

T.W.I.T.T. NEWSLETTER



Lockheed Martin RQ-170 UAV.

(Source: <http://aerowiki.blogspot.com/2009/12/rq-170-sentinel-drone-beast-of-kandahar.html>)

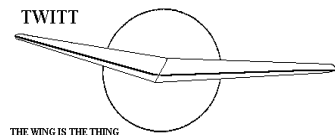
T.W.I.T.T.

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., **1112** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, January 21, 2012, 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

First, I would like to wish everyone a joyous holiday season and a Happy New Year celebration. The year has gone by very fast from my perspective and I am looking forward to 2012 since it will mean the end of my Schweizer 1-26 restoration project.



Second, I would like to thank all our members for sticking with TWITT throughout the years. It has been quite a while since I had to move someone from the active to inactive roster, which is very encouraging since it means you generally enjoy the newsletters.

This issue is special in that we have some very good first hand information from Jim Marske on his initial impressions of the Pioneer 3. It is definitely not a Genesis spin off and has very pleasing lines as you saw in last month's cover shot on takeoff. It has been flown by at least one other pilot, Mike Hostage, who used to be a member of TWITT before his military career started taking up so much of his free time. I know you will enjoy reading about this much-awaited event.

Lastly, I need to apologize to our members that receive the newsletter electronically. I neglected to actually send them the November issue after I sent it to the printer for those of you who get the hardcopy. Part of the oversight was due to me also not posting the November issue to the members' only section of the web site. Both conditions have now been corrected so everything is up to date pending this issue.

Andy



LETTERS TO THE EDITOR

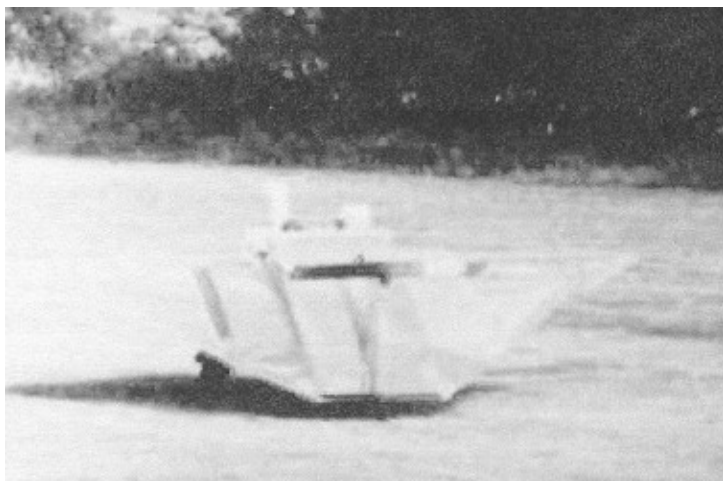
November 10, 2011

Hi Andy. Al Backstrom submitted two photos in the November 1986 newsletter, bottom of page 8, under the Horton Wingless prototype, asking if anyone knew the name of the low aspect ratio flying wing. It appears to have a 10 - 15 degree swept leading edge and a 45 degree swept forward trailing edge outboard of the center section. The engine is up front in the tractor configuration and the second photo, bottom right on page 8 (Nov. 1986) shows it in a shop or hanger with tail dragger retractable gear and an unfinished windshield and canopy. Can you please post or forward my inquiry to Al Backstrom, and see if he discovered any more about this unknown experimental aircraft. The wingspan appears to be approximately 20 ft. or less rhomboidal plan form. The 1911 Italian monoplane, Canova PC - 140, is similar to Nov. '86 pg.8. I hope to learn or see more of this aircraft even though it was 25 years ago when photographed.

Thank you,

Stephen Sawyer
<s-sawyer@sbcglogal.net>

(ed. – Here are the best reproductions I could get of the wing that Stephen has referred to so if anyone knows what it is please help us. There were no answers in the following 1986 issues, but it must be understood that this was at the very beginnings of TWITT and there weren't very many members getting the newsletter and seeing the pictures. Perhaps today we have someone with the knowledge.)



