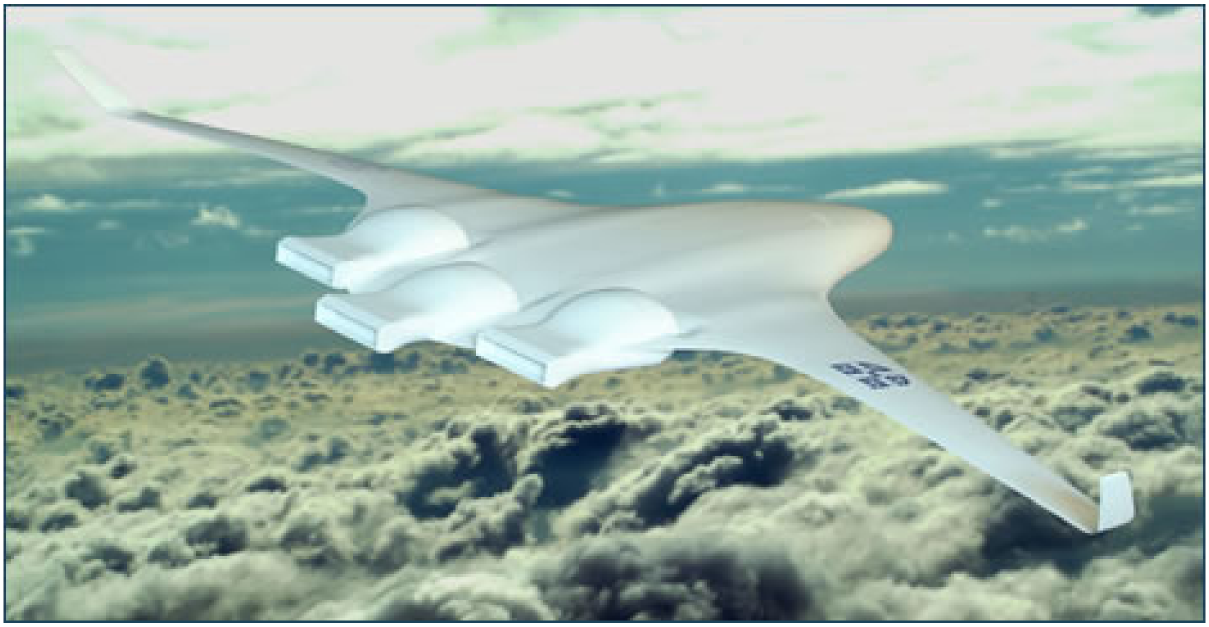
No. 294 DECEMBER 2010

T.W.I.T.T. NEWSLETTER



This looked like a new blended wing body concept that caught my attention when trying to decide on a cover photo. You can see more at:
http://www.treehugger.com/files/2006/11/blended_wing_co.php

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., **1012** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, January 15, 2011, 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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Treasurer:
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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

Lots of good letters and mail this month, which I greatly appreciate, especially when they come with pictures, charts, diagrams and illustrations. For this month it worked perfectly with fitting in the second part of the A.R. Weyl article on tailless aircraft stalling characteristics. Depending on other inputs, I should be able to fit in all of part three next month. It is going to take several more issues to get this all printed since it is an extensive piece on the subject.

I also added a thread from the Mitchell U-2 group on Wicks Aircraft Supply acquiring the U-2 and B-10 kitting rights. As I noted at the thread, there is nothing on their web site yet on this so if you are interested you might have to wait until you see it appear as one of their offerings.

I was looking through the membership roster and was pleased to note that we only have a couple of members who need to renew their subscriptions before the end of the year. This is great since I seems to indicate you are pleased with what you are receiving in the newsletter each month and are still interested in the development of flying wings.

I don't know what the weather is like in your area, but I am having a hard time getting any work done at the hanger with the cooler temperatures we are experiencing in San Diego. Unlike a smaller garage or indoor workshop, there is just no practical and cost effective way to heat it, especially since it is on the shady side of the hanger complex. My fuselage is back from paint, I have a large amount of the hardware from Aircraft Spruce and am ready to starting putting things back together on my 1-26.

Andy

LETTERS TO THE EDITOR

November 4, 2010

I am looking to buy a bird RC or a gull any news is good news thanks.

Captain Bob
<Cptnbobhawaii@yahoo.com>

(ed. – It sent this back to him: I did a little internet searching and really couldn't find an existing RC bird model that would be what you are looking for. The bird models I am aware of all have to be scratch built from some limited plans or were of their own design.

Sorry this couldn't be of more help, but the model companies don't seem to producing these types probably due to low demand and the high cost of developing such a mode.)

