No. 159 SEPTEMBER 1999

T.W.I.T.T. NEWSLETTER

CAN ANYONE IDENTIFY THIS PICTURE? CAN'T FIND WHERE IS ORIGINATED.

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., **9909** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, September 18, 1999, 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).

TWITT NEWSLETTER SEPTEMBER 1999

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

I am really excited about this issue since we have some really nice pictures of the Horten IV restoration from Germany. I made room for all of them in the newsletter since many of you don't have access to the website where I will also publish them, but in full color. We have to thank Eric du Trieu de Terdonck for the pictures and the information that goes with each one. They all came through on the information super highway (Internet e-mail) and are of just super quality.

I just got back from the SHA Western Workshop which was very well attended by homebuilders from all over the western US. The morning speaker sessions were enjoyed by all and covered a wide range of subjects so every homebuilder could learn something new and useful. Bruce Carmichael and his team put together another winner this year, so if you live in Southern California and didn't make it to Tehachapi for at least one of the days, you missed something special.

As I mentioned last month the web page was going to get some updating and I was able to get to it. If you haven't seen it lately make sure to pull it up and go over some of the new material. I added several new links, put out more information than what was in the newsletter on the Nighthawk and, added the Satre S.E. 2100 flying wing. Hopefully by the time you get this I will have added the Horten pictures and published a page with more on the blended wing body concept being worked on by Boeing.

If anyone has something out there that we should include on the web page, like a new link or some pictures you have taken, please let me know. This is "your" site so it needs to represent what our members are all about. If you need any pictures back, I can scan them with no damage and return them to you.

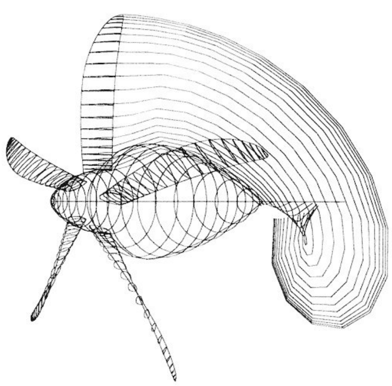
Andy

SEPTEMBER 18,1999 PROGRAM

At our September 8 TWITT meeting, Phil Barnes will review and apply classical and state-of-the-art methods for propeller geometric and aerodynamic design. Aided by charts from Phil's recent presentation at the SAE '99 General, Corporate and Regional Aviation Meeting, we will first cover the basics – pitch, advance ratio, thrust coefficient and, efficiency. The, we will study the effects of the wake on the propeller and this will include a discussion of the classical contributions of Betz, Gauert, Goldstein and Theodorsen.

Next, Phil's "Vortex Step" aerodynamic method will be briefly summarized and its thrust loading prediction compared to both Glauert's prediction and NACA test data. Then, we will apply the method for the preliminary design of a propeller optimized for high-speed cruise, shown with the wake from one blade in the figure below.

Color transparencies will include contemporary and experimental domestic and foreign propeller-powered aircraft and propeller geometries. Copies of Phil's technical paper, published in parallel by SAE with permission, will be available at the SAE price of $15. Copies of Phil's TWITT propeller presentation charts, excluding photographs, will also be available for $10.



MINUTES OF THE JULY 17, 1999 MEETING

(Last month the minutes went up through Taras Kiceniuk's presentation covering vertical dynamic soaring in sink. This month we will finish with horizontal and thermal techniques.)

Let's consider dynamic soaring with horizontal wind shear and see how it is done. When we do this we are using our sailplane as a sort of dynamic windmill. A windmill is fixed to the ground on a tower and uses the earth as a basis for pushing against the moving air. A dynamic soaring glider transfers push (force/impulse/momentum) between fast moving air and air that is at rest, or air that is moving more slowly, or (best of all) air moving in the opposite direction.

