No. 312 JUNE 2012

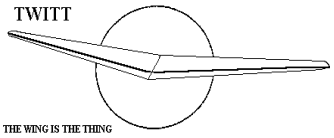
T.W.I.T.T. NEWSLETTER

Mitchell A-10 production ultralight.
Source: http://www.ultralightnews.com/ssulbg/mitchellwing-a10.htm

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., **1206** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, July 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

We have some interesting things for you this month from our members, from the Nurflugel group and the U-2 group that we haven't heard much from lately.

In the letters section you will see one from Clyde Revilee looking to "sell" his nearly complete Marske Pioneer II. You won't believe the price so make sure to take a look. It is in San Diego so would be of most interest to those in the southwest area.

A letter from Paul Sallach by itself would generate some interest in this unusual tailless aircraft. However, when it popped up on eBay the guys at Nurflugel jumped on it with a lot of criticism and other comments on its viability as a flying vehicle. I have also posted more pictures of it on our web site and the link is in the Nurflugel section.

The Mitchell U-2 guys have been a little quiet with what I would call good stuff until a new guy joined and initiated a detailed discussion. I included it because they get into a lot of the construction methodology and calculations that I thought would be of use to everyone in a more general way.

I hope you enjoy this issue and be sure to take a look at the pictures on the web site of the unusual circular wing.

Andy

LETTERS TO THE EDITOR

(ed. – In case you were wondering about the picture and web site link included as filler last month, here is how it originated. I asked Bob Hoey if he had seen this site before? I had picked it up looking for a cover shot for the newsletter and came across the picture at the very bottom that shows tip feathers on the wing of a glider. There is a lot of different and interesting items on this home page so make sure to keep scrolling down to reach the area that covers the picture.)

http://www.bionik.tu-berlin.de/institut/xtutor1.htm

Bob Hoey wrote back with:

I had not seen that website before. The Germans (I think) installed the "wing grid" concept tip feathers on a glider awhile back. They claimed it worked, but the testing was pretty crude. Flight-testing for the L/D on a glider is really tough!! I think that is the picture you referred to. I never did understand the "wing grid" concept anyway.

I have been conversing with Max about the Pegasus design and am just about to start construction of a model. I'll send you some stuff when I get it flying.

Bob Hoey
<bobh@antelecom.net>

I have pretty much given up on finishing the Pioneer IID that I acquired about a year ago, and I was wondering if you would know of anyone who would like to have it. The price is probably reasonable; zero, the only cost would be taking a glider trailer up to Pauma Valley (north of San Diego) to retrieve the wings.

The original trailer only made it that far, before it really started shedding pieces on the freeway. My biggest mistake was not getting rid of the trailer before my wife saw it; she was adamantly opposed to having anything that ugly parked next to the house and that sort of rubbed off on the glider too.

So, I have talked her into letting me get a used production glider, that is flyable right out of the box, but I have to get rid of the Pioneer first.

Here is a view of the Pioneer IID being built by Robert Elhke at:

http://www.continuo.com/marske/pioneer/ehlke/elhke.htm

Elhke was a former Air Force Thunderbirds pilot, and after he retired he started building the glider from scratch back in Wisconsin, but before he could complete it he died of a heart attack.

I have all the documentation and the plans, which are going with it. Please call me at 619-857-8226.

Thanks,

Clyde Revilee
<revilee@cox.net>

(ed. – I talked with Clyde and he indicated the glider is about 80% - 85% complete for those of you who might be interested. The wings are covered so it sounds like there are just a lot of little jobs needed to get it all in working condition. Clyde lives in San Diego so you have an idea of how far you would need to trailer it with whatever system you choose. You have to admit the price is right.)

I was referred to you as a valuable source of information for a craft that I have been asked to assist the owner sell. Very little is known about it, and I would love the opportunity to touch base and learn any insights you have? I have attached a photo for your reference. Let me know who to touch base with to discuss this further?