Ok. Well if you do please forward for me. I'm very interested. I have a complete set of plans for the Turkey Buzzard if that helps.

(ed. – I responded with: If you have the plans that were in one of the model magazines and prepared by Bob Hoey, then you have the only bird model plans that I am aware of.)

It's for sure a Robert Hoey, inked by Joe Demarco Ok, so I've got a project now. Using the base wing rib pattern I'm going to redesign this model and update the construction with what I've learned, (keeping the originals intact). I will improve the fuselage, install a dihedral. And a polyhedral mid wing, carbon lay up spar and reconfigure the aileron feathers to work as natural feathers, reconfigure tail for minor V-tail with feet as downward stabilizers, lengthen wing 30" increasing the entire lift plus balsa skin wing bottoms and leading top edge to main spar. Also clean up the body to wing connecting point,,, plus anything else...paint it like a condor...thats it...I'll make it into a Condor!!!

Bob:

I have been following your correspondence with Andy at TWITT.

My whole purpose in publishing drawings for my birds was to foster experimentation. Looks like you have some new ideas that are worth trying. Be aware that lightweight and low inertia of the wings, especially the outer panels, is the key to successful flight without a vertical tail. I have used "feet" on my Pelican model to add a little directional stability, but it detracts from the appearance in flight.

Good luck, and let me know how it flies.

Bob Hoey
<Bobh@antelecom.net>

November 12, 2010

Hello, Ryan,

Read your correspondence in the TWITT newsletter re your intent to build an R/C Rattler.

I built one last year, starting with the same sketch that you mentioned. I have had several marginally good flights as a glider, air-launching from an R/C mother ship.

I later found a site, which had a 3-view of the airplane and noticed that it had a considerable amount of dihedral - more than I had assumed. I made some modifications and it flies better, but it is still lacking in directional stability. When I slow it to a stall, the nose wanders off to one side or the other and it goes immediately into a slow, flat spin.

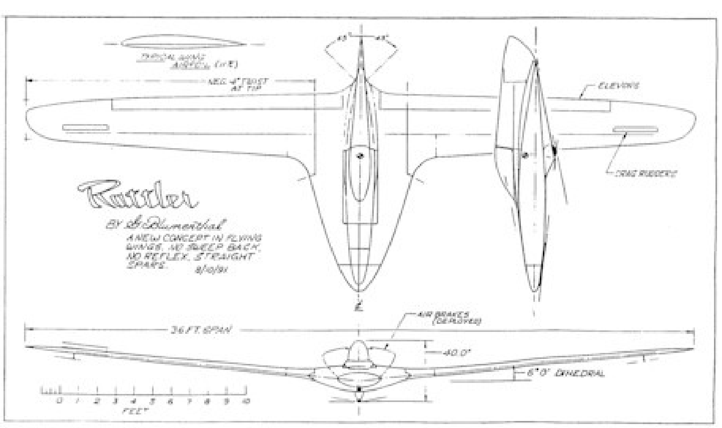
I will attach a couple of photos of my model. Here is the site with the three-view;

http://www.rcsoaringdigest.com/OTW/on-the-wing1/48BlumenthalRattlerMixer.pdf

The overall design does have some promise and I hope to build another one, possibly with a pusher outrunner motor where the rudder is.

Good luck, and please keep me posted on your progress, and successes or failures with the concept.

Bob Hoey
<bobh@antelecom.net>



(ed. – Thanks to Bob for contacting Ryan and offering him some support on this project. I have included the pictures Bob sent along and the 3-view for those of you who don't have Internet.)

November 16, 2010

Attn: TWITT Organization

Based on some of my overall flying wing (tailless) aircraft research critique beliefs: "Flying wing designs have the best 'span loading' efficiency of all aircraft configurations and are easiest to upscale or downscale aspect ratio size on." This means distributing the payload over all or nearly all of the entire wingspan. This technique reduces loads on the wings and results in lower wing structural weight. Theoretically, flying wing designs offer better efficiency than all other wing configurations. This means greater speeds for a given power, or better range for a particular fuel capacity (or both at the same time) as well as better load carrying capability.

Flying wing designs typically utilize long wingspans placing wing tips furthest apart, thus reducing downwash and resulting induced drag. Wingspan to chord ratio, aspect ratio, is a useful way of describing span effect (delta wings similar to the 'spread Eagle wing B-2' are typically in the 2:1 low aspect ratio range for best heavy load, high soaring, long range aircraft designs.). High aspect ratio 'tucked wing Falcon like swept wings such as the F-117' have less drag associated with them for quicker flight maneuver: climbs, turns, dives and much greater speed. I'm working on a book entitled: "Flying Wing (tailless) Aircraft design concepts and my own VTOL flying wing (tailless) aircraft design. It's all about the Delta [1 wing and equal balanced torque/thrust (T=T)] aircraft concept advantages. I've been a member of the EAA since 1993 and I'm a past member of the BFA (Balloon Federation of America) and PRA (Popular Rotorcraft Association).

