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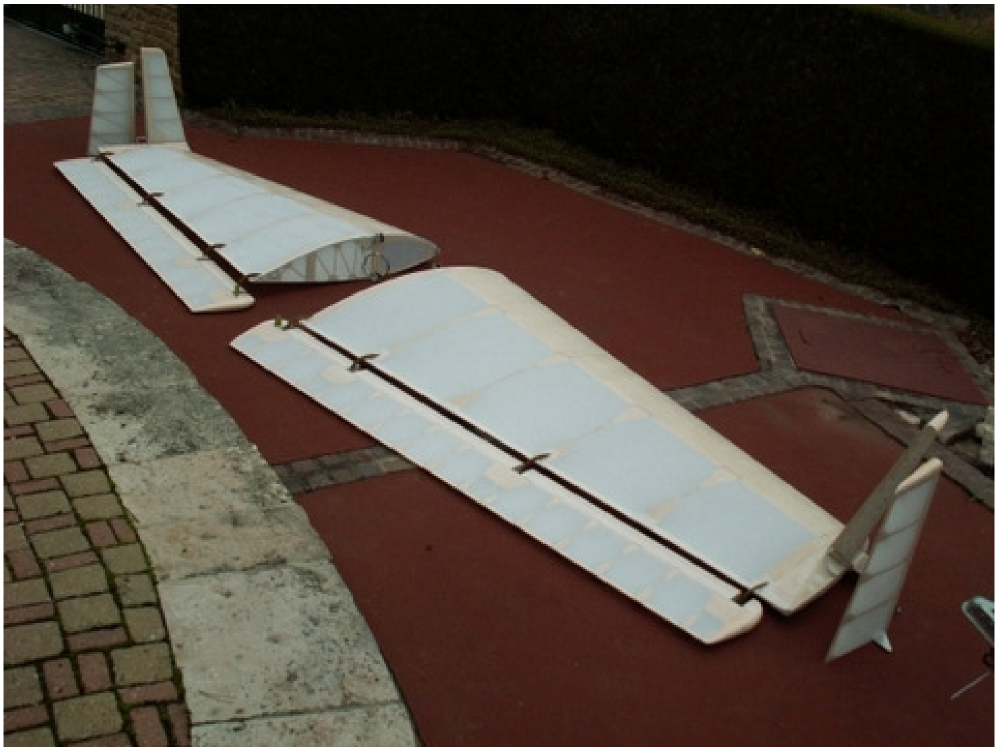
T.W.I.T.T. NEWSLETTER



These are the wings and other components for a Mitchell U-2 that Leconte Phillipe in France had started but now can't complete. It appears he has found someone in Germany that is interested in taking over the project. We will look forward to seeing what progress is made in getting his U-2 flying.

T.W.I.T.T.
The Wing Is The Thing
P.O. Box 20430
El Cajon, CA 92021

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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

As you can see this is another short issue due to the lack of material from our members and even to some extent the Nurflugel group. This will probably be the size of the newsletter for the foreseeable future unless there is sufficient material to support a 12-page issue. I regret that this is the case, but like this month I get to a point where I am a page past 9 but then can't find enough to fill the remaining space. This forces me to cut back to 8-pages due to the way it is printed for mailing.

So I guess I am back on my usual soapbox asking our members to provide letters, pictures, diagrams, illustrations, etc., and then the rest of the members offering comments or additional questions. As I have noted in the past this is a member driven association but there is going to be a point some time in the future that I will either have to go down to 4 pages or less than monthly publication.

I welcome your feedback on the newsletter and the material presented in it, so please help and send in your contributions.

HAPPY HOLIDAYS TO ALL

Andy

LETTERS TO THE EDITOR

Andy,

I wonder if anyone in the TWITT group has been studying distributed propulsion wings. I understand there's a group of papers from people at NASA Langley that will be presented at Aviation 2014 in Atlanta but I've found little discussion in the archives, particularly for light aircraft. Hopefully some TWITT readers who have been thinking about thrust, lift and drag far longer than I have will be able to shed some light on the subject. Please challenge all assumptions!

Normally we think of a "fixed" wing, driven through the air either by propulsion or gravity, and lifted by thermals or by deflecting its chord-wise airflow. We know about rotating wings. A little work has been done over the years with the concept of blown lift -- using some sort of propulsion both to propel the aircraft through the air by reaction, and also to increase the airspeed over the wing to create lift. Concepts as diverse as Jim Bede's XBD-2, Gecheng Zha's "co-flow jet" and the heavy YC-14, YC-15 and similar ideas have been described and built.