November 11, 2011

It appears that there is a bad link for GOTHA Factory Exhibition

On the other Flying Wing/Tailless design page. When click I get sent to:

<http://ww35.fliegerstadt.com/daten/frame2.htm>

While there is some aviation stuff there, I don't find the Gotha factory listed.

Warren Bean
<warren.bean@gmail.com>

(ed. – I will be removing the link from the web site, but I included this as a reminder to our members that if they see a broken link please let me know so I can either find a new link or delete the item.)

November 13, 2011

Andy,

The last newsletter (Nov 2011 #304) was really great. My hats off to Al Bowers and all the participants in the discussion (both practical and theoretical) about lift distribution. You also deserve a pat on the back for editing and putting it all together. Thanks,

Bob Hoey
<bobh@antelecom.net>

(ed. – Thanks for the kind words on the issue. Sometimes there are some things that just need to be

shared. I also put some of this material in Sailplane Builder's November issue since Al if a prominent member of that group. I noticed when I started this issue that I accidentally used #304 twice so the November 2011 issue is really #305.)

November 16, 2011

I would like to make the following suggestion for your links section on twitt.org

Horten Ho 229 & Other Horten Aircraft American & British Intelligence Documents

<http://www.paperlessarchives.com/hortenho229.html>

United States and British intelligence documents covering the development of aircraft designed by the brothers Reimar and Walter Horten, including the Horten HO 229. An additional United States intelligence report shows that the Japanese were developing technology that was much more explicitly stealth than what was applied to the Horton Ho 229.

Jerry Spencer
 Director, BACM Research
 <Jerry.Spencer@paperlessarchives.com>

(ed. – I included this so you could decide for yourselves whether this is a good site. There is one 10 MB PDF file to download that has several different historical documents so if you have the bandwidth for such things it may be worth the time. It might make a good replacement for the broken link noted above.)

November 17, 2011

Hi Folks,

I came across an odd book that tells the story of Waldo Waterman known to us as the inventor of the Arrowbile. Arrowbile (Aerobile) was a flying wing airplane, which could be converted in to a road-able car. It actually made it into production for a very short period of time.

The book is:

"Waldo Pioneer Aviator"
 by Waldo Dean Waterman with Jack Carpenter
 Arsdalen, Bosch & Co. 1988
 ISBN: 0-960073013

This is more or less an autobiography of Waldo and his involvement in the development of early aviation in the American west. It is an interesting to read. There are lots of tidbits that might interest those of us that love aviation history. I think you can still get a copy of the book from Amazon.

There are lots of pictures. There are some pretty good stories. I particularly liked hearing about the development of the Arrowbile and his efforts to make it into a production aircraft.

More can be found at:

<http://www.earlyaviators.com/ewaterma.htm>

and

<http://www.nasm.si.edu/collections/artifact.cfm?id=A19610156000>



pictures of the one hanging in Washington at the ASM
<http://www.nasm.si.edu/imageDetail.cfm?imageID=3170>



And somebody built a model that flew not that long ago:

<http://www.youtube.com/watch?v=GLcFf3Ydsyo>

Enjoy,

Warren Bean
<warren.bean@gmail.com>

Also from Warren: There is a nice article in this month's RC Soaring Digest by Dr. Ferdinando Gale'. It reminds us that even if we are modelers we should consider the lift distribution over the actual span taking in account both wing shape and local foil efficiency - i.e. Span-wise wing loading.

Dr Gale' walks us through the method developed by Oskar Schrenk and was used by the Horten brothers in some of their developments.

The article can be found at:
<http://www.rcsoaringdigest.com/>

(ed. – Waldo was a very interesting gentleman. I had the opportunity to help him rig one of his Curtis replica bi-plane amphibians one day in San Diego. I was in my teens at the time so it was quite an adventure.)

November 24, 2011

This issue (November) was nicely balanced. The cover photo of Jim Marske and his Pioneer III at lift off on its first flight is the sort of things that dreams are made of. To see Jim's dream coming to fruition is no end gratifying.