Unfortunately there is no verified evidence that the craft ever flew, but the owner does believe that it has. Let me know when you are able to put something up? I completely understand that you have to put your

attention on other items. Look forward to hearing from you when there is something to report.

Thank you in advance for your reply!!

Paul Sallach
<paulsallach@gmail.com>
702-285-0604

(ed. – Here are a couple of the pictures that Paul included in his messages. I will be placing more of them throughout this issue since there was some interesting discussion by the Nurflugel group on the merits of this design. It has now been advertised on eBay for a $100,000 starting bid.)

(ed. – Below is my initial reply to his inquiry.)

Thank you for the inquiry. I don't recall ever seeing any pictures, sketches or plans for such a vehicle. I use the word vehicle since I am not certain it is really an airplane unless it can be determined it has successfully flown. Other than the nose wheel shown in the front it looks more like a ground effects vehicle that would skim over even surfaces like water, but that is a guess.

What I can do is put it in a couple of newsletters that I publish each month. One is devoted to flying wings/tailless aircraft (TWITT) and one of our members might have seen something about it. The other is the Experimental Soaring Association (ESA) that has a lot of old timers in it who might have something to offer. The ESA issue will be going out in the next 10 days, whereas the TWITT issue won't go out until the second week of June.

As for finding a buyer, I don't know what to tell you. It is obviously a very unique item that will appeal to a very limited audience. Perhaps putting it in our newsletters might produce someone interested, or at least come up with a referral. That is the best I can tell you at this point in time.

Let me know if you would like me to put it in the newsletters and then let you know what I find out.

Andy Kecskes

Thank you so much for your reply!! I will be grateful for any assistance you or TWITT might be able to provide. I would love for any exposure you might be able to provide in newsletter of posting on a Forum?? Would it be beneficial for me to join TWITT and make a posting myself on a members forum? I will send some separate emails with the photos I have/took. Let me know your thoughts. Thank you again in advance, I really appreciate your help.

Paul Sallach

(ed. – I did suggest that Paul might want to consider joining the Nurflugel group, although after reading through what you will see below perhaps that was a premature suggestion.)

Nurflugel Bulletin Board Threads

I saw this flying wing on eBay.

http://cgi.ebay.com/ebaymotors/UFO-one-kind-/160808196755?pt=Motors_Aircraft&hash=item2570ea5a93

Bill Higdon

Looks like a hovercraft to me!

Ken Baker

It is a "wing". It has a parabola shaped wing that is hard to discern at the rear section-and is basically a modified delta. Notice all the fences on the leading edge. Maybe Al can comment on this, but it looks a bit unstable to me-may be prone to tip stall and a myriad of other problems. Too many "fixes" to suit me. Might be stealthy, but I would want a full history including blueprints, before I ever climbed into this one. Thanks,

Rich Nunn

(ed. – I posted most of the pictures Paul sent me at:

www.twitt.org/Circular Wing Photos.html)

Andy, thanks for posting the pics..

It looks pretty obvious that this airplane, if it flies at all, is likely to have some serious yaw stability problems. The little tiny fin at the back is going to be blanked by the cockpit. The induced flow from the prop will help maintain rudder authority, but the straightening effect of the prop wash will further degrade yaw stability. The prop itself is too close to the C/G for its in-plane forces to have much effect. Meanwhile, the cockpit will act like a huge fin in front of the C/G, and those leading edge fences will add a small but similar effect.

The net result is likely to be a violent static divergence in yaw immediately after liftoff. At least the pilot will find himself facing aft at the back of the plane during the subsequent crash.

Don Stackhouse

Thanks, Andy, wow that design has some problems that should have been obvious. One thing, that apparently isn't obvious because it keeps showing up, is that the thrust is producing a moment around the main gear that pushes the nose down. The only way to get this thing off the ground under its own power would to run it up above flying speed and cut power. When the thrust vs main gear moment disappears it'll jump into the air. Then it'll probably swap ends like Don said.

