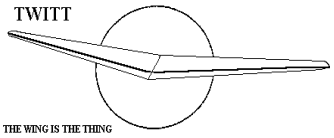
No. 328 OCTOBER 2013

T.W.I.T.T. NEWSLETTER

I took this at the ESA Western Workshop to show the evolution from the Prue 215 in the rear to the Genesis in the foreground. It would appear Irv Prue was ahead of his time in streamlined fuselages.

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., **1310** means this is your last issue unless renewed.



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.

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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

I don't have much to tell you this month. I would like to thank Phil Barnes for his article you can see starting on page 5. This is a synopsis of his presentation at the ESA Western Workshop over Labor Day weekend.

I got an e-mail form an inquirer asking for the .tiff versions of the Horten drawings we have available on the web site. Apparently he wants to see some of the dimensional information more clearly for some project he is working on. The best way to get these files to anyone is through the web site since each one is about at the limit for most Internet Service Provider's transfers. So I have loaded them on to the public area so you won't have to go into the members only section. If you would like them the link is below.

http://www.twitt.org/Horten%20TIFF%20Drawings.html

I imagine some of you are starting to prepare for the winter building season. If you have a project you would like to share please drop me a line with a picture so we can share it with the rest of the members.

Andy

LETTERS TO THE EDITOR

Hi.

Is there anyone building a wing that would like a NEW Weslake 80hp, two cylinder, four stroke engine that was designed from scratch to be an airplane engine. No car parts, electronic ignition, fuel injected ha12@att.net if interested.

Howard Almon

(ed. – This came in on 9/10/13 so it may not be available but if you are interested it would be worth a note to him.)

All:

I am delighted to report that my letter to the Editor *(Aviation Week)* was published on page 8 of Aviation Week, 16 Sept 2013.

My letter pertains to a recent European tech. paper (PLOS) which in effect used groundspeed to compute flight kinetic energy of the dynamic soaring albatross. This error led to their mistaken conclusion that the bird gains energy when flying largely [across] the wind profile. My letter to the Editor states that [airspeed] must be used for the flight kinetic energy, and such is gained when climbing [into] the wind profile.

One or more new presentations can be found at my site

http://www.howfliesthealbatross.com/

With this development, I couldn't have asked for better exposure for my website.

Regards,

Phil Barnes
<pelicanag@aol.com>

(ed. – The following material came in as a series of messages from Jason Wentworth. While they are not all flying wings, they do point out some general ideas about building and provide examples of what can be achieved with limited building resources.)

Hello Andy,

Thank you for publishing the information on the Guillow's "Pocket Launcher" and the tailless jets featured on the Minijets.org website in the September issue! I am glad it was of interest. Also:

Roger's posting (and your response) in the September 2013 issue concerning Bob Kuykendall's HP-24 homebuilt sailplane raises two interesting questions, and I think these questions and your answers to them would be interesting to other readers as well (but I defer to your judgment regarding that). The questions are:

[1] I recently purchased a copy of Peter M. Bowers' 1966 book titled "Soaring Guide." On page 112 there is a photograph of him holding up the partially-completed fuselage of the prototype of the Bowers "Bantam," a simple and inexpensive wood-and-fabric homebuilt sailplane (see: www.homebuiltairplanes.com/forums/soaring/15870-bowers-bantam-glider.html). He designed it with low cost, ease of construction, and ease of rigging & de-rigging uppermost in mind. What became of this project?

In addition:

[2] For many people, a barrier to building one's own homebuilt sailplane is the choice of materials; while there are fine high-performance experimental sailplanes for which plans are available, their frequent use of fiberglass and/or other composite materials requires expertise (and tools) that many would-be sailplane homebuilders lack. Is anyone pursuing new *wooden* homebuilt sailplane designs, either tailless or of conventional configuration? As Peter Bowers found (when he conducted a survey while he was designing the Bantam), people were more interested in low cost and ease of construction, rigging, and de-rigging than in high performance. With just one exception (a glider club whose members wanted a 22:1 glide ratio), everyone who responded to his survey said that a

glide ratio of 20:1 was perfectly adequate for their needs, and they wanted a sailplane that could be built in a typical home workshop. As well:

Perhaps older wooden homebuilt sailplane designs (the Hall Cherokee II [see: http://en.wikipedia.org/wiki/Hall_Cherokee_II]

and the tailless Fauvel AV-36 [see: http://en.wikipedia.org/wiki/Fauvel_AV.36] come to mind) could be refined to take advantage of modern home shop tools (such as routers, which were once used almost exclusively in professional woodworking firms)?