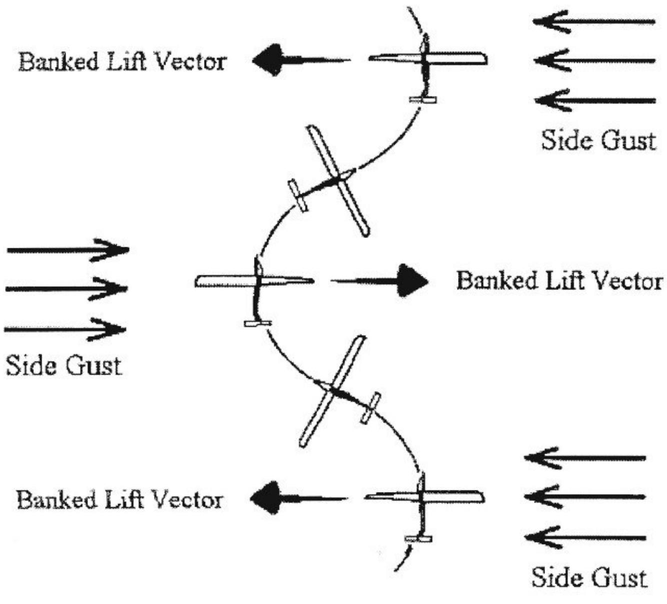
The Albatross is famous for soaring the wing gradient over the open ocean in this way. How can we do it in a glider? First we connect with the fast moving air and push on it opposite to its motion. We do this by banking the glider belly into the wing and pulling back on the stick; this extracts energy from the moving air and gives the glider extra momentum in the direction of the wind. We then maneuver into the air that is not moving (often at a different altitude) and we bank to push on this air in a direction opposite to the initial push. This transfers the glider's extra momentum into the still air. Some energy may be lost in this second push (if the air is not at rest), but overall we can gain energy in the cycle. We then maneuver back to the fast moving air and repeat the process.

The energy gained is equal to three factors multiplied together: the force of the initial push opposite to the air movement, (times) the duration of the push, (times) the difference in velocity between the two blocks (or layers) of air. For example, say we bank the glider and can get a sideways push of 800 lbs. for 3 seconds and the velocity difference between the two air masses is 20 mph. (800 x 20 x 3)/377 = 127 HP-seconds, which is the energy extracted (we need that 377 constant factor for these Pound and HP units). If one whole cycle takes 15 seconds we have an average power of about 8.5 HP, which could be a reasonable amount of power to sustain a maneuvering sailplane. This example is presented for illustration purpose only. Messing around with radical maneuvers near the ground (especially in high winds) is very hazardous and is -- how you say? "For the birds." There are many instances of wind shear at altitude however, and these may prove to be a terrific source of energy for the sailplane pilots of the future.

Let's look for a moment at the sailplane's energy losses; for the energy we can extract from the air by dynamic soaring is of no benefit unless it is greater than the additional losses (negative power) caused by the extra maneuvering required. Sailplane energy losses can be divided into three categories: basic friction drag (also called parasite drag), basic induced drag (drag due to lift), and control drag (a combination of extra friction and induced drag due to control surface deflection, etc.) Drag times true airspeed equals power loss.

The negative power (or loss) due to friction is equal to a constant times the glider's airspeed cubed. The negative power due to induced drag equals a constant times the lift force on the wing squared divided by the glider's speed. Control drag losses can be measured experimentally by wiggling the stick and observing the increase in sink rate (we don't have a simple formula for that one).

We've seen how the dynamic power extracted from the atmosphere is equal to the velocity of the air (in a local inertial reference frame) multiplied by how hard we can push against it with the wing. Or similarly, how the power of energy flow that the glider gets from the air is equal to how hard the air is pushing on the glider in its direction of motion times the glider's speed in the local inertial frame.

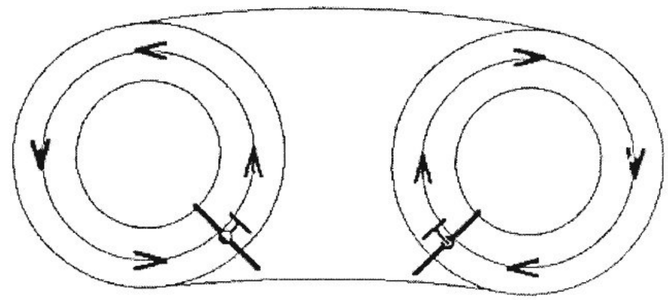


(The glider makes a series of coordinated "S" turns, always turning away from the side gusts. Side gust soaring can work well with low frequency gusts as the changes in lateral velocity can easily be up to 200 f/s while keeping glider speed constant. High frequency response is limited by glider roll rate.)