Pat Durand
Lafayette, LA

(ed. – Pat is not a member (yet) so I asked him if I could publish his thoughts, which he agreed to. He also sent along some additional pieces of his works that I will post to the members only section of the web site since I am not sure they are for public distribution through the open section.

Let me know what you think about what he has to say here and any comments on the other material when you have a chance to go through it.)

Yes, you may post my comments in your December newsletter. I'm also an aviation research writer that has compiled a lot of information toward writing these additional books: 1.) "U.S. Military Airfields of Louisiana", 2.) "Autogyro, Helicopter & VTOL Aircraft design concept developments" and 3.) "Coaxial Helicopter design developments". Attached are some of my flying wing (tailless) aircraft note documents, reference source information- see book numbers: #74-84 and some poems I wrote (the bird related poems, like Jack Northrop's beliefs, are an inspiration to my flying wing (tailless) aircraft concept beliefs.

Pat

November 19, 2010

Hi Andy,

I read your plea for more contributions so I am sending you some history and late info about the twist and turns of my LARA project's development. I'm sending you a bunch of photos with my info so you can stick them in where you feel appropriate.

My article in TWITT Newsletter number 274 (April 2009) describes LARA MK 4's configuration and performance. Although its performance was quite satisfactory I was not happy with the cockpit in the wing configuration for the following reasons. *(ed. – There is also more information in issue #237, March 2006.)*

Reasons For Switching From Mark 5 To Mark 6 Lara

Mark 5 Negatives.

1. No visibility downward without banking or while landing. 2.- Aircraft body high (40") above ground makes entry difficult.
3. Trapdoor and canopy are complicated and expensive to make.
4. 5" deep instrument panel limits and complicates instrument and switch placement.
5. Main landing gear legs are long, heavy and difficult to brace.
6. Long nose gear heavy and creates high drag because of high-speed prop flow.
7. "T" tail complicates control system.
8. "T" tail, anchored to wing trailing edge, needs much bracing.
9. Because canopy is part of lift system, modifying it is very tricky.
10. Folding the outer wing panels over the canopy is complicated, awkward, heavy, and makes the airplane too tall to fit into a one-car garage.

Mark 6 Positives

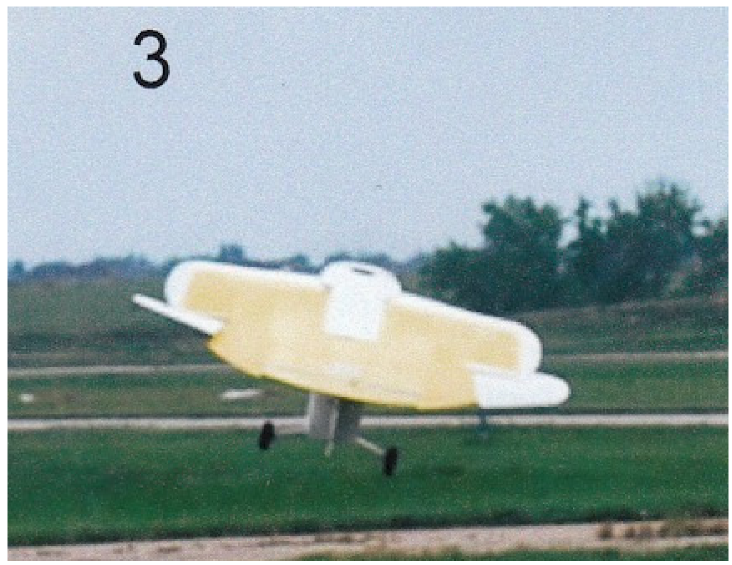
1. Excellent downward visibility at altitude and while taking off and landing
2. Low CG makes ground maneuvering easier and safer.
3. Flat sided pod is easier and cheaper to make and modify.
4. Entry and exit of pod much easier. AC can be flown with doors open.
5. Placing flight instruments in pod and engine instruments in wing keeps installation simple, light and flexible.
6. Landing gear legs are short, light, and below prop blast.
7. "T" tail is simplified into elevons and rudder. Center section trailing edge trims pitch and roll.
8. Pod can be modified to side by side and/or seaplane configuration without affecting wing aerodynamics.
9. Folding outer wing panels downward: allows aircraft to fit through 7'X 8' door; allows safer trailering; helps folding process and folded wings seal pod.
10. Mark 6's weight is only a few more pounds than Mark 5's.
11. Mark 6 is cleaner aerodynamically than Mark 5.