Many thanks in advance for your help.

I don't usually think of Ireland when contemplating tailless aircraft (my thoughts drift to Germany and France), but two new tailless R/C gliders are available from Island Models there (see: www.islandmodels.ie/). One is a non-scale, aerobatic plank design called the Avacro (see: www.islandmodels.ie/index.php/avacro), while the other is a 1/4 scale EPB-1C Backstrom Plank (see: www.islandmodels.ie/index.php/backstrom).

Incidentally, they specialize in 1/4 scale "short kits" of classic sailplanes, and they even offer a 1/3 scale Schleicher Ka-3 (see: www.islandmodels.ie/index.php/13scaleka3).

Avacro

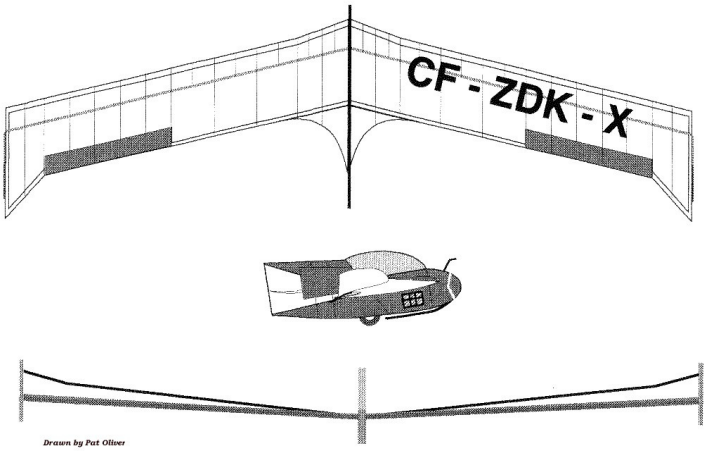
Backstrom

KA-3

I've found two solutions (both gratis) to the TWITT logo glider problem; both would cost TWITT *nothing*,

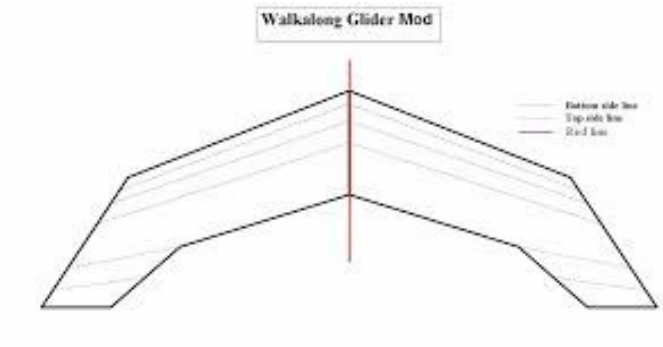
but they would serve to publicize & promote TWITT and the tailless concept. They are as follows:

[1] Just as the Civil Air Patrol (CAP) has downloadable & printable cardstock gliders with CAP decor schemes (see the CAP glider links below), creating a second BKB cardstock tailless glider file (see: www.twitt.org/BKB_PaperGlider.html) with the TWITT logo on the glider would enable anyone to print out as many of them as desired on 8-1/2" X 11" sheets of 110 pound cardstock.