In another paper called The Dynamic Variometer we discuss an instrument designed specifically for dynamic soaring, but here, let's look at some dynamic soaring techniques that we can use with standard instrumentation. Standard instrumentation in this case consists of: a total energy vario; an airspeed indicator, a yaw string and; a sensitive (gee force sensing) "seat of the pants".

First let's look at vertical gust soaring. Thermals are often bumpy; how do we make the bumps work for us? As explained above, the general rule in dynamic soaring is to push on the air opposite to its motion. The faster the air is moving the harder we should push. This leads us to the first principle of dynamic soaring -- increase the gee force in lift, decrease or reverse it in sink. When we feel a bump of extra powerful "lift" we should pull back on the stick and increase the gee force. Vice versa when the "lift" suddenly poops out we should reduce the aerodynamic force on the wing by pushing forward on the stick. One of the difficult aspects of this technique is figuring out what part of the gee force is from the air's motion and what part is due to our control stick movements; experience helps a lot with this!

Working the bumps in this way can increase the power extracted from the air and thus increase our rate of climb or running speed. The technique produces a sort of roller coaster ride and probably will not be popular with passengers. Also extra care is needed if there is other traffic. How vigorously do we work the bumps in this way? We can "over do it" and waste more energy than the extra we're getting if we are not careful; this is because the average induced drag increases when the lift force on the wing is not constant. So some experimentation is necessary to see what works under various conditions. All things considered it is best to err on the gentle side.



(Vortex Ring Soaring - a glider spiraling in a thermal vortex ring - a smooth case of dynamic soaring. This is a cross section, side view with the glider shown twice in two locations.)

As we fly faster induced drag is a smaller percentage of the total drag; this is one reason to fly faster in bumpy lift. If we are running a cloud street and flying fast we can work the bumps more vigorously without so much concern about increasing induced drag.

A situation where dynamic technique can be particularly effective is when we fall out of the side of a thermal. In this case we are suddenly in sink and know pretty much where the lift is (behind us). We want to get back into the lift quickly and lose a minimum of energy to the sinking air. We could lose a lot of energy in a hurry by pushing downward on downward moving air. So the first thing to do after entering the sink is to reduce the aerodynamic force on the wing by pushing forward on the stick, in an extreme situation perhaps even to somewhat negative gee.

Next we can bank up to 90 degrees or so and perform a maneuver similar to the second half of a wing over (the low gee state can enhance roll rate). Once banked up we can increase the gee force since we don't lose any extra energy by pushing ***sideways*** on ***downward*** moving air. This gets us moving back towards the lift. Our speed will increase substantially and hopefully we'll be back in the lift just as we start our pullout. As we pullout (at more than one gee, back in the lift) we'll be getting more energy than usual and may actually be higher after zooming up than we would have been if we'd stayed in the lift in the first place. Obviously this maneuver is no good if there is other traffic below!

Now let's look at dynamic soaring with side gusts. This may or may not prove practical, but if we find ourselves in a situation where the yaw string keeps blowing off to one side or the other (and it's not due to uncoordinated flying) we may be able to work the side gusts. If the string blows to the left, that indicates a gust from the right and that we should bank left to extract the energy. One way to do this is to use the stick alone (no rudder) to initiate the bank, because that will also straighten out the string and restore the (low drag) nose into relative wind attitude.

This is the second principle of dynamic soaring -- bank away from side gusts. As in the vertical gust case there is an energy cost to maneuvering, so the amount of bank must be tailored to the strength of the gust.