With progress in electric motors, it is gradually becoming possible to define the shape of a propulsor's airflow without a huge efficiency penalty, rather than being tied to large rotating machinery or ducts. We also have the ability to produce short bursts of high thrust without the weight penalty of a high power engine. For the moment, consider that it might soon cost the same to make many small engine/propellers as it does one large one, producing the same amount of peak thrust. Now you can divide the thrust and put it all on the upper surface of the wing, for instance. Some is lost in scrubbing drag, and some is gained back because the wing can now have lower drag for given lift over its normal operating range.

At the expense of complexity, we now can have more control and redundancy. The evangelist for this approach at NASA is Mark Moore, and you can find a lot of his discussions on the net, mixed with other powered-lift concepts and operational considerations. There are also at least two commercial efforts in this space, one shown in Ilan Kroo's patents and one described by Pipistrel at this year's Electric Aircraft Symposium. But I am looking for a more general analysis of these tradeoffs, which are beyond my own aero knowledge at the moment. Has anyone here developed a general approach to this idea?

Thanks

David Josephson
<dlj@josephson.com>

(ed. – I have also posted this in the ESA newsletter but haven't received any feedback yet. Hopefully, some of you will have an opinion or two to offer David.)

Thank you Andy, and thank you for spending so much time working on newsletters for two aviation organizations. As an EAA chapter newsletter veteran myself, I know what it takes.

I'm coming pretty late to the party regarding flying wings. It has taken many years for me to become interested enough to want to learn about them. I was once a 15 Meter sailplane racer, and raced power planes at Reno a few times.

Currently, I manufacture and sell an FAA STC approved control system upgrade device for certified power planes called EZ Flap.
http://www.ezflaphandle.com/
for anyone who has a power plane using manual "Johnson Bar" flaps.

I have also taken over another STC project, converting the Cessna tricycle gear 172/175 back to tail wheel configuration. This has been an incredible complex, challenging, and rewarding project. I'm not quite finished with it yet, but it should be available sometime in 2014.

My interest in TWITT has developed from numerous brainstorming sessions with ESA President Murry Rozansky, concentrating on minimalist or ultra-efficient light personal aircraft. I am interested in learning more about the Backstrom series, especially the later attempts (successful or unsuccessful) to increase performance using a modern laminar airfoil.

Bill Berle

(ed. – This was in reply to my usual welcoming e-mail to new members. I ask them what brought them to TWITT and what interests they have that might overlap with our members. Welcome Bill.)

Hi Andy,

I was trying to read the newsletters and the computer displays only the left hand side of print. The newsletter appears to be split or cut off vertically.

Stephen Sawyer

(ed. – I included this short note since there may be others out there with a similar problem in reading the newsletters available in the members only section. Since I didn't hear back from Stephen I have to assume he found a resolution to the problem. Using F5 to refresh the page may sometimes help with such issues or using the compatibility option under the Tools drop down of your browser. The normal view will have a split at the bottom with advertising, but this is due to using the "free" option from the host for a controlled section of the web site. Please let me know if you have difficulties so I can determine if they are something I need to address with the host.)

NURFLUGEL THREADS

I have just uploaded a photo of my current build project, a 2m flying wing, this is a follow on from a half scale 1m prototype I have already flown. I designed the wing after reading K. Nickels book and before I knew a lot about the Horten style wings (My latest design is a Horten style wing).

Still got the fuselage pod to make to house a small brushless motor and covering and R/C gear to fit, Hopefully get it flying early next year.

John Newton

What's on the leading edges near the wingtips?

Martin Tigasson

They are partial span drooped leading edges to prevent tip stalling, I found these were required on the half scale prototype. The wing was simply cut and an extra balsa infil section added in glued on with Aerobond contact adhesive. They make a HUGE difference!

John

Hello,

Ken Kellet of Fantasy of Flight (near Orlando) told me something which might be not known here: Several years ago in some airfield in Boulder USA some guy wanted to test his own made flying wing. Full scale. After a few tests the pilot/builder stopped the tests due to fear of bad things. It seemed not to be very stable.
Does anybody know something about this flying wing?
Keep that brain creative,

Koen Van de Kerckhove

I flew the Marske Pioneer 1A extensively flown in the Boulder Municipal Airport in 1970 but I don't think that's what you are asking about.