Also:

[2] A downloadable, tailless cardstock or paper "Walkalong Glider" file (see: https://www.google.com/search?q=walkalong+glider+plans&tbm=isch&tbo=u&source=univ&sa=X&ei=Buo6UsmtJ6asigKLi4GYAg&ved=0CCkQsAQ&biw=800&bih=403&dpr=1 [this link has swept and plank designs], www.instructables.com/id/Paper_Airplane_Walkalong_Glider/ [this link has links to other variants], and www.pbs.org/saf/1109/features/makeplane.htm) could have the TWITT logo on the walkalong glider(s),



which people could print out in whatever quantities they wish. (A walkalong glider is a slope soarer, with the person who launches it acting as a moving "slope," keeping the glider airborne via the air pushed outward and upward by his or her body while walking [or by a hand-held flat fan--just a sheet of cardboard--that the launching person slowly waves under the glider while walking along.] Only tailless designs work well as walkalong gliders, incidentally--their short pitch moment arms are an advantage for this application!)

As well:

(ed. – I included a picture of someone using a walkalong glider so you see how it works. This was the invention of Dr. Paul MacCready's son Tyler and is a fun thing to play with.)

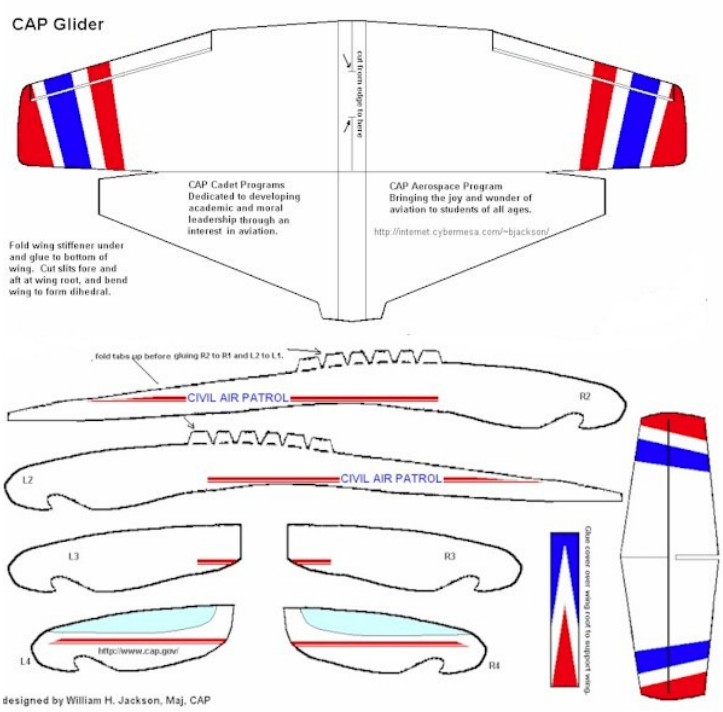
Below are several links to Civil Air Patrol (CAP) downloadable & printable cardstock gliders with CAP decor schemes: *(partial example on next page)*

Large CAP Glider www.nmcap.org/ae/Activities/PDF/CAPGlider_Lg.pdf

Small CAP Glider www.nmcap.org/ae/Activities/PDF/CAPGliderMod5BW.pdf

CAP TG-4A Glider www.nmcap.org/ae/Activities/PDF/AFATG4A.pdf and www.nmcap.org/ae/Activities/QuickPlane.htm

CAP Glider assembly & flying instructions www.nmcap.org/ae/Activities/PDF/InstructionforCAPGlider.pdf
CAP cardstock model rockets and altitude tracker www.nmcap.org/ae/Activities/



I hope this material will be helpful.

Jason Wentworth

(ed. – This came in from the guestbook page on our website but I don't have an answer for him. Perhaps one of you could help with an e-mail address. If so, please forward it directly to Chip.)