In an ideal case the gusts will oscillate side to side and we can make a series of "S" turns and get energy. In another case there may be a wind shear with altitude where we can create our own side gusts by diving and zooming in conjunction with "S" turns or a racetrack oval course.

Another very interesting form of dynamic soaring is flying in a thermal vortex ring. A vortex ring is like a smoke ring, only without the smoke, and in the case of a thermal it is moving upward. This is an unusually smooth form of dynamic soaring and we may not even know that we're doing it.

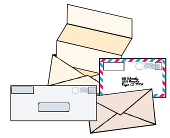
On the bottom side of a thermal vortex ring there is an inward flow of air; on the top side the flow is outward from the core. If we are spiraling on the lower side our bank angle will cause us to be pushing ***outward*** on ***inward*** moving air, which, as we recall is in accordance with the general dynamic soaring rule -- push the air opposite to its motion! The extra energy will show up in the form of forward impulse and we'll find ourselves gaining extra speed or spiraling with a more nose high attitude than is usual. This may be what's going on when we "core a thermal bubble" and find that a steep bank angle works better than steady-state upward-lift theory would predict. This could be a third principle of dynamic soaring -- seek out inward moving air to spiral in.

In summary, there are many situations where dynamic soaring technique can provide an extra source of energy for the glider pilot. The general rule for getting energy from the atmosphere is -- ***push on the air opposite to its direction of motion.***

This completes our discussion of dynamic soaring, hopefully the ideas presented here will advance the state of soaring art, producing longer, faster and funner flights. The potential for getting energy from the velocity fluctuations in the atmosphere may prove to open a whole new era in motorless flight.

In another paper called ***The Dynamic Variometer*** we'll look at some ways of building a vario for dynamic soaring. This next generation instrument may revolutionize soaring.

(ed. - We have the vario paper and another one titled ***Calculations on Soaring Sink*** that are available for $3 if you would like to read more about this fascinating subject. Taras has put a lot of time and thought into this analysis and it is also being explored by aerodynamicists in other countries, like Germany. One group of German students have created a short computer generated video showing an albatross doing its zooming maneuver and then translating it into how a glider would accomplish the same thing.)



LETTERS TO THE EDITOR

7/24/99

TWITT:

Please find enclosed my renewal check and picture of my newest and largest flying wing R/C glider. The TWITT staff me be pleased to know it was designed using information obtained through your publication.

The first was Phil Barnes' September 1995 presentation of "Mathmatical Characterization and Visualization of Aircraft Geometry". His PMC-Z9 airfoil and some of his thoughts on stable pelican flight were used in the design. Also his "Aerodynamic Design Charts for Straight and Tapered Wings" along with Nickel's and Wohlfart's Tailless Aircraft Theory and Practice provided plan form and load distribution information.

This wing has only been flown fifteen times for a total of about 1.5 hours in winds from 12-25 mph. So far top speed is only in the 50-60 mph range but no dives over 20º have been tried and no ballast has been added. It is still definitely in the de-bug stage. Specs are:

Span	6'
Root Chord	18"
Tip Chord	9"
Weight	4 lbs empty (room for 8 lbs of ballast)
Wing Area	7.33 sq. ft.

Controls Aileron & Elevator

Thanks to all who have helped to make flying wing information available.

Sincerely,

Allan Morse

(ed. - Thanks for the picture which is shown below. We are glad that some of the information and people made available through TWITT were of assistance to you in designing this flying wing. I know of one other modeler that is looking into the PMC-Z9 airfoil and is going to contact Phil about.)

7/14/99

TWITT:

It was sort of June in July, or was that July in June? In any event I took my trusty marking pen and corrected the date. Most likely no one called or wrote about it because your TWITT newsletter is so filled with interesting reading that no one much notices such mundane items as the newsletter date.

Wow! The BWB is by far the nicest aviation design I've ever seen; thanks to R.H. Liebeck, M. A.. Page and B.K. Rawdon, I'd say that Boeing has a real winner there. To me it appears to be a hybrid between Northrop's historic flying wing and a circular wing aircraft; what an inovative design it is. Maybe smaller version of it could be made also, possibly including gliders?