Thank you for pointing out that the wing is loaded and the wheel is off of the ground. These facts are not necessarily obvious at first glance. They got by me until I read your column.

Upon second look I also noticed the shadow of the split yoke tow line coming back to the under-leading-edge release points, so important to launch and towing flexibility in a short coupled glider. This arrangement also allows auto and winch tow of Jim's designs.

I do not subscribe to Nurflugel and Al Bowers presentation and the email discussion of same were dead on important. For those of us that work with wings through experimentation and studied intuition this sort of discussion is very illuminating.

My subscription to the newsletter has proven very satisfying.

Thank you,

Lauren Williams
<petalumatroley@sbcglobal.net>

(ed. – I am glad you enjoyed the issue and are enjoying your membership. You will enjoy the next letter.)

November 4, 2011

Hi Andy.

The picture you had in the September issue was of me after landing taken by Mike Hostage who made a special trip to Ohio just to see the Pioneer 3. Not only did he look at it but he requested permission to take an auto tow immediately after my two flights.

The latest photos you have were taken by Matt Kollman. Matt worked with us for several years in building the prototype Genesis sailplane.



ABOVE: This is a before picture to give you an idea of the strides made in completing this beautiful sailplane.

How does the Pioneer 3 fly? It is definitely the highest performance glider I have ever flown. Perhaps the trickiest part is flying air tow as there is almost always some slack in the towline. When traversing thermals I found myself with lots of slack in the line. I solved that problem by flying with the spoilers partly extended. I cut a detent for the spoiler handle to lock into during tow. The climb to 2,000 ft is considerably less than any other single place sailplane. The tow pilot made a remark that he cannot tell that I am back there.



ABOVE: Jim getting ready in the cockpit for another flight. It looks like a very comfortable position for doing long flights. **BELOW:** A nice shot of the wing root profile. Note there is no horizontal trim tab on the top of the vertical like the Genesis.



In free flight she handles quite well and is stable about all axis. The first thing I noticed off tow was that I was constantly using too much rudder. Traditionally,

flying wings, due to the short moment arm of a central fuselage mounted rudder, require lots of rudder input to offset the aileron adverse yaw. However, the Pioneer 3 requires less rudder input than their long tailed (gifted tadpoles) sailplane brothers. It looks like the aileron anti-servos are doing their job. The servo trim tabs are built into the outboard end of each aileron. Despite their diminutive size (1.25 x 20") they deflect upwards only, and at the same rate as the aileron motion deflects upwards, i.e. when the differentially operated aileron moves upwards 20 degrees the tab rotates upwards 20 degrees. The tab is projected to the relative airstream at 40 degrees. The airflow behind the tab is undoubtedly separated causing drag to offset the adverse yaw drag. I'll have to detach the pushrod to the tab to see how much the anti-servo contributes.



ABOVE: The other big difference in profiles is the wing especially at the inboard end where the elevators are more pronounced and similar to the earlier Pioneer models.

Roll rate seems very good with a fast response. This may be due to the light wing panel weight of 81 lbs and sufficient rudder power to allow the wing dihedral to aid the roll. Yaw stability is adequate but feels weak when compared to a tailed aircraft. Kicking in rudder and releasing it the nose swings back at about half the time rate as a tailed sailplane. Again, the yaw stability is entirely adequate and is not a reason for concern.

Pitch stability is very good making it easy to hold a given airspeed. As yet, I have not explored the Phugoid cycle in the fixed or stick free attitudes. The elevator, as well as the ailerons, are mass balanced. Speed trim is accomplished through a travelling weight down the length of the fuselage. The 8 lb lead weight

is cranked forward for high-speed flight and aft for thermaling. By changing the center of gravity to match the airspeed the elevator will always be trimmed flush with the wing regardless of airspeed. Not only is drag reduced at all speeds, but more importantly, the wing will operate at a higher CL in thermals.