The photos of the full size mockup show some of the problems listed above.

I had a wing from an earlier model so I modified its elevons, stuck an electric motor on its leading edge and added the pod type fuselage to it.

We took the model to the local airport to test it on one of the inactive taxiways. While we were getting ready the afternoon thunderstorms began to form. By the time we were ready to fly, low breezes began to swirl around us. On our first test run a breeze caused the model to run off the narrow taxiway and tumble in the tall grass. A superficial examination didn't find any crucial damage so during a calm period our test pilot started number 2 test run with the results shown in the progressive photos below.

Three of us watched the catastrophe develop and we still have three different opinions about why it occurred. I saw the model swerve towards the grass edge of the taxi way, rise into the air, drop its right wing, suddenly swoop into a vertical climbing turn to about 10 feet above the ground and then plunge vertically into a large puddle of water.



The pilot said he held the elevons at full left roll during the flight.

Maybe some TWITT members have ideas about our model's behavior.

Jim Loyd
Thornton, CO

(ed. – My thanks to Jim for the article and pictures. He also sent along the follow-on to the project after the crash and I will publish that in the January issue.)

THE AEROPLANE MAY 9, 1947

AERONAUTICAL ENGINEERING

Stalling Phenomena and the Tailless Aeroplane II

By A. R. Weyl,: A.F.R.Ac.S,

From investigations by B.M. Jones and W. S. Farren it is established that, in two-dimensional flow, the stall may set in chord-wise in two distinct manners. The flow may separate first at a chord-wise station not far from the maximum section camber at the upper wing surface and progress form there slowly or at a great rate towards the trailing edge ("front" stall). Alternatively, the separation of the boundary layer may originate near the trailing edge and spread from there, at lesser rate, towards the leading edge ("rear" stall).

In respect to the rate of this chord-wise spreading, the results of pressure distribution tests made by R.M. Pinkerton on an N.A.C.A. 2412 aerofoil at different Reynolds numbers (Ref. 1), is instructive, though the tests refer to an aerofoil section which had very gradual stalling qualities. At low Reynolds numbers (R.N.=0.45 x 10^6) the chord-wise spreading of the flow separation covers an incidence range of 4.5 degrees. At higher Reynolds numbers, the rate of progress seems to become more abrupt but still rather gradual and without a fundamental change in the shape of the lift distribution. This would indicate that a simultaneous span-wise stall of a wing composed of such aerofoil sections would not adversely affect the stability of a tailless aeroplane of the "Flying Plank" type.

With many commonly employed aerofoil sections and at the high Reynolds numbers of practical flight, the forward separation of the flow wins in the contest between laminar front stall and turbulent rear stall (Ref. 2). In the 1.ft curves (lift versus incidence), this is characterized by an abrupt loss of lift at the critical incidence. Lift discontinuities beyond the critical incidence indicate that the two forms of chord-wise stall-development may occur alternatively.

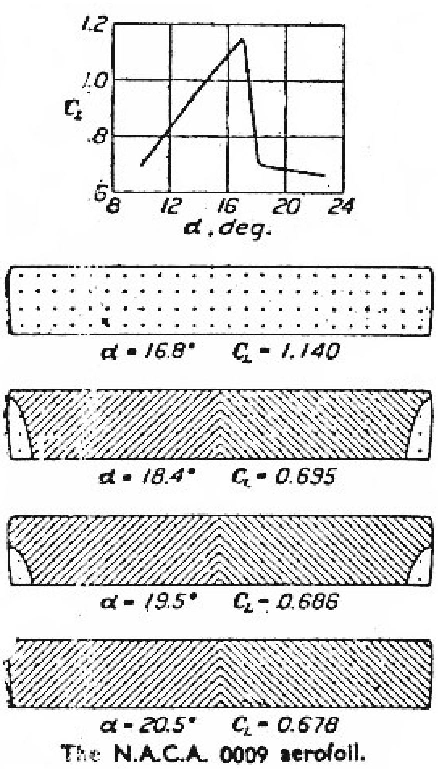
For the tailless aircraft, the incipient rear stall will cause a progressive loss of control, the control surfaces being generally of the flap type. Hence there will be a warning felt by sloppiness in the controls when, with such a tailless aeroplane, the critical wing incidence is being reached. With the " Flying Plank " type, the aerodynamic centre of the wing will shift forward, resulting in a decrease of the longitudinal static stability. A change in the trim will also become apparent. Its sense depends on the reflex in the aerofoil section camber.