Wolfgang Uhl where can I locate him for information on his U2 I have one and want to update mine during the rebuild

Chip Brandt
<ghbrandt@ctc.net>

Aerodynamic Study of the Wright Brothers' 1902 Glider and 1903 Flyer

By J. Philip Barnes 06 Oct 2013

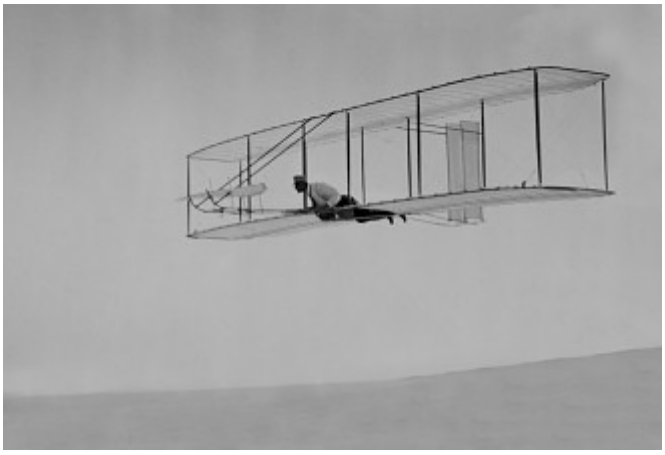
This article, excerpted from the author's "Configuration Aerodynamics" study found at www.HowFliesTheAlbatross.com, reviews and renews our understanding of key aerodynamic features of the Wright Brothers' 1902 Glider and 1903 Flyer. In particular, we apply a 3D lifting-line computer model to analyze the distributed aerodynamic forces on the 1902 glider, discuss the impact of the changes with the 1903 flyer, and provide a brief historical narrative.

Wilbur and Orville

The Wright Brothers brought us the world's first piloted and powered airplane. They did this without high school diplomas or college degrees. However, they possessed aptitude and persevered over numerous obstacles, often aided by their powerful collaboration. Understanding the importance of learning to control gliding flight before adding power, they became first to independently control pitch, roll, and yaw.

The Wrights implemented a system approach to integrate and develop existing and new methods for aerodynamics, flight control, structures, and propulsion. And, not only did they design their own engine, but they also invented aerial propeller theory. Although with their wind-tunnel they measured the "lift-to-drift" of various wing and multi-wing configurations, they did not measure pitching moment, as they did not understand its importance. This lack of understanding

did not prevent their success. Indeed, for their 1902 glider, it may have sheltered the canard from stall. But for their 1903 powered "Flyer," it presented a major obstacle barely overcome by superior piloting skills.



Wilbur pilots the ***original*** 1902 Glider at the Outer Banks of North Carolina.

The Wright Brothers wisely selected the sand dunes of the Outer Banks of North Carolina for their testing. On a windy day, the dunes would provide an updraft to reduce ground speed and to enable slope soaring. But more important, the sand cushioned inevitable hard landings.

The original version of the 1902 glider incorporated a fixed double fin which failed to overcome, or perhaps even aided, the adverse yaw which led to many hard landings. With wing warping, a roll to the left was accompanied by an unwanted yaw to the right.

Notice the modest wing camber and near-zero canard-to-wing decalage. The latter is characteristic of most or all photos of the glider in action, and it provides our first hint that the aircraft was flown "statically unstable" in pitch, where the glider was actively stabilized with small variations in canard incidence set by the pilot holding by eye a fixed horizon. But as noted later, the variations of canard incidence would be far greater for the 1903 Flyer. *(See photo at top of right column)*

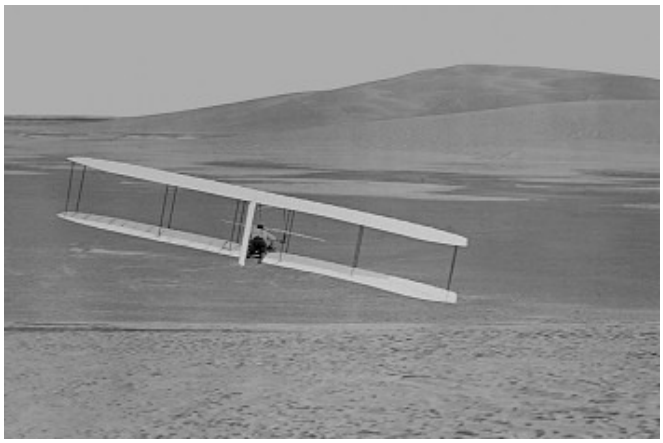
Upon Wilbur's discovery of adverse yaw, the Brothers' powerful collaboration came to the rescue. Orville suggested making the fin movable, thus increasing its ability to generate yawing moments. Wilbur then added that the fin should be coupled with roll to promote coordinated turns. These features, together with changing the "bi-fin" to a "mono-fin," were implemented with great success. The photo at the right shows coupled roll and yaw in action. The

Dan Tate and Wilbur launch Orville in the ***modified*** 1902 glider

right-hand wing incidence has been increased by warping, with the fin deflected trailing-edge-left in an attempt to negate the adverse yaw due to the increased drag on the right-hand wing.