I recall a brief encounter with the builder of an approximately 10 - 12m span Horten-like, man-carrying glider completed around that time in the Boulder, Colorado area. The builder's name was something like Bobbe or Bobbus. The wood and fabric glider seemed to have very good workmanship. He wasn't part of the gliding community at Boulder so I don't know anything about him except he seemed to be in his 20's in 1970.

I recall the builder wasn't a very experienced pilot and asked Bruce Miller to test fly it. I recall a conversation with Bruce where he asked for my thoughts. Bruce had flown the P1A. I gave him some ideas of what he might expect and warned him to be very careful. I left the area for about 6 months shortly after and never heard what the test flights were like or if Bruce encountered any problems but I suspect he did since the glider and its owner seemed to disappear as quickly as they had appeared. Unfortunately, Bruce Miller passed away over a decade ago before I had a chance to talk to him about it.

n141sf

Ball-Bortoe Aviation in Boulder is probably the organization. Don't know what other craft they might have worked on.

http://en.wikipedia.org/wiki/Ball-Bartoe_Jetwing

Rick Page

Ken Kellet was indeed talking about something that looked like a Horten. I guess you have found the project i was looking for. Sad to see little info is known. Anybody knows more?

Koen

I recall both Bruce and I were concerned about span wise flow on the swept wing and the effect it would have on boundary layer thickness over the elevons. This led to concerns about lift-off characteristics with the CG moved far enough forward to assure good pitch stability for the first few test flights. We thought it might "pop-up" when the elevons finally got a grip on the airflow. If there was twist in the wing, it wasn't obvious.

The pilot lay prone in the cockpit with ineffective looking restraints and no room for a parachute which gives one pause when contemplating a first test flight.

n141sf

Could it be the Hoppe H-1 presented in the April 94 TWITT newsletter, an experimental glider with prone pilot configuration. The registration N147 is still valid. (I have just posted the copy of the concerned TWITT newsletter) Some members have more information on that glider N147?

Thanks in advance!

Philippe Vigneron

(ed. – Unfortunately I don't have the images stored anywhere and I can't effectively copy them from the PDF version of the scanned April '94 issue. You will have to access the issue through the members only section of the web site. The user ID and password are in the masthead portion of each issue so go back to page 1 and sign on.)

That's it! Bob Hoppe was the builder.

n141sf

Hello all,

Having seen Dan Mosers excellent R/C models featuring "blown" wings got me thinking whether you could use something similar to solve the issues of tip stalling on the narrow chord, low Reynolds number wingtips seen on R/C Horten style wings.

What I am envisaging would be high pressure air used as boundary layer control (as per the Blackburn Bucanneer) on an all moving wing tip when the model is at low speed to prevent premature flow separation and lower the effective stall speed (in terms of the aircrafts airspeed not the local flow speed) of the tip.

I wonder if some of this air could also be fed over the split line between the movable tip and the wing tip and the wing to smooth out the airflow there, in addition could the ratio be varied at each wing tip to provide additional adverse yaw reduction/control.

This may all be impractical but just an idea to see what the rest of you think.

John Newton

Hi John,

I have no idea whether this is of use at the dynamic pressures encountered on a small chord at low speed but Schleicher use a form of blowing on a lot of their full-size designs. Simply, the wing is made as a sealed, finite internal volume. A couple of pitot tubes under each wing that are connected to that volume raise the internal pressure by a smidgen and this pressure difference is allowed to dissipate through a long line of tiny holes drilled through the undersurface just in front of the laminar-to-turbulent conversion point. This stimulates the flow over the undersurface and helps it to stick to the wing for a little longer. The big advantage of this scheme is no power or pump is needed. The pitots are about 10 - 15 mm in internal diameter and stand off the underside of the wing by a centimeter or two and the tiny holes are somewhat less than 0.5 mm. You would not think this would work but it does.

Chris Bryant

Dear John and others: Well all this about tip stall has me wondering...how does your wingtip move? Is it up and down or is there a portion that extends from the wing itself? I was thinking about some of the other German designs where they had an anhedral tip which was to prevent wing tip stall at low speeds. If this were a moveable tip with a simple hinge, then the tip could be in a normal position when flying normally, and be moved downward when in a tight turn or at very low speeds. The North American XB-70 used a similar wingtip.

Blowing the wingtip could provide just the "ticket" however, to keep the boundary layer on the wing instead of it going turbulent...HMMM have to consider this more...might be lighter with less linkages too.