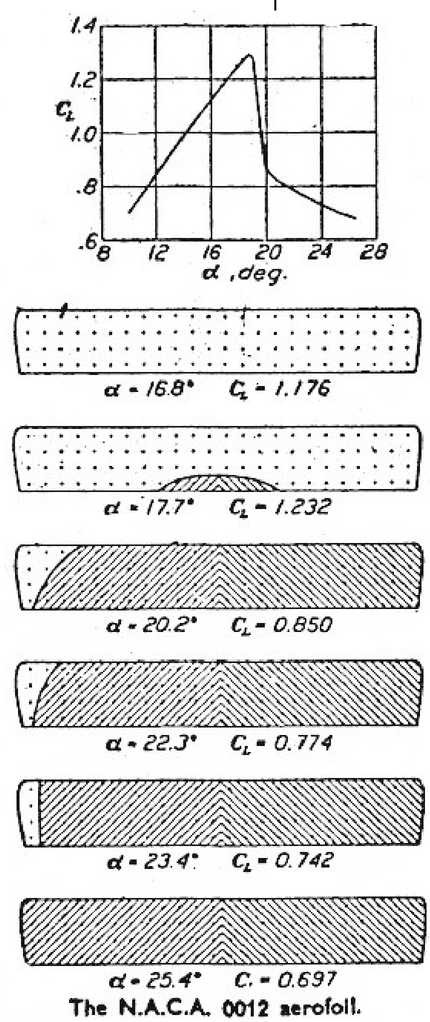
The incipient front stall is not likely to give warning by affecting the control feel. Though it may entail less variation in the static stability, the rapid development of the stall form “B” must be deemed a dangerous feature. With tailless aeroplanes, tendencies to "whip" stall are catastrophic and ought to be excluded by appropriate design measures.

But even a simultaneous "rear" stall of form "C" all along the span may be undesirable for a tailless aeroplane. Besides the roll damping and the control in roll, the control in pitch is lost as well, and brake rudders may even accentuate the spreading of the stall chord-wise, when operated. At the same time, the trim in pitch is seriously disturbed, and, as we shall see again later, often enough not in a sense which would tend to bring the aeroplane back to smaller incidences.

It seems that simultaneous stalling all along the span is, for a tailless aeroplane, only admissible for the case when the critical incidence is reached otherwise than by elevator action e.g., not in a straight stall, or by displacement of the centre of gravity.

To obtain a stall in straight, not otherwise disturbed flight, the pilot has to produce positive pitching moments by a displacement of elevator flaps. The





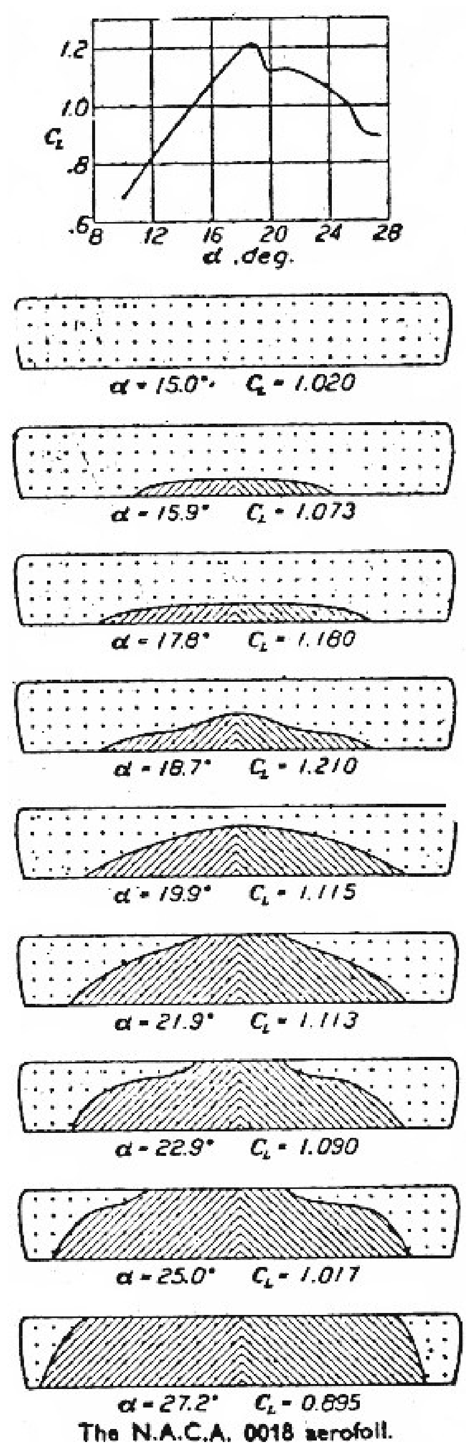


Fig. 5 – Stalling contours of three N.A.C.A. aerofoils with rounded tips. Approximate test velocity, 84 f.p.s. Cross-hatched areas indicate stalled region.