The spoilers, or air brakes, are of the Schempp-Hirth type. I have not used them before due to their high parts count and complexity but I must say they function marvelously. I should have used them years ago. There is no pitch change when being deployed and they shoot you right out of the sky when necessary. Spot landings are a breeze and the P-3 sets down smoothly on the hard surface or on the sod runway.



ABOVE: Landing after another great flight.

I have not had a chance to determine the L/D performance but it certainly has a very low sink rate and can cover a lot of ground. Needless to say, I am not at all disappointed with this sailplane. Too bad that it is late in the soaring season and I'll have to wait till next Spring to complete the flight testing. In the meantime I need to build a trailer - good winter project.

Jim Marske
<jim@marskeaircraft.com>

(ed. – My thanks to Jim for the pictures and his recap of the how the Pioneer 3 is performing so far. We look forward to hearing more about the flight testing when it is completed.)

November 27, 2011

Greetings. I wanted to update you on the Pioneer 3 progress. Jim has made several flights on the Pioneer 3 and it is performing well. We haven't had a

chance to gather performance data but flight characteristics are as expected. Good control harmony, spoilers are very effective with no pitch change. We're done flying for the season so it will be March before flight tests are resumed.

Work is underway on two more Pioneers. Our first Pioneer 3 kit is scheduled for delivery to Mike Hostage in February 2012. A second Pioneer 3 belonging to Jim Geoble should be flying by April 2012. Check my website for more updates www.kollmanwings.com

Jim has redesigned the spar center section to eliminate the steel cage in the prototype. We are also incorporating a retractable wheel and skid. Water tanks are also being added to increase the wing loading.

I'm working on editing some video of the flights and will post it when finished. Feel free to contact me or Jim if you have any questions.

Matt Kollman
<kollman123@gmail.com>

(ed. – This came in with some duplicative information but also some additional facts of the Pioneer and what is in store for the project going forward.)

(ed. – The following came from Norm Masters in answer to a question on the Mitchell U-2 Yahoo group bulletin board. Others out there considering a U-2 project may have the same question. This is not to confuse the Victory Wing or Stealth Wing that were also Don Mitchell designs.)

Could someone answer a question for me? Is there a difference between a Mitchell U2 and a U2 Superwing?

Doug

It's the Mitchell U-2 "Superwing". One design but as you look through the archives and photos you'll find that everyone builds slightly different. Welcome to the group.

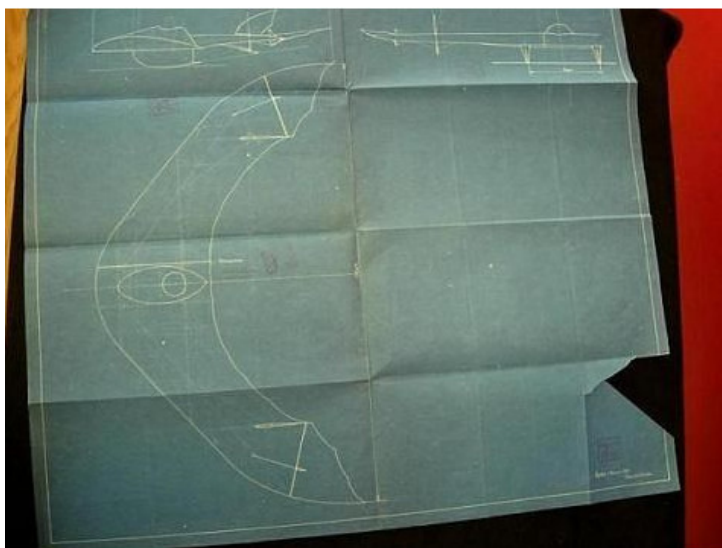
Norm

I have just posted in the file section the photo of a 3V blue-print drawing found on a auction web-site. The only mention concerning this drawing is "Gotha 1921 Halbrecht Klaube".