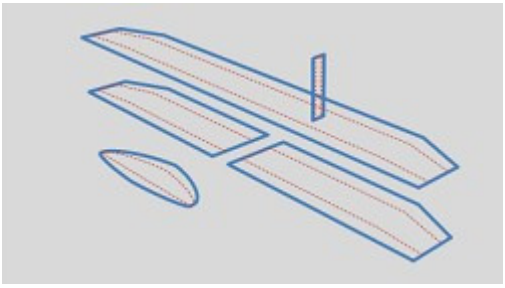
> *This is the third photo of the glider supporting our assessment that the average decalage for the canard was near zero.*

The modified glider enjoyed over a thousand flights, the longest lasting more than a minute. We don't need a *YouTube* video to imagine the excitement the brothers must have felt as each took a turn piloting a flight.



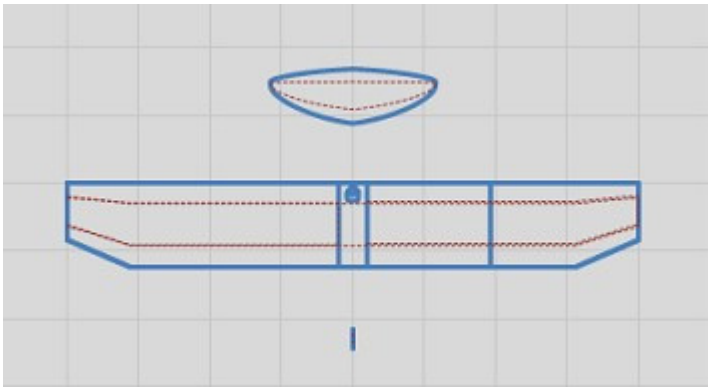
Coupled roll and yaw in action.

We now turn to our 3D lifting-line analysis of the 1902 Wright Glider, beginning with various views of the model. Notice first the lower-wing cutout for the pilot. This in effect transforms the aircraft into somewhat of a triplane, not counting the canard.

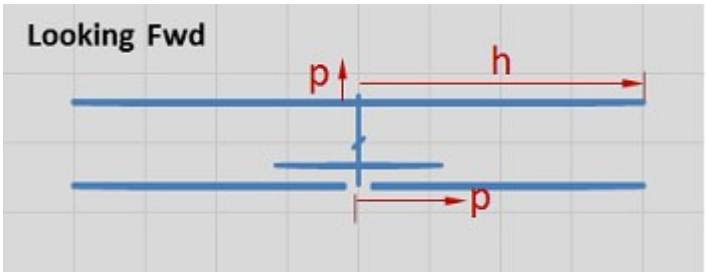


Isometric view of the 1902 Glider.

With what amounts to an *aerodynamic finite-element method,* we align horseshoe vortices at the lifting lines (nominally at ¼-chord) of each aerodynamic surface, then solving about 100 linear-simultaneous equations representing the mutual influences of the vortices with the boundary conditions set by the local slope of the "equivalent-plate" airfoil along a downwash line positioned at ¾-chord. The vector-based approach accommodates sideslip and/or asymmetric geometry, including non-planar and/or vertical surfaces.