angular displacement of such flaps affects the distribution of the effective section incidences along the span. Consequently, in the span region of the elevator flaps, the effective section incidences are decreased, and the stall will develop over these span parts later than at the rest of the span, provided the wing is designed for simultaneous stalling all along the span, with the elevator flaps in their neutral position.

It follows that simultaneous stall over the span—if desirable or not--cannot become a feature of tailless aeroplanes for all flying conditions under which an high-incidence stall may occur. The wing system is designed to exhibit simultaneous stall with the elevator adjusted for trim-at the critical incidence, the stall will originate at isolated parts of the span, when the stall is induced by other than elevator action (say, by a gust, or in circling flight). This will not lead to satisfactory solutions. Moreover, with sweep-back, for instance, it would imply premature tip stall, when such condition is adhered to for the choice of wing twist and of aerofoil selection along the span.

The incipient stall is connected with changes in the flow pattern, which are of a rapid, unstable character. This flow instability expresses itself in fluctuations of the pressures and forces experienced. Within a narrow, range of incidences; changes from sound flow to complex separation hive been observed, while the incidence was not changed. With such alternating flow patterns, no symmetry in the reduced lift distribution over the span can be expected. Even a very minor disturbance or dissymmetry at the wing, moreover, will make one wing stall earlier than the other one, with consequent disturbance of the attitude of the aeroplane (Ref. 4). Very slight differences in the nose radius of local aerofoil sections have been found to cause one wing to stall first. The stall originated at the span-wise station where the nose radius was smallest (Ref. 70). Hence the fairly common experience of wing dropping in wing systems which ought to exhibit simultaneous stall all along the span.

Stalling tests in glides with is twin-jet fighter of elliptical wing shape and laminar-flow aerofoil section, proved that the rate of incidence change can greatly modify the character of a near simultaneous stall. With slow operation of the elevator, the aeroplane dropped one wing abruptly and lost considerable altitude before it could be brought under control again; the same happened when the incidence at which the wing began to drop (due to a minute inaccuracy in manufacture), was maintained. But when the elevator was pulled back quickly so as to pass through the critical range of incidence quickly, the aeroplane could be brought into an easily controlled stalled flight.

Concluding, it would seem that simultaneous stalling all along the span is, for a tailless aeroplane, neither desirable nor practically achievable.

This is one serious consequence: it implies that, in respect of the maximum lift coefficient, the tailless aeroplane will remain below the optimum value which can be realized with equal span, equal aspect ratio and equal aerofoil section. It also means that the tailless aeroplane will not have a wing system of minimum induced drag, although, in practice, the difference may become negligibly small. In al probability, this inherent aerodynamic deficiency should be more than balanced by other advantages pertaining to tailless aeroplanes in general.

L. Prandtl (Ref. 5) has most probably been the first to investigate the phenomena of the span-wise spreading of the incipient stall and the factors influencing it. He pointed out the difference between a stall originating at the wing root and a tip stall, and he related these phenomena to the wing plan shape, the Reynolds number and the wing twist. Since this work, which was done in 1920, various research workers have studied theoretically and experimentally how and why the incipient stall spreads over the span. The British experimenters W.E. Gray and H.B. Irving (Ref 6) were probably the first to describe the flow mechanics responsible for the influence of the plan shape; from this, further fruitful research has developed.

The behavior of a wing in respect of span-wise development of separation from the incipient to the complete stall seems to be governed by: (a) Aspect ratio of the wing; (b) Angle of sweep of the leading edge and of the trailing edge of the wing; (c) Taper of the wing in plan; (d) Twist of the wing; (e) Thickness ratio of the aerofoil section constituting the wing; (f) Shape of the aerofoil sections (especially nose radius, camber and chord position of maximum section thickness), and its variation along the span; (g) Reynolds number (and its variation along the span); (h) Local interference phenomena (including the effect of slipstream), local surface irregularities and surface roughness; (i) Dihedral effect; and (k) Shape of the wing tips.

When discussing these points, it is necessary to realize that the manner in which the stall is being brought about will, in general, have a bearing on the character and on the spreading of the stall, since it is, for instance, possible to produce over one and the same aerofoil and at the same Reynolds number, alternatively “front” stall as well as “rear” stall, simply by varying the condition under which the stalled condition is brought into existence.