I was wondering if any group member can help me with more information concerning this aircraft. Thanks in advance,

retrofitprsp@yahoo.com

(ed. – Below are the two items that he posted to the bulletin board. The nose wheel appears to be one of the Hortens' in an Argentina aero museum and the three view looks familiar but not related to the drawing. Can anyone fill in the blanks since there didn't appear to be any answers from the Nurflugel group. Thanks.)



Nurflugel Bulletin Board Thread

(ed. – The following is a thread I found on the pros and cons of using a prone pilot position. Rather than identify each person in the conversation, I have just put it together in the order it occurred over a week or so period.

I think it is self explanatory enough to follow along with the various thoughts regardless of who was contributing.)

Who Could Test Prone Seat of H IV or H VI or H III f?

A nybody with experience in the prone seat of the Hortens. Please, tell me:

- Was it easy to get in and out?
- Was it hard to adjust to this kind of seating?
- Was it comfortable?
- Did you expect to get tired neck after a long time? (This one really puzzles me. Hang glider pilots don't have this problem, I was told.
- What is the difference between both head positions?)
- How was the steering bar? Felt good in hand? To close to body?
- Was it weird to have your elbows pointing outwards?

All info could help me.

T here are some hang gliding pilots that use a small cord in the back of the helmet to help the neck muscles but these are a minority. What pilots do all the time is to rotate the whole body up around the hanging point to improve visibility and relax the muscles when flying slow in gaggles. If the pilot is not very fit then the prone position becomes tiring after some hours of flying. Otherwise, we manage to fly 7+ hours in a X-Country flight or fly several hours for days, during competitions. Actually the shoulder and the arms are the weak link not so much the neck.

T hanks for informing me about the hang glider aspect of my questions. I will try all kinds of stuff for my project. Currently busy making a test bank to try out all kind of positions. Time will tell more.

G rab a saw, a screw gun, some scrap plywood or the equivalent along with some cushioning and start experimenting. After awhile you'll have a set up that fits your style, then design the glider around yourself and your "cockpit".

I hang glide also, and whenever I'm flying very slowly and the drag penalty is minimal, I "rock up" into a position that I believe might be similar to the Horten's pilot position. Helps prevent getting a sore neck on long flights.

Just build something adjustable, and use it while watching TV or reading.

I plan to place the test bank in front of the TV and have a duration test by watching the newly Blue Ray collection of all six Star Wars.

Hey, reading the book "All the Wing" in it might give it all a new dimension. By the way ...that book is a must have!

As has been written, the prone hang gliding position is not so tiresome for the neck and head muscles even for hours long flights. The normal head position for long flights is not horizontal, rather pointed downward. That limits the visibility up and forward, but as the practice shows these not really needs for flying. The hang glider control forces around 6-8 kg at normal flight, and proportional the movement. At turbulent weather or high G turns, the control force peaks could reach the 25-30 kg.

For example, at calm weather conditions and longer flights, I usually employ the "chin control" method resting my chin on the speed-bar and leaving my arms hang a while.

The common problem with the HG harnesses is the extra pressure from the shoulder and thigh straps. These could restrict the blood flow, resulting fatigue or numbness.

The Horten's sailplanes prone positions wasn't a real prone, rather a mixture of the kneeling and prone position (Horten IV), or slightly upward prone position. The Horten IV had a chin and armrests, which is shown in this video <http://www.youtube.com/watch?v=CQMaJw9q8vs> at the 8:15 point.

Also, you could see, the control was a simple, short yoke. Guess, due the long wingspan the control forces was rather low.

Flying prone has several disadvantages.

First of all, this is a head first position at collision, and the crumbling zone rather short or none. The hang gilder pilot moves to an upright position at emergency situations, but for a rigid glider is quite impossible.

At an emergency, hard to leave the plane, if the whole cockpit canopy isn't ejectable. Also, for a jump, you should lift up, your upper body, pull your legs to squat and jump.

For cockpit ergonomics the prone position quite problematic. On supine position, there are a lot of visible, easy to reach position for instruments, equipments and storage around the pilot. For prone

position, you must put these in front of the pilot, which will obstruct the visibility. The other hang glider pilot could tells you, sometimes how hard to pick even a sandwich from a pocket in the air, if you can't see.