Rich Nunn

At low Re, the flow would rather be laminar and separated than turbulent and attached. This is one of the big reasons why full-scale airfoils don't work well on models. Full-scale airplanes want to keep the boundary layer laminar as long as possible to minimize drag, while models need to force it to become turbulent sooner in order to minimize drag (by keeping the flow attached, something turbulent boundary layers are better at than are laminar ones). The airfoils on that Schleicher sailplane operate at low enough Re's that using turbulators (those little holes, although there are many other forms of turbulators as well, such as the dimples on a golf ball), that force the boundary layer to transition to turbulent a little before it would try to separate if it was still laminar, can be a benefit.

The little holes method has a number of disadvantages, such as manufacturing cost, complexity, and keeping the holes from getting plugged with bugs and dirt. However, they have the advantage of being able to be turned on and off, if turbulation is only needed in one portion of the plane's operating envelope.

The tilting wingtips on the XB-70 were to deal with a problem that comes up at supersonic conditions. As shock waves start to form on the wings, the aerodynamic pitching moment tends to increase and the center of lift moves aft, causing a strong nose-down trim change that could overpower the pitch controls. High altitude, high-speed airplanes with a lot of weight distributed in the ends of the longitudinal axis also tend to have problems getting enough yaw stability ("dumbell effect", first explored on the Douglas X-3 "Stilletto") By tilting the wingtips (which on a delta are at the rear of the wing) down, it effectively removes them from the lift-making process, moving the lift distribution forward and mitigating the pitch trim change, while also adding to the effective vertical fin area, mitigating the yaw stability problem. It's not something that normally applies to the realm where our typical airplanes operate (except maybe some of the ones Al Bowers works on).

Don Stackhouse

Dear Don and others: so what would you recommend for an 11 meter (or so) Horton wing to minimize tip stall besides washout? I f I could add slats say about 1 meter long to the leading edge or would you suggest a row of turbulators near the wingtip? This would simplify things a bunch since I would not have to twist the wing during construction. This will be a powered wing similar to the Pul 10, but with rudders on the main portion of the wing similar to a Lippisch P11..Maybe with an MH airfoil instead of a Horten?

Rich

How about a partial span drooped leading edge, know this would spoil the lines somewhat, but it does help delay/prevent tip stalling and is simple to design/add in. The problem with slats is that they add additional drag at all points of the flight envelope.

My wingtips pivot as per the Short Sherpa, i.e. they pivot about the pitch axis to provide roll and pitch control (in effect all moving elevons) and not droop up/down as per the XB-70. Interestingly I came across a report some time ago where tip surfaces as per the XB-70 were used on a model to provide pitch/ roll control combined with proverse yaw.

John

Is there some reason you are expecting tip stall problems?

Normally a BSLD wing design results in a certain amount of natural tip stall resistance, simply because the reduction in lift near the tips (relative to an elliptical lift distribution) reduces the tendency for the tips to stall. The twist (washout) typical of a BSLD is part of that, but it's the overall lift distribution and the lower required lift coefficients at the tips that actually provides it. If your local Reynolds numbers ("Re") near the tip are in the range where turbulators can be beneficial, that's another matter, although they can help prevent tip stall in some cases. You have to look at the local Re's and do what works best in relation to that.

In addition, in your example typically we are talking about airplanes with elevons at the tips for pitch control. This means that to raise the nose and reduce airspeed by increasing the overall angle of attack, you have to deflect the elevons upwards, which further increases the effective washout and reduces the likelihood of tip stall.

Of course that assumes you aren't doing anything funny with the planform. If you achieve the BSLD through changes in chord, not twist, then it is possible to have high lift coefficients and low Re's at the tips, setting the stage for tip stall problems.

There are other issues that can complicate things, you can still have tip stall problems, despite all of the above. The planes to watch out for are ones that have very low wing loadings and can therefore make extremely tight turns, which in turn causes a substantial difference in the airspeeds of the two wingtips. This causes a difference in the lift coefficients needed at the tips, as well as their relative Re's (lower Re not only increases drag, it also reduces max lift coefficient). This is generally less of an issue for manned aircraft, but for very lightweight models in a tight thermal turn, it's very possible to have twice the airspeed for the wingtip on the outside of the turn than you have at the inside wingtip. Since lift is proportional to the square of the airspeed, that means the lift coefficient at that inside wingtip is FOUR TIMES greater than the outside wingtip, and at half the Reynolds number! In some cases, the lift coefficients for the portions of the wing near the tip (note, not at the tip itself, where lift is zero for both an elliptical distribution and a BSLD) could be higher than at the root.

The bottom line is that just about ANY design can be made to tip stall if you can make it light enough and turn tight enough.