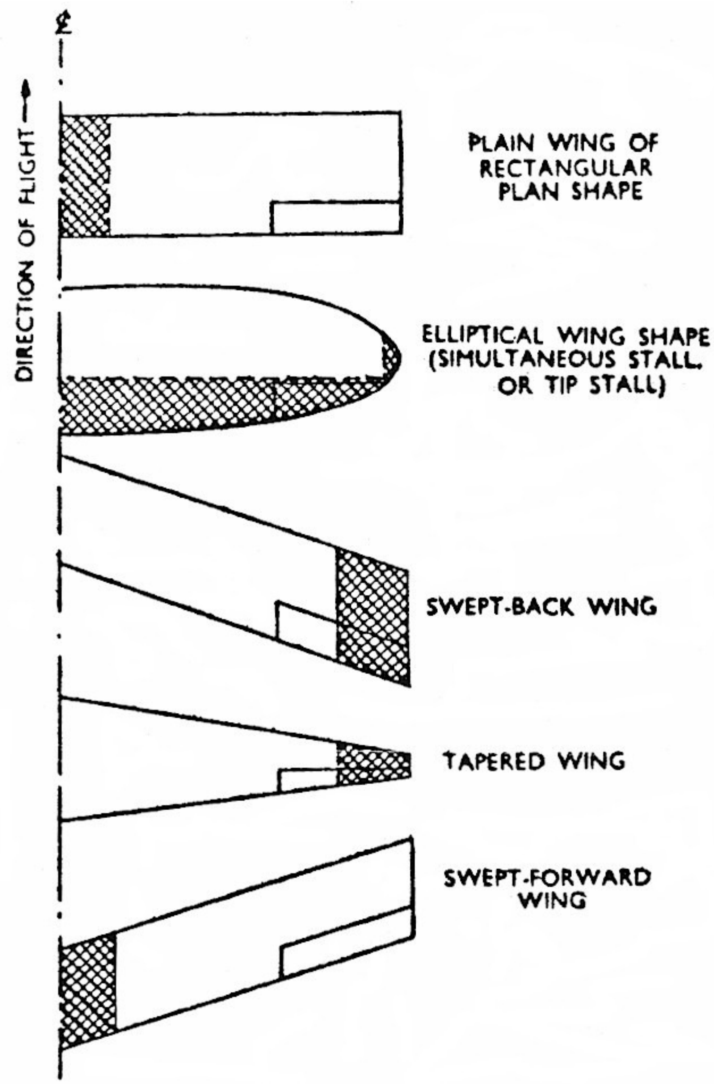


Fig. 6 – Influence of the plan shape on the incipient stall of untwisted wing systems. The shaded area indicates the region at which the stall is most likely to occur first.

As mentioned, it cannot even be safely assumed that the least harmful stall is induced by a gradual increase of the incidence in straight flight, as, for instance, during a landing maneuver. And the stall caused in circling flight may, again, have a quite different character. Power-on and power-off conditions will also affect the spreading of the flow separation as well as the region of its inception. The provision and setting of flap will vary the character of the stall to a large extent. There is some indication that the worst stalling character is often displayed under the influence of gusts, especially when they affect the wing partially only.

M.A. Garbell mentions (Ref. 7) “the dangerous characteristics of certain tailless designs which assume negative values of damping in pitch through trailing edge airflow separation and wing tip stall during violent nose-up pitching movements with the airplane trimmed for high CL’s . . . “, and suggests shifting the centre of gravity forward in order to increase the static longitudinal stability. This is clearly a matter of stability at the incipient stall, which is of great importance for the rational design of tailless aeroplanes.

For reasons of practical design, the discussion of stalling characteristics relating to tailless aeroplanes is best based on the comparative comparison of the different wing plan shapes and of the influence of the aerofoils chosen.

In theory, an aerofoil of elliptical plan shape, of constant aerofoil section and with no twist which retains an elliptic lift grading over the span at all incidences of lift, stalls simultaneously along its entire span. In reality, this is not quite so; wind-tunnel tests prove that such an elliptic aerofoil usually has an incipient stall at the wing tips. The reason is that the Reynolds number decreases towards the tips, since it is based on the local aerofoil chord. Hence for simultaneous stall and for maximum possible lift coefficient, twisted rectangular wings will satisfy the condition.

In the next part of this article, the flow mechanics of the spreading of the stall in a span-wise direction will be discussed in detail.