Hope that you can get the BWB inovative design engineers on the TWITT quest list as the BWB is a wonderful, fabulous design. I like that old aviation adage, "It it looks good, it will fly good", and the BWB concept sure has the aesthetics.

Best regards,

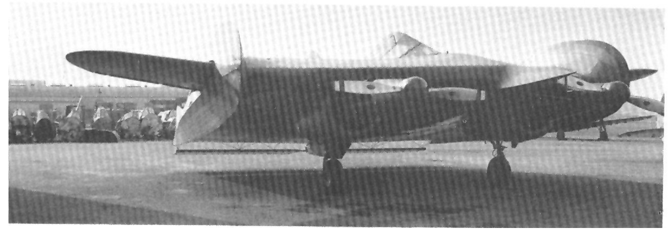
Edwin Sward

(ed. - Thanks for the comments on the newsletter and BWB. We are going to try and get Al Bowers down from the Dryden Flight Research Center some time next year, after he has had a chance to get the BWB test program under control. He is the lead NASA engineer on the project and has a vested interest in flying wings, so should be able to do the subject justice. I will keep everyone informed when we find out more about this program.)

8/10/99

TWITT:

Sorry to take so long to get a print of the Horton Wingless, but my original has been liberated and I had to find the negative. I could have brushed the lint off it, but was in a hurry and thought the photo people would do it. It has taken over a month to get the prints back. Here are some computer enlargements for you also. The end of the top line of the writing on the bottom of the tip plate is apparently "the Horton Wingless was built", and the end of the next line is "would fly!". Will look at the negative under a microscope at work tonight to see if any more is legible.



As you can see, it is the full size Horton with the 450's. The fabric is removed from the pointed nose, left tip plate, and vertical fins and rudders. The engine cowling and props are also gone. The photo was take with my first camera, a little Kodak with 620 film. The lens is so bad taht the focus is blurred on the edges so the rudder and fin frames are only partially visible.

Sorry to hear about Jack Lambie. When I lived there it was a fabulous experience to meet people like him at your meetings.

Glad I could contribute something on the Horton. Will get this in the mail and send a note later if I can read more off the negative.

Best wishes,

Larry Nicholson

(ed. - Thanks for the picture which I have included above. I hope that Horton is able to get something going again on an updated version of this design, since I think it would prove quite interesting.

For those of you who may not have heard, Jack Lambie was killed in a home accident in mid-June. He was a unique individual and will be missed by all in the aviation community.)

8/18/99

(The following is from an e-mail to the Nurflugel mailing list by Reinhold_Stadler@mt.man.de.)

H IV Event

The H IV event on Saturday (8/14) at the Deutsches Museum, Flugwerft Oberschleissheim, is over. We had a very interesting auditorium with more than 200 people. The finished H IV looks great.

Lots of very useful discussions, but unfortunately there was no time to go into detail with everybody. It was a very inspiring mix of old Horten employees and pilots as well as young researchers and fans. At least I have learned a lot and new work to do on the Horten airplanes.

Some of the interesting names available (not sorted either by importance nor alphabet, nor complete as I had no chance to meet all):

Mrs./ Mr. Nickel, sister of Hortens, involved in design/ Horten pilot and employee, involved in design process
Mrs./ Mr. Zuebert, Horten pilot and employee, later on pilot on the Bachem Natter
Mr. Mayensohn, Horten employee, saved one of the surviving H IV
Mr. Zacher, D-30 pilot on the comparsion H IV/D-30, flew Horten airplanes
Mr. Uden, runs the Horten archive
Mr. Hanickel, restorer of H IV
Mr. Bentley, H IX researcher and member of Classic Books
Mr. Gapsch and Kehrer, experienced Horten model pilots with more than 100 Horten wings, have systematically solved the adverse yaw on empirical basis
Mrs./ Mr. Mattlener, the PUL 10 is still alive!

And I was lucky to meet some other friends of the Nurflugel-email list:
Mr. Ottens, well known H IX researcher
Mr. de Trieu de Terdonck, H IX researcher

Thats what I like! Afterwards I realized from the guest book that others were here I would have liked to speak to: Gudrun and Kai Horten and so on....