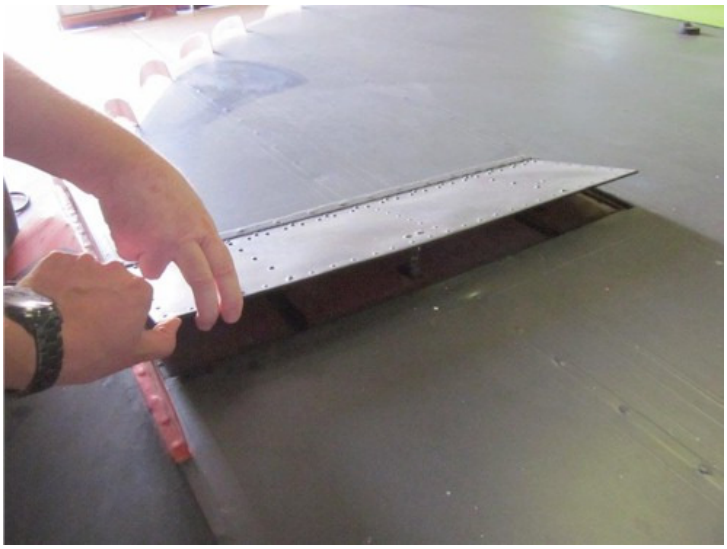
Norm Masters

I don't see any registration numbers, nor do I see the word "experimental" in any of the photos.

From looking at the instrument panel, I notice the tail wheel is retractable, the front not. That would add more side area up front, contributing to Don's impressions of yaw instability.

Someone should tackle this one on XPlane.

Bill and Bunny Kuhlman



I agree the thrust line is more appropriate on a ground effect machine but it might be well to remember the ARUP planes flew.

Dennis

The ARUPs also had long landing gear that allowed a fairly high ground incidence and the thrust line passed through both the center of drag and the 3D center of gravity. That alignment of the force and the loads isn't absolutely necessary for flight but it makes things a lot simpler.

Norm Masters

(ed. – Norm's comments were the last ones that came in before I reached my cutoff deadline for material. I checked eBay as of June 1st but no one has placed a bid, or at least one that met the reserve limit.)

Lloyd Watson has done a lot of work putting the Jim Marske interview and history on the Internet. It's very worth taking a look, I especially loved the footage of all the flying wing planks. Everyone should take the time to look through all the parts (7 parts I believe).

http://youtu.be/oalFPM10HOY

Enjoy!

Al Bowers
<Albion.H.Bowers@nasa.gov>

Thanks to all that have sent very nice messages on the 10 part series on Jim's History. Bob you are correct there is not much I put in on the Genesis because at the time of this recording a few years back there was a request not to go into to much detail about that sailplane by that group. So I left much of that material out.

Much of the History is from Jim's own home movies and other video that friends and builders made during not only test flying but just for fun. The majority of the P2 is my bird in Texas prior to also flying the Monarch.

Jim has been a true friend and incredible humble designer that I found extremely interesting. I decided on a whim to visit him and see if I could talk him into discussing his history. It was all shot in two days. The balance of the video was edited over the next fall.

My thanks to Al Bowers and Bob for their comments and assistance!

Now that the P3 has sprouted its wings and my tongue is wagging I went back and reviewed the history. I had not watched it in the past years. The master video has since disappeared somewhere in tons of DV tapes. I just wanted all of the guys interested in Flying Wing Sailplanes to enjoy the incredible stories I heard of How Jim found his calling! And Boy what a gift he has.

All enjoy and my prayer and hope is to be able to add on a few chapters on the P3 as not only Jim's P3 is up but as
more kits take to the air.

God Bless all and to Jim Marske. Thanks and continued Blessings.

ALSO...if anyone is interested check out! More info on Monarch and P3 see:

www.kollmanwings.com/

Lloyd Watson
<pilotltw@yahoo.com>

On the lower-left of the cover of Martin Simons' Model Aircraft Aerodynamics is a gorgeous, huge model of a flying wing. Any notion of what it is, who built it, and how it flew?

