the tips on their early "plank" type sailplanes. The vortices interfered. About his XM-1 glider, Jim wrote that drag rudder (hinged horizontally to the elevon) effectiveness was hindered and that a 15" tip extension past the hinged surface dramatically increased performance too. I don't know whether this performance increase was entirely due to increased span. FWIW.

Serge

February 7, 2005
From: "Jamie Crane" <jcranegt90@tds.net>
Subject: Introduction

I am in the early planning to build a full-size wing that would qualify for the new sport pilot category. The PUL-9 or 10 would fit the requirement very well and the N9M could be a possibility, but after searching the archive it seems that there is very little available as far as drawings or plans to study on any of these. I have been to most of the web sites mentioned in the archive and recognize some of the members in this group from their web sites. Any additional information on these aircraft would be very helpful.

Thanks in advance,

Jamie

February 8, 2005
From: "Roberto Cerana" <roberto.cerana@tin.it>
Subject: Re: Introduction

Very difficult to find plans of PUL 10/PUL 9. You do not find the plans in the archive because they do not stay there. Do not plan to build a PUL 10 (below) because is a wrong wing. I know the people that they have flown for more than 100 hours and they said to me all the problems they have had. At the end the PUL 10 crashed for instability.

The next week I will have a meeting with this people because I would like to build a wing like a PUL 10 for me but without the mistakes they have made.

I do not know where you live but if you have planned to build I think is a better choice to speak with these people before. The original project (Horten draw) is the PUL 9 (below) much better than PUL10 according these people.

I give you my complete address and telephone number:

Roberto Cerana
Via Galileo Galilei 5
21057-Olgiate Olona ( Va )
Italy
Telephone and fax number Italy 0331-640530

I do not know if from international you must use 0331 or 331.

Greetings,

Roberto

February 23, 2005
From: Russell Lee <russlee_99@yahoo.com>
Subject: Re: Digest Number 1569

I am struggling to untangle the elevon deflection schedule that Reimar used on the four Ho IV sailplanes.

I had a thought (yes, I know - dangerous!) Could Reimar have set up the wings on one or more Ho IV so that the elevons deflected to different angles between the left and right wing sections?

It could be a clever way to double the number of different schedules he could test per flight...

What led me down this slippery slope is that Reinhold Stadler seems to suggest that the Ho IV prototype Werk Nr. 24 deflections were asymmetrical between the wing halves. Reinhold, if I misunderstood your findings, I apologize - this is strictly my interpretation!

The assessment published in the Wilkinson report, Aero 1703, shows that Werk Nr. 25 had some rather marked asymmetry between the left and right sections but I always thought the glider had been mishandled and mis-rigged before Wilkinson and his team examined it.

Russ Lee

February 23, 2005
From: Albion Bowers <al.bowers@dfrc.nasa.gov>
Subject: Re: Digest Number 1569

Russ,

Russ, if YOU can't figure it out with YOUR documentation, what do you think WE CAN DO!?! Seriously, we appreciate your asking us. And yes, Reinhold potentially has insight here that few of the rest of us would have...

No, it doesn't work that way. You'd still get asymmetric deflections on the wing going up and the wing going down when rolling. I get headaches from thinking about the implications from a stab & control standpoint (it probably would have given old RT Jones a headache too, and he was a BIG promoter of the oblique wing idea!).

Now this is a distinct possibility. Because of the adjustment range in the pushrods built into the wings. Looking at the drawings *(Wilkinson report),* this is obvious, as the amount of adjustment available far exceeded that necessary to simply "rig" the wings; changing the gearing of the control surfaces on the wings, and the consequent "handling" of the aircraft afterwards as well.

In such a case, it may have been that the aircraft was being re-geared for a different control throw scheme, and the crew was interrupted part way through the process. This could be for any number of reasons, another project needing more hands for help, or the chaos at the end of the war, or anything else.

I would assume this. Keep in mind, the MSU H IV (Werk Nr 25 IIRC) was also mis-rigged after MSU rebuilt it, and the MSU folks were pretty astute themselves. In Georgy-Falvy's report, the control deflections clearly show that the surfaces were mis-rigged (at no stick deflection were ALL the surfaces faired SIMULTANEOUSLY, this is clearly mis-rigged).

Also, if so it is unfortunate that Reimar was unable to complete his experiments on gearing. It may have been he was thinking about the adverse yaw problem at that point. The documents I have copies of show that he did SOLVE this problem in Argentina, but he may have been thinking about it while he was still in Germany.

Intriguing...

Al

February 24, 2005
From: Bill & Bunny Kuhlman
<bsquared@appleisp.net>
Subject: 01/05 Aerospace America article

The January 2005 issue of Aerospace America, the AIAA magazine, features an article entitled "New Twist on an Old Wing Theory." The paragraph of note states: "It shows that an unswept wing of any planform shape can be designed with proper twist implementation to produce less induced drag than any tapered wing with no twist."

There is no mention of the use of this technology as applied to swept wings.

The end of the article describes "twisterons," full span ailerons which can be deflected to differing upward and downward angles throughout their entire length.