Washout alone cannot fix this. By the time you crank in enough washout to prevent the tips from stalling, you will end up with downward-lifting wingtips and a badly distorted lift distribution, especially in level flight. A much more effective approach is to use a variation of airfoils along the span, each tailored to match the local requirements, and with greater stall resistance designed into the airfoils on the outboard portions of the wing. Planform can help here as well, with a little more chord at the tips than optimum, and correspondingly lower local lift coefficients.

However, properly done, you should not have to resort to high-lift (but very draggy) devices such as slots or slats.

Don

Thanks guys...glad to see that there are more advanced minds than that of mine...to keep me out of trouble so I can anticipate construction techniques better....and with more investigations....into each area to better tailor my ideas into something more concrete than something on paper.

Rich Nunn

There are some issues to consider.

1. Make sure your pivot axis passes through the aerodynamic center ("AC") of the control surface (typically the 25% chord location on the surface's Mean Aerodynamic Chord ("MAC"). Otherwise you're setting the stage for things like snatching of the control surface, flutter, etc.. The surface also needs to be as light as possible (what really matters is the rotational inertia about the pivot axis), and mass-balanced around the pivot axis.

You also have to be careful with things like drooped leading edges and other things that effectively add camber to the control surface's airfoils. These can increase the aerodynamic pitching moments. In the case of an aileron, the increased pitch forces on the left side are counterbalanced by the forces on the right side, increasing the stresses in the control linkages but otherwise not causing a problem. However, in the case of an elevon, these increased forces would show up as a nose-up trim force in the control stick, where they would have to be overcome by the pilot. The result could be a loss of control.

I remember hearing of a homebuilt a while back that had a little bit of under-camber in the underside of the ailerons. The builder faithfully constructed this into one aileron, but when they built the other one they took a shortcut and made that aileron flat-bottomed. The mismatch in the aerodynamic pitching moments between the two caused an imbalance in the control forces, too large for the pilot to overcome. The plane rolled over and crashed, killing the pilot, right after liftoff on its first flight.

2. All-moving control surfaces tend to be a structural nightmare. The primary load-bearing structure is also a moving part, and the cross-section of the structural member connecting the control surface to the rest of the airplane is forced to be round, and fit through a hole that is smaller than the dimensions of the airfoil at that point. You are forced to deal with high bending and torsional loads in a part that is also forced to be small and skinny. This typically drives the structural weight up higher than what a conventional two-element flying surface would weigh. This also makes some of the problems listed in #1 above more difficult to deal with.

3. In addition, for the same control authority, an all-flying control surface arrangement typically needs to be about 20% or so larger than a 2-element arrangement. The two (or 3) element surface changes both its angle of attack and its camber when deflected, an all-flying control surface changes only its angle of attack.

The main reason we see a lot of all-flying horizontal tails on General Aviation airplanes is because in that particular case it lowers manufacturing costs (cheaper to build one horizontal tail surface instead of two, and the fact that it's balanced in bending between the right and left sides makes life easier for the pivot structure). The same is not true of ailerons or rudders, so we don't generally see all-flying control surfaces there. However, even in the case of the horizontal tail, the problem with getting enough control authority from an all-flying control surface can still be a problem. An example is the early Cessna Cardinal, which was prone to stalling the horizontal tail in the landing flair when at forward C/G's. The result was a lot of bent props and nose wheels. They dealt with it initially by restricting the forward C/G limit, then later by adding some slots to the horizontal tail to increase its downward-lifting capability, at the expense of drag.

On supersonic aircraft, changing the camber of an airfoil via a control surface hinge can cause changes in the shock waves on the airfoil, resulting in extremely high control forces. This is why supersonic aircraft tend to have all-flying control surfaces.

Don

Thanks Don, some great information, I have cut the pink foam blanks for the wingtips (pleased with the result, a nice sharp trailing edge and very smooth finish) but could still go the conventional trailing edge hinged surface route as opposed to all moving tips, my concern is that since the tips are approximately 50mm by 4mm thick and at Reynolds around 50,000 any hinge line is going to cause flow separation problems that may not occur on a smooth all moving surface.

John

As far as I know, Horten-type nurflugels do not have a tip stall problem that needs to be address.. their characteristic BSLD (Bell-Shaped Lift Distribution) results in unloaded tips that are not anywhere near stall in normal flight conditions.. very low alpha and local CL..

However, in the case of more elliptically loaded nurflugels, tip stalls could be a real possibility, and the droop LE feature could be useful.

Daniel Moser

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