A poor image of the cover is at:

<http://books.google.com/books?id=R2xvegHiRecC>

Philip Randolph

It's a Horten 7, and there aren't many around, so it could be of German origin (the model, not the original) ;).

Rob

As I recall the H-VII was Walter's favorite. I don't know off hand who you can get a kit from but there's a build log going on, on RCG, right now with some drawings being posted.

I haven't been following it but I looked in because of your question. Here's the page with the drawing:

http://www.rcgroups.com/forums/showthread.php?t=1617068&page=8#post21574265

Norm Masters

The H VII was built by "Dutch Flying Wing Team" around 1993 here is link on their homepage:

http://www.dfwt.nl/.

Jörg Schaden

(ed. – If you haven't seen this site yet you definitely need to click on the link. The flying wing models are fantastic and there are some excellent videos.)

Mitchell U-2 Bulletin Board Threads

Hi Chaps

Just joined and getting ready to start cutting material, starting with the spars in general and the dreaded laminated bows in particular. I have been poring over the drawings and trawling through past postings which has been very interesting, as well as cutting down the number of questions I need to ask! Well, the drawings are rather fun in a treasure hunt sort of way, with little nuggets of info scattered joyfully amongst the sheets. I think I caught most of the gotchas about dimensions having skillfully spotted clues such as the notes "when laying out spars be sure spar width...." and "it may be necessary to 'bow' ..." but I would be happy to have confirmation about parts of the lower inboard spar cap sizing; the instructions are a bit confused, as the materials list page 3 dated 1-19-81 squabbles with page 12 same date, and the drawings have no opinion on the matter. So here is my best effort at sizing:
outboard spar as a whole, and inboard spar inner caps (#1) upper and lower as per drawings, and then these:

Inboard spar - laminated bow finished dimension 1" width and 1 3/4" depth no taper (all 4 are the same) I am going to laminate 4 x 1/4" or 8 x 1/8 depending on what I can find.

Inboard spar lower cap(#2) 1" width, 1 3/4" depth taper to 1 1/4"

The bow size will make the scarfing easier - I don't understand the 1 3/8" sizes, which I suppose are previous versions. The taper to 1 1/4" on #2 lower gives a bit more wood at the fitting rather than exactly matching the fitting width (the drawings and build photos seem to show a wider cap).I shall layout spars on the table with spar depths matching the rib drawings. Thanks for reading this far(!) - any comments or criticism?

Just as background -I am in England, can see from my house the airfield where Glen Miller took off for the last time and not far from the erstwhile home of the 306th BG "Always First". My inchoate plans for the U2 are:

1) Build to SSDR (single seat deregulation)/ Part 103 specifications, and add lightness to get under the magic 253.5316lbs or as our glorious C.A.A. would have it, 115kgs. If I can't do that then I am in trouble, as the design is not approved in the UK.

2) Rejigificate pod frame and wing attachment to better transfer loads from spar and engine

3)Move main undercarriage legs to pod (that spar again).

4)Use the smallest motor commensurate with getting airborne with a reasonable RoC.

5)Hope to get at least 1 in 15 glide ratio by attention to wing surface finish and general drag reduction.

6)Have great fun building and experimenting, free from (almost)any regulation.

Jono

I think building the U2 at less than 115 kg would be difficult. How are you going to reduce the weight? This is already a lightly built aircraft. You could substitute carbon fiber tubing for the steel in the fuselage, but this will greatly increase the cost. I'm not all that familiar with the CAA regs - I have enough trouble keeping up with US FARs.

2) I agree with moving the LG to the frame makes sense. I also want to change the overall shape of the cockpit to something akin to Wolfgang Ulf's U2 which looks like a standard sailplane pod. He also has retractable gear that looks very nice, though the mains do attach to the wing spars.

4) A smaller motor will help to reduce weight and keeping the weight low should allow good performance.

5) Keeping the weight down will help with glide performance but equally important is how smooth the fuselage and wing are. Laminar flow and a folding prop, adding a fairing over the engine as well as choosing an engine that can be buried easily (an inverted 2 stroke will do well.)