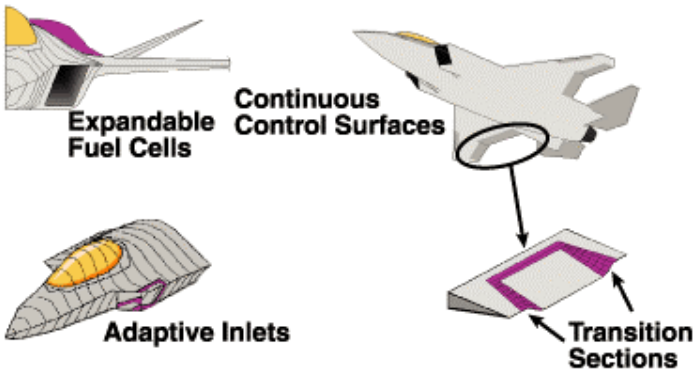
One of the additional benefits of wing twist tailoring is suppression of the tip vortex and a reduction of needed elevator trim.

Fascinating article, but we're wondering if there are any misconceptions or errors in thinking which are being sustained or promoted.

Bill & Bunny Kuhlman

February 24, 2005
From: Albion Bowers <al.bowers@dfrc.nasa.gov>
Subject: 01/05 Aerospace America article

Exactly. But then, when you only have 2000 words (or however many) authors often have to limit the numbers of words. It's one of the problems of big publications, you have to fit THEIR format.




These are neat devices. If you couple them with a continuous outer mold-line you have a VASTLY advantageous system. Low drag (no gaps or discontinuities) and continuously variable across the span. The problem is the force required to power these things is high, unless you do some creative things to reduce (or "tailor") the force required.

http://www.afrlhorizons.com/Briefs/Dec02/VA0203.html

I didn't catch any *(misconceptions)*. But I thought it didn't go far enough. But like the rest of us here, I'm biased. :-)

*(On another thread)*

*Doug Holverson writes:*

*"Also, if so it is unfortunate that Reimar was unable to complete his experiments on gearing. It may have been he was thinking about the adverse yaw problem at that point. The documents I have copies of show that he did SOLVE this problem in Argentina, but he may have been thinking about it while he was still in Germany. So how did he solve it?"*

Now wait a second Doug. Didn't you build a Horten-ized Klingberg? I seem to recall that you were building one. In order to do that, you've gotta understand what we're trying to do here. ;-)

Seriously, because Reimar used the ENTIRE trailing edge of the H IV and H VI for roll, there were pretty substantial amounts of adverse yaw in those aircraft (as well as the H III before them and others afterwards, until his later Argentine designs). If he had changed the gearing so that most of the roll came from the outermost elevons, the adverse yaw would have been greatly reduced, possibly eliminated. Further, playing with the gearing could have maintained a stronger bell shaped span load over more of the envelope by using the entire trailing edge control surfaces.

Unfortunately, Horten compromised on his Argentine sailplanes (I think it was all he could do in the less sophisticated conditions, so he reduced the system complexity), and only put in single elevons on each side (the H XV a/b/c series, the H X b/c, H I b/c, etc). If the gearing had been refined in the H IV and H VI, those would remain the ultimate flying wing sailplanes, even through to today.

IMHO. (In My Humble Opinion)

Al

PS. An all composite (maybe a carbon spar with fiberglass skins) H VI with the proper gearing and modern airfoils (Wortmann, Eppler, or Horstman-Quast) would be devastating in competition. Use continuous mold line surfaces and twisterons (twistervons?). Something in the 24 to 30 m span range...

February 24, 2005
From: doug holverson <dholverson@cox.net>
Subject: Re: 01/05 Aerospace America article

*Al Bowers writes:*

*"Now wait a second Doug. Didn't you build a Horten-ized Klingberg? I seem to recall that you were building*

*one. In order to do that, you've gotta understand what we're trying to do here. ;-)"*

I thought a lot about it. Cut out the servey jigs and then got very cold feet when nothing lined up with the blueprints.

*Al writes: "Seriously, because Reimar . . . . surfaces."*

So if I was building a 'wing, I would gear the outer elevons to deflect more and the inner ones to deflect less?

DGH

February 24, 2005
From: Carlo Godel <regiaero@acsol.net>
Subject: Re: 01/05 Aerospace America article

*(Response to Al and Doug's comments above.)*

One can also make the ailerons move differentially allowing only the up aileron to move and have no down aileron movement at all. The down aileron produces far more drag creating the adverse yaw, when you eliminate the down aileron it will eliminate the adverse yaw. It works very well in small models of 2M or less in span using separate elevator surfaces.