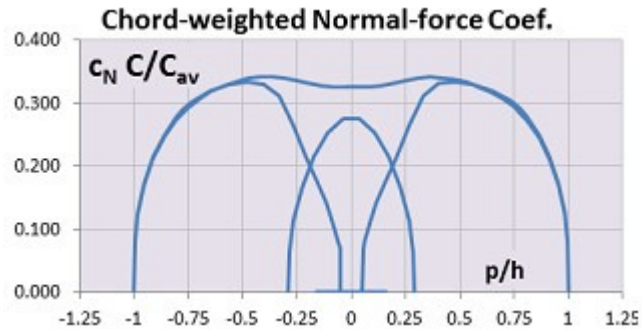


Plan view of the 1902 Glider with lifting and downwash lines



Rear view of the 1902 Glider

Next we show the spanwise distribution of chord-weighted lift, including the effects of pitch trim for the estimated center of gravity position with -5% static margin. The canard lift balances not only the nose-down moment of the wing lift vector acting (at 23% chord) aft of the c.g., but also the nose-down pitching moment coefficient (-0.02 each) of the modestly-cambered wings.



Spanwise distribution of chord-weighted lift, 1902 Glider

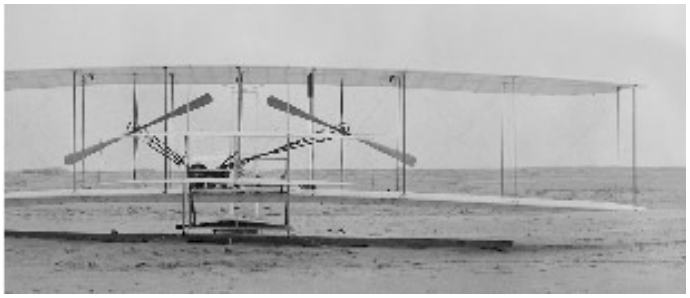
Next is shown the distribution of lift ("normal force") coefficient. Notice that the canard is loaded about 50% greater than any of the "three" wings. As previously noted, the center of gravity (with pilot) is aft of the aerodynamic center by about 5% of the mean aerodynamic chord. The photos of the glider in flight suggest that this level of pitch instability was manageable. Curiously, if the Wrights had balanced the glider farther forward, the added canard load would risk canard stall with incidence excursions, and this might have delayed or prevented their success. Thus for the *1902 Glider*, what the Wrights didn't know (pitch stability) may have aided success. But that same lack of understanding was nearly disastrous for the *1903 Flyer*.

Spanwise distribution of lift coefficient

With the 1903 Flyer, the brothers dangerously departed from their usual step-by-step approach. Instead of "simply" adding a propulsion system to their 1902 glider, or a scaled-up version thereof, they made significant changes which, initially unknown to them, would have undesirable effects. First, they mounted the engine and propellers well aft of an already tail-heavy c.g. But they also changed the canard from a monoplane to a biplane, doubling both its

aerodynamic lift capability and its pitch-destabilizing influence. Whereas the 1902 glider flew at a manageable -5% static margin (+5% would be the norm in the following decades), their 1903 Flyer would now be all but unflyable at -25% static margin, easily twice the instability of a modern fighter aircraft.

Below: The world's most historic aviation photograph - Wilbur gives chase to Orville - 17 Dec 1903



Front view of the 1903 Flyer

U-2 Bulleting Board Threads

Hi everybody, Norman and all...

I am almost satisfied with my new giant wing to think about selling my U-2...As the 'older' guys know, I have been involved with it for a number of years. I guess it was a continuous on-going project. I am doing the same with my new project (Choucas motorglider).Norm, your advice was good choosing between the Monnet motorglider and the Choucas and I do not regret it. My U-2 is perhaps the oldest U-2 flying around. I was thinking maybe giving it to a museum but it would be better to have fun with it before putting it to a static state. I had different birds through my life but I always kept the U-2.Like an old leather jacket that just fits you. Anyway I am asking 12,000.00 Canadian. Wow ! Seems as a high price ,but this bird is flying and SAFE. At least to my knowledge and it is been flown for 800 hrs. Controls are smooth and there is no loose no-where. Been pampered thorough the years. So, you can look at the photos section (U-2 stuff Part2) and for all the specs, look in the file section 'U-2 specs.rtf'. If you are building now, this might give you some tips or hints to complete your own project.