Thanks for your comment. Understanding the hang glider problems makes me think harder to avoid them in my project. Thanks for mentioning the blood flow obstruction due to the straps. Didn't have that as a point of attention ...yet. I will try to give the pilot as much leaning area for his total body as possible. I hope that keeps the contact pains and so as little as possible.

Crash survivability in a prone pilot situation can be better if ...there is enough crumple zone in front of them. That way the cockpit functions as a huge helmet.

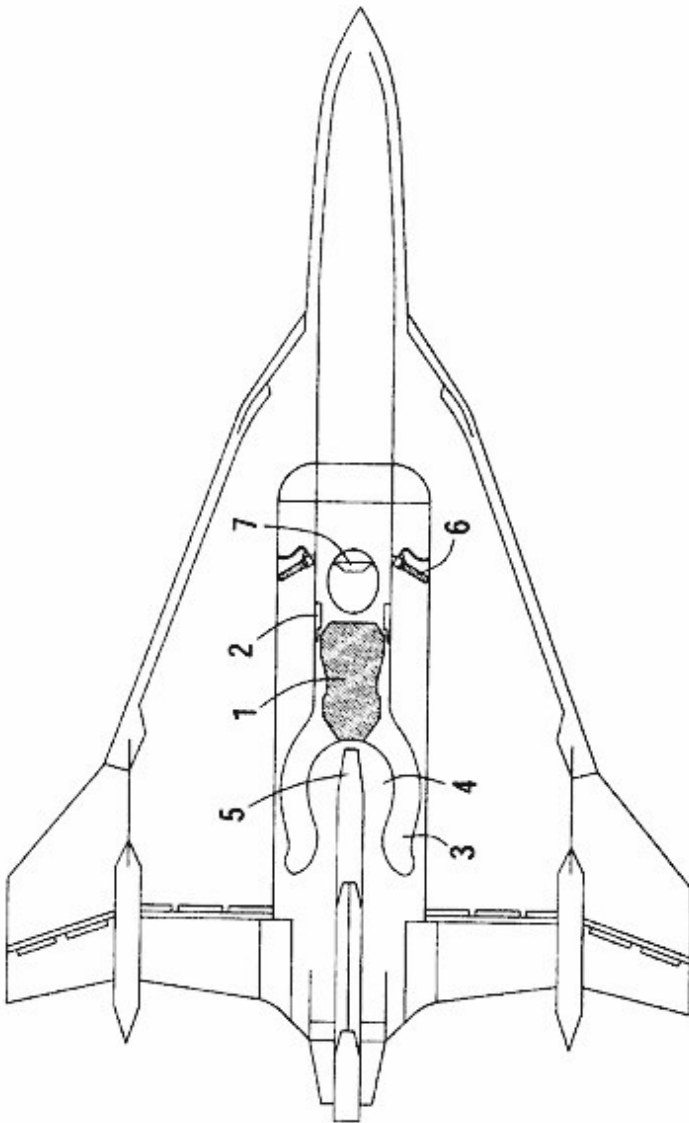
I will continue the making of my test couch. Hopefully it will be finished end this week or next week.

Bailing out of the Horten IV might have been easier than you imagine. It would guess you would first release the harness or the canopy and push off with your arms. I suspect windblast would assist you there and you would either kick off or roll off backward and clear.

Years ago when it was advertised for sale I made an inquiry that Jim Marske answered. He advised me that it wasn't in the greatest shape and related an incident in 1968 when Ray Parker flew it once. The canopy and fairing is a tight fit with the backpack parachutes of that era over the pilot's back but for whatever reason the canopy blew off in flight. That destroyed the center section lift and put the ship into a dive that took full back stick to maintain level flight. He said "the landing was a bit abrupt with one upset pilot on board". In retrospect, I wish I had bought it.

I had found this patent (US6315244) during my prone pilot search in the early days.