I had that many discussions that I even had no time to take photos. So I will ask other to get some....

One important person was missing, unfortunately: Mr. Scheidhauer, as his health is not good. But I phoned with him on his birthday and he was already well informed. He would have liked to see that airplane ready after all this time....

Greetings,

Reinhold

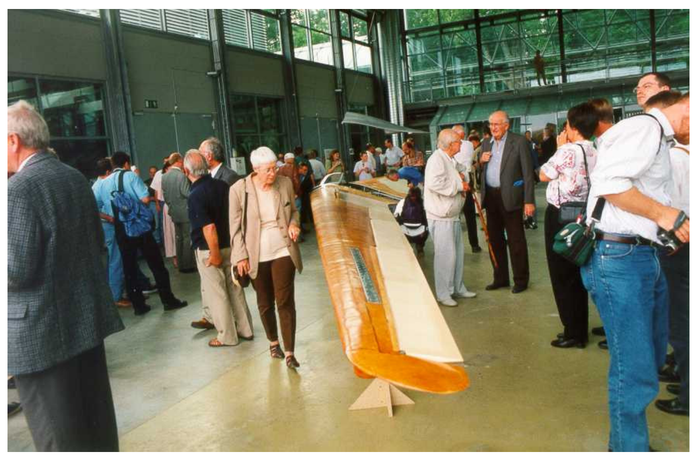
(ed. - It just so happens that Eric du Trieu de Terdonck has sent along the pictures that Reinhold mentioned, but I imagine not through any coordination between them. I have included these pictures in the newsletter although it doesn't do them justice since they are in beautiful color. Eric also included the following information in his e-mail that contained the pictures.)

There was a nice presentation of the Horten Ho IV the 14th of August at the Deutsche Museum - section Oberschleissheim. This presentation was started with a historical overview by Mr. E. Uden (with a video of his visit in Argentina to Dr. Reimar Horten and the Ho V take-off and landing), a technical presentation by Mr. R. Stadler and a review of the restoration work and all the problems related by Mr. Peter Hanickel. Then we had the chance to see the Horten IV which was really not a waste of time.

Please find enclosed some photos which were taken during the presentation of the restored Horten Ho IV glider.

It has to be noted that Mr. Peter Hanickel, who was in charge of this job has done very nice work. It has been restored in perfect condition. Mr Hanickel has also found, with some old pictures, that this glider is the registration "D-10-1451" with building code "Werk-Nr. 26" which means that there is mistake in the book <u>Nurflugel</u> (in the book the W.-Nr. 26 is with registration D-10-1452).)

BOTTOM LEFT COLUMN: View of the central part of the wing with the air brakes open. The jettisonable top hatch can be seen hanging above the cockpit area. Under the aft part of the hatch (but not clearly visible) are Mr. Reinhold Stadler and Mr. B. Mattlener with his wife.



ABOVE: View of the Horten IV from the left wing. In this view you can't clearly see the actual dimensions of the wing, but it is very large and the chord at the tip is very small (about your two hands together). On the right of the wing you can see Mr. Hans Zacher (with the stick) talking with Dr. Nickel.

ABOVE: Full view of the Horten IV from the right wing. On the lower part of the photo you can see Dr. Karl Nickel (black suit) and his wife (Horten's sister).

6/28/99

TWITT:

The subject is the "Horten Bell Shaped Formula". I know that now, with computers, "we" have newer and better formulas.

I do not know German, nor understand formulas. I will assume that for a given length of span and probably width of chord, there will be a washout of "X" inches or centimeters.

So, in a nutshell, let us assume a half wing with 100.0 span and a base/centerline chord of 10.0. What would the washout be at each 10.0 span? I assume that this is what Mr. Horten designed.