6) I like the freedom from regulation and red tape that part 103 gives. Originally I had planned on building an ultralight motorglider but I found the U2 much more appealing. I already have a PPL and will work on a sailplane ticket with motor glider signoff while I am building.

Paul Hardy

Getting that design below 300 pounds is going to require some engineering and probably some expensive materials. Styrofoam nose ribs are as light as they can be and plywood for the D-tube is hard to beat (A friend and I are experimenting with composite sandwich but I don't expect a big savings). A socked spar with graphite carbon pultruded rod and Kevlar sock would make a lighter spar than wood but just substituting materials won't work. A carbon spar engineered to be the same strength as the wooden one will have substantially smaller caps so then you'll have to redesign the ribs. You may be able to improve on the foam nose ribs but it won't be easy and the savings there will probably be very small if any (but there are so many that if you can save 1 gram on the tip rib it will add up fast). The aft ribs may offer more weight savings but the structure is about as efficient as it can be so any savings you can get there will be through material substitution. Don't bother trying to replace the metal bell-cranks with composite, there aren't that many, you'll only save a few grams at best. No material has a fatigue life comparable to steel of the same weight so be very careful about substituting structural steel parts (especially something that will be hard to inspect). Really the heaviest things in the airplane are you and the engine. You need an honest 20 horsepower to get a decent climb. If you are sure that you will always be operating from a long runway in flat land you might be satisfied with 17 or 18 but less than that would really make it a dog. We had a talk about a promising little engine, from Polini, called "Thor" that might save you a few pounds.

www.polini.it/en/page_429.html

Norm Masters

Hi Paul, good to hear from you.

Yes, I think you are right about the general difficulty, especially as I am avoiding any expensive high tech materials. In the end if I can get airborne at the 115kg limit even if it means sacrificing glide performance (or indeed any performance!)then the project will be a resounding success.. as to how, my first priority will be to build accurately and carefully and have the minimum of equipment installed and have a very lightweight covering and that elusive tiny engine (the 115kg figure is empty weight with no fuel, 300kg all up)

I agree the design is lightweight already but I am hopeful as the specs for the B10 show much reduced weight compared to the U2 which I am presuming to be mostly pod/cage and engine differences as the wings appear much the same size. I guess until the

wing structure is built and weighed it will be difficult to gauge what is left for pods folding props (I like that idea!) and wheels...

I also found a past post from the group where someone had built theirs at 103 weight but didn't write down the name!. It would be great to have weight data from several finished and flying aircraft.
Maybe I'll make that bottom spar cap 1 1/8" after all! Yes, I like the shape of Wolfgang Ulm's machine - I wonder what it weighs. Any comment on the spar cap sizes?

Hey Norm, thanks for replying.

I agree, but in my case where there is room for engineering, or rather 'Tinkering', the expensive materials is a no no! It sounds like you and your friend have thought through the composite materials route to improve aerodynamics (?) which sounds interesting.

I am keeping to the plans with regard to the aerodynamics and wing structure, and am not sure based on past group messages the stock performance will justify too much emphasis on those expensive materials.

I really like your point about saving a gram on each of a lot of parts adding up fast - that's my plan in a nutshell. I had a look at the Thor engines after reading the posts - nice. As well as paramotor engines perhaps large model engines too.

We'll see how heavy the thing becomes as work progresses.

Did you have comment on my cap sizes?

Jono

Hey Paul:

He has the wrong measurements for what he wrote below:

Inboard spar - laminated bow finished dimension 1" width and 1 3/4" depth no taper (all 4 are the same) I am going to laminate 4 x 1/4" or 8 x 1/8 depending on what I can find.

ANSWER:

There is tapering, one is 2 1/4" tapers to 1 3/4" and is 1" thick, the other side I believe is tapers 1 3/4 to 1 3/8" and also 1" thick.
He is right re using 4x 1/4" or 8 x 1/8", the 1/4" will work fine and is a little cheaper.