<http://www.google.com/search?tbm=pts&tbo=1&hl=en&q=US+6315244>



Have fun with it. Remark the blended idea. That's the way in my opinion, rather than thinking straps and belts and partial patches here and there.

Making the test bed out of squared or tubes or planar stuff and putting pillows here and there... have you ever really tried to make a prone test bed like that? It is a nightmare of anti-ergonomics.

Go to a beach, mold sand around you as you best feel, then cast the shape surface to take it away.

I hope to get some quick results using all kinds of quick stuff to get first estimates. Once I have those, I will make a metal frame that is adjustable and nearly the stuff I did with pillows and so. Euh ...beach is 100 km from here. And ...I guess the notorious mayor of Knokke would execute me if he saw me pouring fiberglass and epoxy into a sand pit.

You don't need to cast fiberglass and epoxy, use plaster and cut it in a few shell parts to take away. Reinforce while casting plaster with fabric (rough fiber) and small bits of woods you find on the beach. To the mayor, tell him you are ground control and making sculptures with natural elements. He will reply that the sea is blue and there's nothing he can do, looking far on the horizon and finally complimenting you for the artistic touch.

Or have someone deliver you some sand (building stuff) and do whatever you like in your garden. Or use your garden earth. Or steal it from your neighbors.

But if you don't see the usefulness of beginning to shape the pilot couch in this way, stick to your method. Just remark that different starting methods in modeling the thing will drive you into different end solutions. Well begun is half done. Sometimes even more than half of the share of it and for ground-breaking issues, usually it is what it is all about. Literally.

Thanks for the advise. I guess I will leave the neighbors gardens like it is. Still trying to avoid that mayor (you should know him ...euh ...better not). But I totally agree with your idea that the beginning influences the end results.

(ed. – This is a separate thread but along the same lines. The contributors are some of the same from above with a few new ones expressing their opinion.)

Who Could Test Prone Seat/Accident Protection

Crash protection has always been the bane of prone pilots. As a youngster I was in San Diego and watched the Wee Bee fly, but shortly after was in Georgetown, TX to witness a guy try to fly a similarly sized glider. It survived some scary auto tows, and they decided it needed more speed and altitude. It wallowed badly on aero tow, seemed to stall, and lost all altitude in a high-speed diving recovery, ending up in a wooded area. I let others check the wreckage.

In the late 70s when I was editor of the VSA journal, I corresponded with Dr. Franklin Farrar who built and flew perhaps the cleanest flying wing glider in the '50s (*image on next page*). He tested it several times, and it suffered from ill conceived rotating tip controls. Worse yet, these were activated by grab handles in the wings, and wrist action. He added a fin, and eventually tried to fly it behind a car himself, despite modest piloting experience. Years later when I visited him the evidence of his disfiguring facial

injuries were still visible, and he was lucky at that. He still owns the craft, last time I was aware.



Anybody with insights on the Exulans prone contraption?

http://www.delta-club-82.com/bible/photo.php?id_aile=708&langue=en

They seem doing a good job around the pilot head, don't they,



Interesting! I would have used a "cranked" bird-like wing as a strategy to get the wing spar carry through structure aft of a normal "supine" seated cockpit to provide more cockpit length while keeping the CG where it needs to be.

Prone cockpits work fine. Everyone I've spoken with who has flown one likes them. The biggest issue I see is the difficulty in twisting the neck around to see into turns - something motorcyclists are familiar with.

When I was a hang gliding instructor I was very emphatic about teaching the students to remain in the upright position until well after the launch, and to go from prone to upright early in the approach so that they would have some time to get

used to being upright before actually landing. I would caution them that if things went wrong it was better to start breaking things starting with their toes and working up from there.

I like to believe that someday I will build a Pilot-in-wing (PIW) flying wing glider. If I ever do, the "cockpit" will be designed so that by pivoting around hip mounted fittings I'll be able to fly with my feet in front, rather than my head. I've seen people become quadriplegics and it's just senseless to fly prone during launches and landings. The atmosphere is uncertain, although your aeronautical engineering may be perfect you're operating the machine in an invisible medium that has no compassion whatsoever.