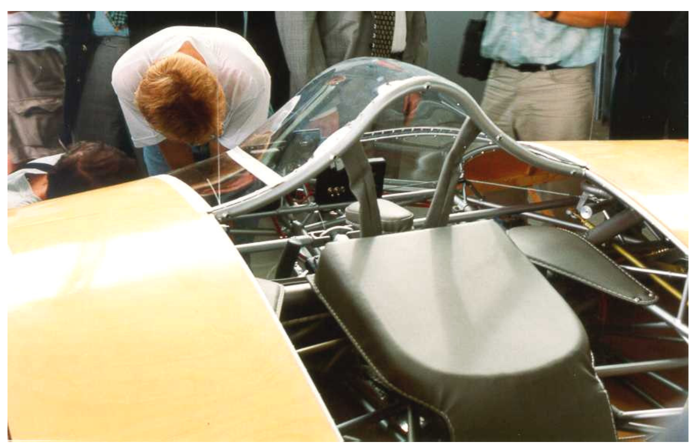
If the formula is a very complicated item, too much for a person to understand, then forget it. I assume that the end result is very basic.

I do thank you,

Eugene Turner

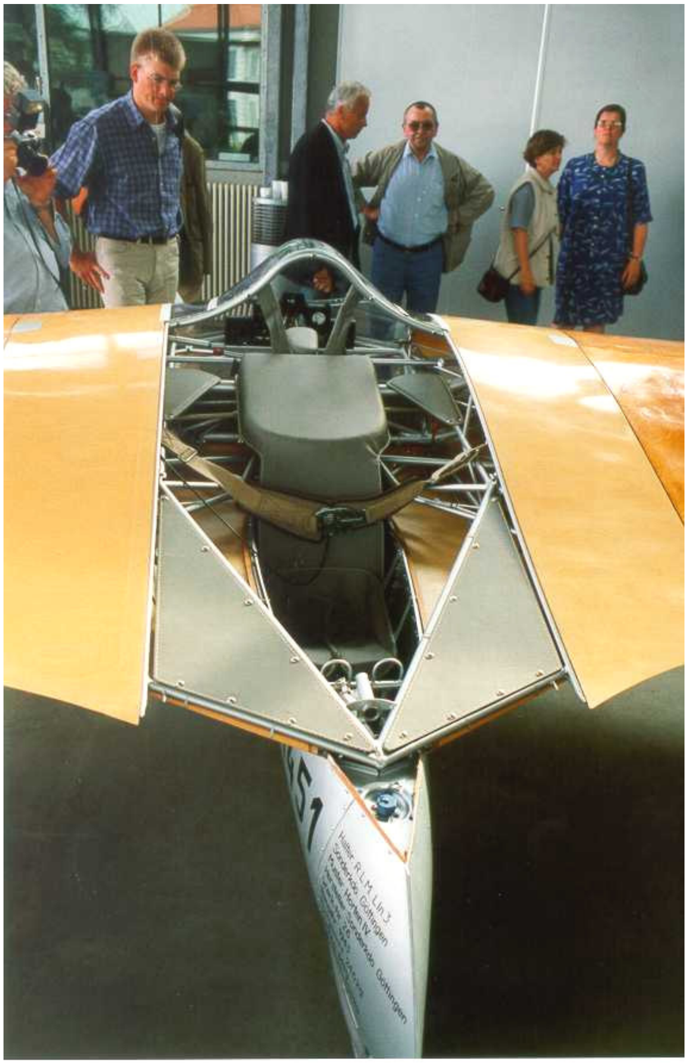
(ed. - Good to hear from you again. Sorry it took so long to get your comments in the newsletter. It will be interesting to see what the "experts" have to say about them.)

ABOVE: Bottom aft part of the Horten IV fuselage pod with all the data. The data was reconstructed by Mr. Peter Hanickel with the help of old photos. He found that there was a mistake in the book <u>Nurflugel</u> by Dr. Reimar Horten and Mr. P.F. Selinger. The photos are shown on page 105 of the book and the mistakes are on pages 102 & 229. The Werk-Nr. 16 is not D-10-1452, but D-10-1451.