Carlo

February 25, 2005
From: Russell Lee <russlee_99@yahoo.com>
Subject: Re: Digest Number 1571

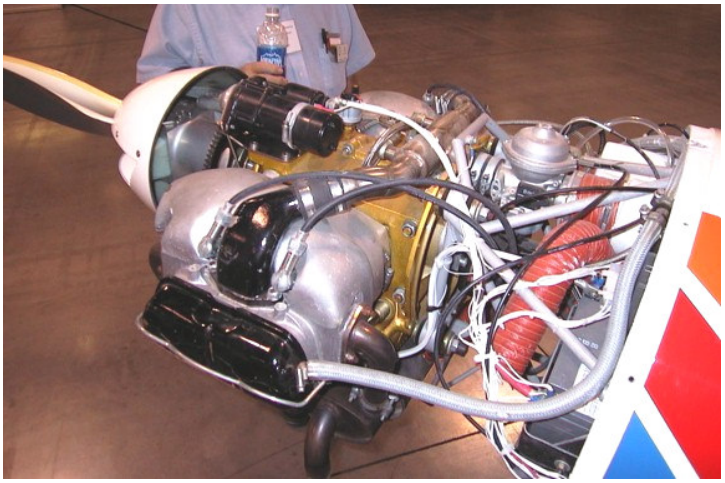
Maybe the key problem was Reimar's attempt to use elevons rather than flapervators. From the Ho I until well after WWII, he uses these long, broad elevons that usually span from 1/3 to 2/3 of the half-span trailing edge. If he had concentrated on making small ailerons work from the get-go and combined the elevator function with the flaps, could he have designed better-handling wings (less adverse yaw) with higher L/D?

So, Why elevons? Beginning with the Ho I, was he interested in using the trailing edge to experiment with lift distribution?

If so, then he had two fundamentally different goals: Development the most efficient lift distribution for all-wing aircraft in level flight; and for maneuvering, solve adverse yaw with minimum impact on L/D.

Maybe he designed the Ho IV and VI as another series of experiments and thus, adverse yaw was acceptable under that condition. He admits the Ho IV b was designed with series production in mind.

Russ Lee



**ABOVE:** This is a Rotax 542 4-cylinder motorglider installation with a forward folding propeller (vs. feathering) at the SSA convention.

February 25, 2005
From: Albion Bowers <al.bowers@dfrc.nasa.gov>
Subject: Re: Digest Number 1571

Russell -

That's the control scheme for the original H I and reversed for ALL the Northrop flying wings. And it's a failed solution. Here's why: you're at the ragged edge of stall hanging there with the nose high (how you got there, pilot error or adverse gust, whatever, it doesn't matter). With the elevator up, the load is on the wing tips. You stall the tips and enter a spin (asymmetric is almost always a fact of life, one side or the other will let go first). With elevons, you have the tips with control surfaces up, so they have a "geometric" washout, which helps to prevent the tips stalling. So the center stalls first, the nose falls through, and it can gracefully recover controlled flight. Some characterize this as "mushing" flight when entered gently.

Ideally, you'd like the entire trailing edge to deflect in a proportional ratio to trim at the desired flight condition. But the roll control should be primarily near the tips. So the tips are the elevons, and the rest are elevators.

I think Reimar found the solution. But he was never able to fully execute on it. I still believe that had the total solution been applied to the H IV or H VI, it would have been a breakthrough like nothing seen in soaring, or possibly aviation, since Wilbur & Orville.

It would have been the closest thing to bird-like flight ever done, both in performance and handling. IMHO.

Al

February 26, 2005
From: Chris Bryant <chris@palenquin.demon.co.uk>
Subject: Re: Digest Number 1571

Perhaps a 'cultural' point is relevant here.

Given that the performances of gliders in the late 1930s and early 1940s was such that the majority of their flight time was spent in circling flight as opposed to level flight, then the emphasis up to this time was on minimizing sink rates and, therefore, maximizing climb rates. Better L/Ds were a bonus but secondary to better climb rates. The corollary is that they thought it worthwhile to fly in thunderclouds whereas we - with our much higher L/Ds and mission adaptable control systems - would feel such excursions to be a rather dangerous waste of time. Our emphasis is on efficiency with speed; don't stick around in the sink.

So, climbing performance, control and stability in the turn were paramount over cross-country speeds. If what Al says was true, it seems that Reimar Horten was beginning to look much farther ahead. He wanted it both ways.

Chris Bryant

February 27, 2005
From: Russell Lee <russlee_99@yahoo.com>
Subject: Re: Digest Number 1573

Chris, that is absolutely a key issue and I would argue that Reimar was 'late to the party.' The trend to higher wing loading/faster cruise starts in Germany about 1935, however, he continues designing and building Ho IIs, 'IIIs, and the ultimate 'floater,' the Parabel. *(Sidebar: I had always overlooked this little jewel but it really was a fascinating design, span 12.2 m (40 ft), empty weight 89.1 kg (198 lb), that is 25.2 kg, 56 lb, less than an FAA Part 103 ultralight but only approximately 100 lb more than most hang gliders! The structure was extraordinarily light-weight, for example, the leading edge skin thickness varied from .6 to 1 mm (.04 - .02 in). Remarkable that before WWII Horten could design and build such a lightweight cantilever structure fitted with a completely enclosed cockpit! - end of sidebar)*. My point is that construction on the Parabel was still underway when the war began late in '39! I am not sure why he stayed with the floater designs for so long in the face of so many successful penetrators – the Wiens, Riehers, Mieses, etc. but it was not until the Luftwaffe put him to work converting Ho IIIs to carry ammunition for Op SeaLion did he break completely from past work and begin to build the Ho IV.

Russ

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