I made a second set of outboard wings with the reflex using a xerox photocopier and used reflexed #7 inboard as a starting point and reduced each outboard rib proportionally. The idea was to be able to switch outboards panels if the new one was not satisfactory which I never did. The new outboard reflexed wings extend the speed envelope. Stall from 37 to 33 mph and cruise went from 55 to 60.Horns for the elevons were modified to be at the same exact position than before and also got thicker. You can see them (shaded area) in the photo section, Hitbull album.

The Koenig engine was very popular among gliders few years ago. In, total weighs less than 60 pounds, all included and have a max HP of 24 at 4000 RPM. Reduction is, I believe, 2.25 running a nice (over 20 layers) laminated prop.

It is more or less 11,500 US

Guy Provost from Montreal
<guy.provost01@videotron.ca>

Hi, Guy--

I have been looking at the new pictures you uploaded. WOW that's a nice looking plane. If I had any money I'd run up there and grab it. I may not have said so when we corresponded years ago about choosing a new motor-glider but I've always been impressed by your work on the U-2. I wish you many years of fun and safe flying with the Choucas and hope it becomes your new old leather jacket

Norm Masters

It is not to my taste yet but it is getting there. I had multiple problems at the beginning, wrong motor mounts, wrong prop, harmonic between the main and the tail wheel, FLUTTER in the ailerons, brand new 503 hunting up and down, cg far too much after, I had to redo the whole tail section in carbon and move the parachute forward and the battery and also add ballast . Porpoising on take-offs and landings just to name a few, (really like a Fauvel and other similar wings). Most of it fixed.What's left to be done....foldable prop vibrates like hell. The Duc blades are very good performers but they do vibrate like hell. Static balance is perfect and also the moments of each blade, I took a long time to figure out it was not my handmade hub which folds the blades. Now, they are back in France for a checkup, even if they have the same moment, one has 50 grams more (2 ounces). Those blades are made with carbon (which is pre-impregnated over a foam shape) .So, where and what is that 50 grams. I suspect that they do not flex the same when they run at 2300.I am using now a 3 blades Ivoprop which does a very good job but not for gliding. The other thing left is to change the carbon main gear, it is a one piece thing up to the wheels. No suspension and cracky, specially when it is cold. Next week, I am installing an alu landing gear from Grove. The whole thing including the wheel pants weights an extra 2 pounds to my big surprise. This big heavy giant wing takes off within 5 seconds and climb 600 FPM just with the 503,at 80 degrees F. That amazes me...
The rumors tells me that you will or already put your hand on a U-2...I'll be glad to help get this bird up safely, it could and can be done...

Guy

Hi, Guy--

I did pick up a U-2 with a friend last Sunday but it's certainly not mine. The wing is finished but needs some minor repairs. The cockpit and engine mount have been changed a little bit from DM's plans so we'll have to design a custom cover for that. No big problem but the plane won't fly until we seal the air leakage through the center section. Other than that it's in pretty good shape. We don't plan to do any modifications until after it's finished and has flown around the patch. If Roger is satisfied with it at that point we may not do much other than a drag cleanup.

It's interesting that you had to fix those details on your Choucas. It's really surprising that they sold you a pair of propeller blades that were so mismatched. One would think that they would check the weight and balance at the factory and match them up because there is some random variation. Also a three bladed prop will always vibrate less than a two blade because of gyroscopic precession. A 2 blade prop has its inertia all on one axis and will precess at 1/2 of the prop RPM during maneuvers. Any number of blades greater than 2 has its inertia evenly distributed around the prop disk and the precession wobble will be smoothed out to a constant pull.

Norm

Norm,

Could you tell us about the power plant that is currently installed and describe the changes

made or will be made to the U-2? Have any pictures been posted?

Thanks.

Terry Menees

Hi, Terry--

The engine is a Honda 250. So far the plane appears to conform to the plans except for the size of the pod and an additional triangle on the motor mount that appears to be intended for roll-over protection. Since we're concentrating on the pod we haven't reconnected the wings so there's not a lot to take pictures of yet. Here's a pic of it before we disassemble it for the long trip back to Colorado. The guys in Watonga were great. Packing it on the trailer turned out to be a bigger job than we expected but with their help we got it all packed nice and secure and stayed on scheduled. We're looking closely at Guy Provost's pictures and others in the group photos directory for ideas on how to finish the pod. I'll leave any more comments about this plane to Roger since it's his plane now.