Flying in the prone position is wonderful. But it should only be done when you're not close to something you might hit.

Thanks, your links guided me to the Quark glider, another prone pilot glider.

The Farrar has the pilot very close to the nose of the airplane. The Quark does too. Really unhealthy when you have a crash. My project has more than half a meter structure in front of the pilots head. I truly hope it gives more protection. I hate if somebody would get the same scars in the face as I got from my Velomobile crash.

I found this dissertation from the group that developed the Exulans in Pretoria.

Meintjes 2003 Comparative study into occupant concepts with respect to crash response

<http://upetd.up.ac.za/thesis/available/etd-01112005-124913/unrestricted/00dissertation.pdf>

They make a comparative analysis of the seating positions. I did not read it yet but seems quite well informed.

AVAILABLE PLANS & REFERENCE MATERIAL

Coming Soon: Tailless Aircraft Bibliography Edition 1-g

Edition 1-f, which is sold out, contained over 5600 annotated tailless aircraft and related listings: reports, papers, books, articles, patents, etc. of 1867 - present, listed chronologically and supported by introductory material, 3 Appendices, and other helpful information. Historical overview. Information on sources, location and acquisition of material. Alphabetical listing of 370 creators of tailless and related aircraft, including dates and configurations. More. Only a limited number printed. Not cross referenced: 342 pages. It was

spiral bound in plain black vinyl. By far the largest ever of its kind - a unique source of hardcore information.

But don't despair, Edition 1-g is in the works and will be bigger and better than ever. It will also include a very extensive listing of the relevant U.S. patents, which may be the most comprehensive one ever put together. A publication date has not been set yet, so check back here once in a while.

Prices: To Be Announced

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Books by Bruce Carmichael:

Personal Aircraft Drag Reduction: \$30 pp + \$17 postage outside USA: Low drag R&D history, laminar aircraft design, 300 mph on 100 hp.

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VIDEOS AND AUDIO TAPES



(ed. – These videos are also now available on DVD, at the buyer's choice.)

VHS tape containing First Flights "Flying Wings," Discovery Channel's The Wing Will Fly, and ME-163, SWIFT flight footage, Paragliding, and other miscellaneous items (approximately 3½+ hours of material).

Cost: \$8.00 postage paid
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VHS tape of Al Bowers' September 19, 1998 presentation on "The Horten H X Series: Ultra Light Flying Wing Sailplanes." The package includes Al's 20 pages of slides so you won't have to squint at the TV screen trying to read what he is explaining. This was an excellent presentation covering Horten history and an analysis of bell and elliptical lift distributions.

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VHS tape of July 15, 2000 presentation by Stefanie Brochocki on the design history of the BKB-1 (Brochocki,Kasper,Bodek) as related by her father Stefan. The second part of this program was conducted by Henry Jex on the design and flights of the radio controlled Quetzalcoatlus northropi (pterodactyl) used in the Smithsonian IMAX film. This was an Aerovironment project led by Dr. Paul MacCready.

Cost: \$8.00 postage paid
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An Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Meeting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio cassette tape of Alex's presentation explaining the material.

Cost: \$5.00 postage paid
 Add: \$1.50 for foreign postage

VHS of Paul MacCready's presentation on March 21,1998, covering his experiences with flying wings and how flying wings occur in nature. Tape includes Aerovironment's "Doing More With Much Less", and the presentations

by Rudy Opitz, Dez George-Falvy and Jim Marske at the 1997 Flying Wing Symposiums at Harris Hill, plus some other miscellaneous "stuff".

Cost: \$8.00 postage paid in US
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VHS of Robert Hoey's presentation on November 20, 1999, covering his group's experimentation with radio controlled bird models being used to explore the control and performance parameters of birds. Tape comes with a complete set of the overhead slides used in the presentation.

Cost : \$10.00 postage paid in US
 \$15.00 foreign orders

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