(To be continued)

U-2 Bulletin Board Threads

(ed. – I am including this thread for what is it worth. I looked at Wick’s web site and didn’t see any mention of Mitchell flying wing kits being made available so don’t know if this is a timing issue because the information is so new, or whether this is an old story that is just resurfacing. If true, those of you who may have been contemplating building a U-2 or B-10 this may be what you were looking for to speed up the

construction process. If anyone knows more about this, I would be interested in what you have.)

December 1, 2010

What's up with all the recent additions to the group? We've had a sudden spurt in new membership and have had more new members in the last week than in the last 3 months.

Did some magazine or news group have an article on the U-2 to generate some new interest?

Posted by the board's Moderator

Exactly.

http://www.eaa.org/lightplaneworld/articles/1011_wicks.asp

Jim Covington

There was an excellent article in the latest issue of the EAA Sport Pilot magazine about the Mitchell designs and links to some fine you tube videos.
I have always been interested in the designs but hadn't been able to see one in person. They look like a fantastic motor glider type; the U-2 had the best L/D ratio of the two and so would be my choice to build. Now to save up for the plans. How detailed are the plans set? Are there any known errors in the drawings?

I would be interested in using a Rotax 503 or similar engine for power is that something that could be done?

The photo section shows some very interesting projects and it looks like it should be an easy build.

Mike Heit A&P IA
Rocky Mountain Aviation Services LLC

Yeah, EAA had an article on Wick's signing a contract with Richard Avalon to market wood kits for the B-10 and U-2 in Light Plane World. Either they meant Carol Avalon, or Richard managed what Houdini couldn't.

Rick Girard

It's really nice if this company is going to produce kits for the U2. I sincerely hope, however, that they have incorporated the improvements that Guy Provost recommends(reinforcement of the wing spar around the main gear fittings and shock absorbers on the gear etc). Also, it would be nice if they give realistic information about the glide ratio of the U2 (which, according to Guy, is much less than 22:1), instructions about CG adjustment etc.

I am preparing my hangar for this winter's repair of the crack in the central wing spar of my U2 and the addition of shock absorbers on the main gear. I also will have to turn the elevons upside down and shift left them to right because the builder mounted them in reversed position.

It's nice to see one of my pictures of Tibor's U2 and my B10 and a link to one of my U2 videos in the EAA article.

I could not find any reference to Mitchell wing kits on Wick's home page, however.

Carl Hyllander

I spoke with Richard Avalon a couple months before he was hospitalized concerning buying a kit. He said he didn't have any ready, but that he was working on a deal for someone else to produce them. He didn't say who he was talking to, but I now suspect that he was referring to Wicks.

Andy Gamache

I recently have been contemplating building another plane and was looking thru my plans stash and found the U2. I searched online and found the company was still offering plans and then the pic's of the foreign built retract version really caught my attention. I made a few attempt to contact the company about structural revisions to the plans, if there are drawings for the retract system, and other improvements the new drawings may contain but have not received a response.

I would like to build and modify a U2 like the retract version on the company's web site but does anyone know what improvements/drawings are current for the retract and structural enhancements and the safety record of whatever amount are flying. Is there a known VNE, has there been flutter of balanced surfaces. I have read most post on the group and have read don't build, to its great, and beef up suggestions.

Lonnie Prince

AVAILABLE PLANS & REFERENCE MATERIAL

Coming Soon: Tailless Aircraft Bibliography Edition 1-g

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

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

Prices: To Be Announced

Serge Krauss, Jr. skrauss@earthlink.net
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Books by Bruce Carmichael:
Personal Aircraft Drag Reduction: $30 pp + $17 postage outside USA: Low drag R&D history, laminar aircraft design, 300 mph on 100 hp.
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VIDEOS AND AUDIO TAPES

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

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VHS tape of Al Bowers' September 19, 1998 presentation on "The Horten H X Series: Ultra Light Flying Wing Sailplanes." The package includes Al's 20 pages of slides so you won't have to squint at the TV screen trying to read what he is explaining. This was an excellent presentation covering Horten history and an analysis of bell and elliptical lift distributions.
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VHS tape of July 15, 2000 presentation by Stefanie Brochocki on the design history of the BKB-1 (Brochocki,Kasper,Bodek) as related by her father Stefan. The second part of this program was conducted by Henry Jex on the design and flights of the radio controlled Quetzalcoatlus northropi (pterodactyl) used in the Smithsonian IMAX film. This was an Aerovironment project led by Dr. Paul MacCready.
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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.
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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".
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VHS of Robert Hoey's presentation on November 20, 1999, covering his group's experimentation with radio controlled bird models being used to explore the control and performance parameters of birds. Tape comes with a complete set of the overhead slides used in the presentation.
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