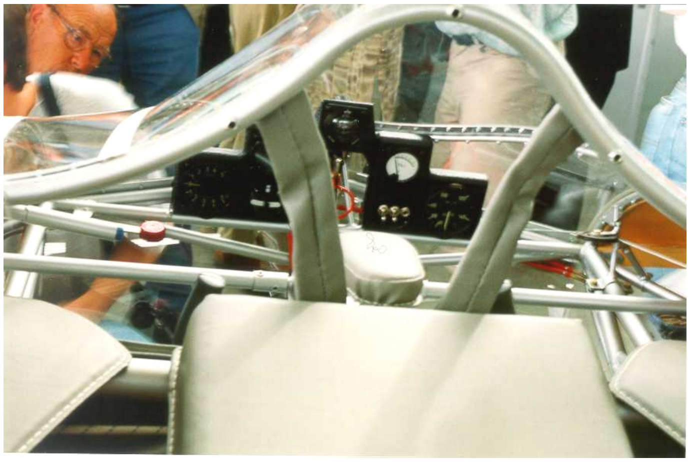
ABOVE: Here is more detail of the cockpit section. The left part of the double stick is visible jsut off the upper left corner of the chest pad. Unfortunately, there are no details on this stick. This is a very interesting part of the aircraft because it is a very nice kinematic system. As an engineer, I love this system. It is a square block with instruments on top, a handle on each side, and slides fore and aft on a round tube. (ed. - This shot also gives you a better

look at the arm rests, chin pad and sholder straps - vertical pieces on either side of the chin pad.)



ABOVE: View of the center section taken from the aft perspective. This shows the seat (if it can be called that) and forward instrument panel. There are other instruments on the control stick (not visible). You can see the center section has been rebuilt in perfect condition. Mr. Hanickel did this work with help from a set of 30 photos and a few drawings that still exist. The space dedicated to the pilot is very small and during the presentation it was said the first Horten IV center section was designed around the pilot, Heinz Scheidhauer, who is not very big. The next Horten IV had to be enlarged by 10cm, because it was too small. I (Eric) could see this when Mr. Hans Zacher tried to get into the cockpit since he is a bigger man and didn't fit very well in the small space. (ed. - You can also see the rudder peddles at the very bottom of the vee structure. You can also see the armrest pads and large chest pad.)

ABOVE: Another shot from the aft side. This give a clearer view of the top hatch shape so you can see the cockpit gets even smaller once it's in place. (ed. - The area protruding down from the lower center of the hatch was probably were the parachute was stored. The Horten IV tested at Mississippi State had some difficulties keeping the hatch secured during flight because of scant room between it and the pilot's back, with just a little movement causing it to separate.)



ABOVE: A closer shot of the instrument panel and now you can see both the sticks at the forward edge of the chest pad. (ed. - It almost gives you an idea of what it would be like to lay down in the cockpit and look out the front of the canopy.)

ABOVE: Mr. Hans Zacher at the command of the Horten IV. He has the double sticks in his hands. Dr. Karl Nickel can be seen standing in the background (long-sleeve white shirt with bolo tie). (ed. - This shot shows what Eric meant about the cockpit size for someone larger than the original pilot. Obviously, the top hatch would not fit well with Mr. Zacher.)

BOTTOM RIGHT COLUMN: A view from front showing the nose gear. The wheels are really a dolly that falls away upon takeoff. The skid can then be retracted during flight. Landing is on the front skid, which is lowered, and a rear skid that is built into the aft fuselage area.

ABOVE: Mr. Zacher making a comment after a remark coming from one of the spectators. Mr. Hanickel is on the left side of the picture immediately behind the little girl. (ed. - You can also get a better view of the top hatch from this angle and see the area for a parachute. The whole thing looks a little claustrophobic for my taste.)

ABOVE: This is the remains of a wing part from a Horten HoIVb. I cannot remember the explanations given on the display board. Perhaps Mr. Stadler can give us more details.

ABOVE: Remains of the center section from a Horten HoIVb. I have no details on the history of these parts. (ed. - Perhaps Russ Lee can give us a little more information on the origin of some of these parts, since I believe most of them came from the NASM for the German restoration project.)