Norm

I had never given this much thought until I saw the inside of a U-2 but, if you build it with the nose gear half inside the pod, as shown on the manual cover page you end up with a big peanut shaped hole in the floor. Aside from disrupting the airflow under the pod this hole lets a lot of air through which spoils lift in what should be the most efficient area. Even with a fairly tight fitting canopy there's still going to be a lot of leakage in critical areas. How have you guys addressed this problem? I was thinking of a rubberized fabric boot. A rigid box would also do the trick but that should have been built in with the framework. Now it's very crowded in there.

Norm

Rubber boots are often used on pushrods where they pass through the pressure vessel on pressurized aircraft. Would it be possible to fabricate a fiberglass blister fairing for the inside of the pod?

Terry

Not to mention letting a lot of dirt and debris in on the takeoff and landing. A similar setup on my P-swift caught me by surprise the first time I went to take off on a dew covered grass strip. As I'm accelerating suddenly my face is being blasted with water. Then I'm airborne and when I can see again, well, I can't really too well because the inside of the canopy is coated with water and wet grass! It's way out of reach with the straps on. Fun times.

Joe Street

I figured that I'd have to use some tape but I didn't think of a fender. The wheel doesn't move through very many degrees so that actually sounds like a pretty good idea. Now to find a weightless material to make something out of.

Norm

I saw Wolfgang's U2 fly, and it seemed to behave well, he said he could soar a bit with power off, too, but would need 3m/sec updraft to stay up. I'll have a closer looks at the photos in flight re. the elevon angle.

The trim tabs were very long, but he had oversized them and then cut them back to zero with an angle of 10 degrees or so towards the part where he had kept the full chord of the tabs. He did have a small bungee on the stick, but nothing impressive. I agree with the thrust line being not right compared to the system's CG. I always keep in mind the photos of Dick Rowley's U2 with the seriously tilted-down Cuyuna. That is about how it should be. I prefer to have a fairing between the rear of the canopy and motor rather than unclean air to the prop and a open engine mount. (again, dick Rowley (and Wolfgang) used just that.

I have a lot of work to do still on the U2 I bought, and it looks like it's going to be heavy...

Solo210er

AVAILABLE PLANS & REFERENCE MATERIAL

Tailless Aircraft Bibliography

My book containing several thousand annotated entries and appendices listing well over three hundred tailless designers/creators and their aircraft is no longer in print. I expect *eventually* to make available on disc a fairly comprehensive annotated and perhaps illustrated listing of pre-21st century tailless and related-interest aircraft documents in PDF format. Meanwhile, I will continue to provide information from my files to serious researchers. I'm sorry for the continuing delay, but life happens.

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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.
Ultralight & Light Self Launching Sailplanes: $20 pp: 23 ultralights, 16 lights, 18 sustainer engines, 56 self launch engines, history, safety, prop drag reduction, performance.
Collected Sailplane Articles & Soaring Mishaps: $30 pp: 72 articles incl. 6 misadventures, future predictions, ULSP, dynamic soaring, 20 years SHA workshop.
Collected Aircraft Performance Improvements: $30 pp: 14 articles, 7 lectures, Oshkosh Appraisal, AR-5 and VMAX Probe Drag Analysis, fuselage drag & propeller location studies.

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Capistrano Beach, CA 92624 (949) 496-5191

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
Add: $2.00 for foreign postage

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.
Cost: $10.00 postage paid
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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
Add: $2.00 for foreign postage

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

FLYING WING SALES

BLUEPRINTS – Available for the Mitchell Wing Model U-2 Superwing Experimental motor glider and the B-10 Ultralight motor glider. These two aircraft were designed by Don Mitchell and are considered by many to be the finest flying wing airplanes available. The complete drawings, which include instructions, constructions photos and a flight manual cost $250 US delivery, $280 foreign delivery, postage paid.

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