The other spar I will write re in morning.

Inboard spar lower cap(#2) 1" width, 1 3/4" depth taper to 1 1/4"

The bow size will make the scarfing easier - I don't understand the 1 3/8" sizes, which I suppose are previous versions. The taper to 1 1/4" on #2 lower gives a bit more wood at the fitting rather than exactly matching the fitting width (the drawings and build photos seem to show a wider cap).I shall layout spars on the table with spar depths matching the rib drawings.

Ryan

Hello Ryan. Those spars, eh?! I am going cross-eyed. I am concerned only with the inboard spar caps.

I am defining cap sizes as follows: Depth, which is the height of the cap measured top to bottom i.e. the vertical face as installed. and Width, which is the thickness measured chord wise i.e. from nose to tail.

The U2 has been around for 30 odd years scratch built and in kit form. I imagine some detail changes have been made as a result of service experience and production cost savings, we cannot expect anything else, but this is cottage industry and the paperwork may not keep up with the changes. We have to understand each U2 follows a generally detailed plan but each ends up bespoke. As H. Mignet said " I am not designing for imbeciles."

That said, this semi imbecile finds:

The instructions on pages 3 and 12 (mine are dated 1-19-81) disagree:
Page 3 #2 upper width 1" and depth 1 3/4" tapering to 1 1/4".
Page 12 #2 upper width 1" and depth 1 3/4" BUT tapering to 1 3/8".

and

Page 3 #2 lower width 1" and depth 1 3/8" tapering to 1 1/8".
Page 12 #2 lower width 1" and depth 1 3/8 BUT tapering to 1 1/4"

Similarly

Page 3 bows 4 each 1" x 1 3/4" x 44" i.e. all the same. And some that are "uncut" 1" x 1 3/8" x 44"

Page 12 bows upper 1" x 1 7/8" x 44"
lower 1" x 1 1/2" x 44"

I am guessing these are all kit parts and essentially finished sizes

So, since the upper #1 cap tapers TO 1 3/4" and the upper #2 tapers FROM 1 3/4", a 3/4" depth bow would scarf in nicely.

Both pages agree that lower #1 tapers TO 1 3/8" and lower #2 tapers FROM 1 3/8", so a 1 3/8" depth bow would again scarf in OK.

So, yes, I think you are right. I think I am obsessing about the bows too much.

Have cut you any wood yet?

Jono

When seeking to reduce weight (or cost), look for the big items. The in-born tendency of people is to zero in on little stuff. After the big stuff, look at the repeating items, like ribs.

On the U2, the heavy items are the landing gear, its wheels and supports, the engine, of course, the instruments, seat, and the frame that supports these items. The frame as detailed is structurally deficient already.

The elevons and rudders could be reduced in weight with some careful design. Not much there, though. Eliminate all fiberglass wherever possible. Brown polyurethane foam covered with lightweight Ceconite is much lighter for compound curved items like tips.

We weighed everything as we went along, hoping to beat the limit. In my opinion, it can't be done, but don't let that discourage you.

Dave Gingerich

Reducing weight is multiplicative. The only "real" instrument you need is an air speed indicator. A small GPS will give you excellent altitude and compass function and more.

A lighter pilot will allow lighter structures as well. Bicycling sheds the pounds off me incredibly quickly.

Doug Hoffman

I have been reading some comments over the past year or two that the adoption of polyurethane foam in aircraft wasn't such a good idea. Specifically that it doesn't stand up to vibration or impact well when incorporated into a sandwich.

Here is link is to the homebuiltairplanes.com composites FAQ. It links to other treads containing, among other things, a table of plastic foam properties and a discussion of some observations of old polyurethane foam including a sandwich firewall that had the foam disintegrate.

http://www.homebuiltairplanes.com/forums/composites/8888-read-first-composites-faq.html

For non structural parts like wing tips and fairings I'd just pick the lowest density foam from the table.

Norm Masters

Hi Dave:

Uh oh that's not good. By choosing a lighter engine I was hoping most of the donkey work would be done (no pun intended) but if we are saying the empty weight is gusting 300lbs even with a small engine then that will be a problem, as to lose 50 lbs is going some...

Point taken about the big items. Did you keep a record of the weights? I would be interested to know what the wing without elevons, rudder and control system weighed. That would give an idea of what is possible. I have a pair of alloy Azusa wheels and tires which I thought were light- 1.5 kgs each. Ouch. No good at this rate. There is the fellow who got the 103 weight which I found trawling past posts. Have you a final AUW for your machine?

Hey Doug:

Yes an ASI is about all I had in mind for analog stuff. You can get some good electronic hang glider instruments now.
I like that word multiplicative!

Funnily enough was just thinking about resurrecting our bicycles as our 6 yr old is needing some practice.

And I so need to shed some anyway.

Regulations in our SSDR 115kg limit relate only to empty weight, so my weight is important only for performance and structural reasons. So obviously quite important but not for legal reasons (up to the 300kg max limit)

Hi Dave:

Yes, I thought that too, a lot of solid spruce. I imagine for ease of construction. I wonder if reduced weights at tip end would critically increase bending moment at the root. Good point about fiberglass and I like that foam and fabric idea.

Don't worry, refusing to be discouraged yet..

Jono

I am sorry, but the weights were on the back of an envelope and are long gone. I sold the project when Tom died. The estimates got better and better as components were finished. (Fewer things to estimate.) I recall only that we were looking for an engine weighing 15 lb. when everything else was there or could be estimated.

I recall a quote from Rutan, made when they were building Voyager: "If you drop it, and it falls to the floor, it's too heavy."

Dave

Ok not to worry. Was that 15lb engine needed to succeed in getting under the 254lb limit? Once I have built the spars and ribs, I shall be able to guesstimate plywood and foam weights and get a better idea of the final wing weight and whether there'll be anything left from the 115kg allowance for something to sit in... great Rutan quote!
I'll sleep on it.

Jono

I am just saying that after building everything as light as was within my skill, there was no way we were going to make 254 lb. I was in favor of the smallest practical motor, which I guessed to be in the 15 - 20 hp range, but everything in that range seemed to be in some kind of crazy limbo-land. We eventually settled for a Rotax 277 from a Falcon XP, but by that time Tom's cancer was winning.

The kit was Douglas Fir, which is heavier than Sitka Spruce. I even used a little balsa, of which I have a secret stash. Every little bit helps, even if you can't make the magic number.

Dave

When reducing weight there are two very important considerations that I haven't heard a lot about.

The first is strength. If you reduce the strength of any on the parts you run the risk of a catastrophic failure. If making serious changes in the material you might want to do some tests like sandbag testing to assure that the wings are able to handle flight loads. If the gross weight is 400# and the plane is rated for + or- 3gs then you need to test the wing right side up and inverted with 1200 pounds. If you want to have a 50% margin over the rating, 1800 pounds is required.

Second is weight and balance. If you cut weight without considering the balance you can create a dynamically unstable aircraft. Especially in a flying wing which is very short coupled this can be a critical problem. Someone mentioned using a 15 pound engine. The design is for a 55 pound engine and it is the furthest aft station so the effect of reducing 40 pounds could be very dangerous.

That being said, and remembering it as you build, there are a few ways to reduce a lot of weight, if not the cost. The D sections can be fabricated without foam using carbon fiber rather than plywood over Styrofoam. The fuselage can be built in a similar fashion as can the spars. I'm always leery of mixing wood and carbon fiber where they need to flex in the same amount, so you might need to fabricate the ribs as well with CF.

Trying to make the changes as near to the cg as possible to reduce the problems of shifting the cg.

There are performance limitations under part 103 - stall speed and max speed - that also would make the U2 a real stretch for ultralight status here. Are their similar limits under the CAA? Will your mythical 15-pound engine produce the 35 horsepower the plans list as a minimum for the U2?

Paul Hardy

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.
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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
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
Add: $2.00 for foreign postage

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

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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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