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T.W.I.T.T. NEWSLETTER

A conceptual drawing of the bi-directional flying wing. Source:
http://wordlesstech.com/wp-content/uploads/2012/09/Supersonic-Bi-Directional-Flying-Wing-2.jpg

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

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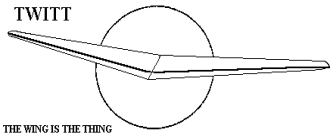

THE WING IS THE THING (T.W.I.T.T.)

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.

T.W.I.T.T. Officers:

President: Andy Kecskes (619) 980-9831
Treasurer:
Editor: Andy Kecskes
Archivist: Gavin Slater

The **T.W.I.T.T.** office is located at:
Hanger A-4, Gillespie Field, El Cajon, California.
Mailing address: P.O. Box 20430
El Cajon, CA 92021

(619) 589-1898 (Evenings – Pacific Time)
E-Mail: twitt@pobox.com
Internet: http://www.twitt.org
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TWITT gatherings are held on the third Saturday of every odd numbered month, at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

I hope you enjoy this issue. It has a variety of stuff that should be of interest to some while not others but there is something for everyone.

There doesn't appear to be much going on in the flying wing world lately, at least from my perspective. There were some articles in the latest issues of Aviation Week on further development of the blended wing body design especially as it relates to heavy cargo airlift. This appears to be one way to introduce this concept to the flying public since past surveys have indicated they wouldn't fly in such an airliner. Wingspan was another issue trying to fit the airplane into the standard terminal gates without folding the tips ala on an aircraft carrier. If you are interested in this concept and want more information, don't forget we have a section on the web site that might help fill in the blanks.

Speaking of the web site, if you have anything you would like to add to the site for others to see, please let me know. Also, if you find any broken links in some of the areas also let me know so I can remove them or find the new link to the subject matter. I don't check on these things due to the amount of time it takes so I have to rely on users to tell me of any problems.

LETTERS TO THE EDITOR

Andy,

NASA 219072 (or "On Wings of the Minimum Induced Drag: Spanload Implications for Aircraft and Birds") has finally been completed.

Its weird getting up in the morning and not knowing what I will be working on anymore…

This is a public document. It is unclassified, unlimited distribution. I'd love to see it somewhere on an open server with a link everyone can access. And publication in TWITT or EHA is at your discretion…

Albion H Bowers albion.h.bowers@nasa.gov
Chief Scientist
NASA Neil A. Armstrong Flight Research Center
w: 661.276.3716 c: 661.209.0304
"soar with eagles…"

(ed. – I thought the fastest way to get this out to everyone would be to put a link on the TWITT website directly to the paper. If you know of other newsletters or organization that would like this link, please forward it to them since this is a public document. I have included the abstract, introduction and one section with a graph below to give you an idea on what this paper is about, but it is 22 pages long with illustrations so not very practical for publishing in short segments that would be required to distribute it through this newsletter.

http://www.twitt.org/219072.html)

Abstract

For nearly a century Ludwig Prandtl's lifting-line theory remains a standard tool for understanding and analyzing aircraft wings. The tool, said Prandtl, initially points to the elliptical spanload as the most efficient wing choice, and it, too, has become the standard in aviation.

Having no other model, avian researchers have used the elliptical spanload virtually since its introduction. Yet over the last half-century, research in bird flight has generated increasing data incongruous with the elliptical spanload.

In 1933 Prandtl published a little-known paper presenting a superior spanload: any other solution produces greater drag. We argue that this second spanload is the correct model for bird flight data. Based on research we present a unifying theory for superior efficiency and coordinated control in a single solution. Specifically, Prandtl's second spanload offers the only solution to three aspects of bird flight: how birds are able to turn and maneuver without a vertical tail; why birds fly in formation with their wingtips overlapped; and why narrow wingtips do not result in wingtip stall.

We performed research using two experimental aircraft designed in accordance with the fundamentals of Prandtl's second paper, but applying recent developments, to validate the various potentials of the new spanload, to wit: as an alternative for avian researchers, to demonstrate the concept of proverse yaw, and to offer a new method of aircraft control and efficiency.

Introduction

In 1922 Ludwig Prandtl published his "lifting line" theory in English; the tool enabled the calculation of lift and drag for a given wing. Using this tool results in the optimum spanload for minimum induced drag (the greatest efficiency) for a given span, which, Prandtl said, was elliptical (ref. 1). Since then, the lifting line theory and elliptical spanload have become the standard design tool and wing spanloading in aviation. So ubiquitous is it that avian researchers have relied on it to explain bird flight data almost since its introduction. But in 1933 Prandtl published a second paper on the subject in which he conceded that his first conclusion was incomplete: there was a superior spanload solution to maximum efficiency for a given structural weight. "That the wingspan has to be specified," he wrote, "leads to the invalid assertion that the elliptical distribution is best" (ref. 2). His new bell-shaped spanload creates a wing that is 11 percent more efficient and has 22 percent greater span than its elliptically-loaded cousin, all while using exactly the same amount of structure. It results in the minimum drag solution in every case of physical wings: any other solution will produce greater drag. Oddly, Prandtl's second spanload remains virtually unknown.

Sometime around 1935 Reimar Horten independently derived an approximate equivalent to Prandtl's 1933 solution. Horten dubbed it "bell shaped" for its wing loading. The extant evidence shows sufficient

differences between the two men's methods, objectives, and conclusions to exclude any mingling of information on this subject despite being contemporaries. While Prandtl calculated the total induced drag for a wing with this new spanload, he did not examine the distribution of the induced drag across the span, and so he missed its implications. Horten, on the other hand, did calculate the induced drag across the span of the wing, and in 1950 concluded that something singularly possible existed with such a spanload, although he never conclusively proved it (refs. 3, 4). What Prandtl missed and Horten believed existed with respect to the alternate spanloading (the bell) is proverse yaw. Figure 1 shows the elliptical and bell spanloads of Ludwig Prandtl.

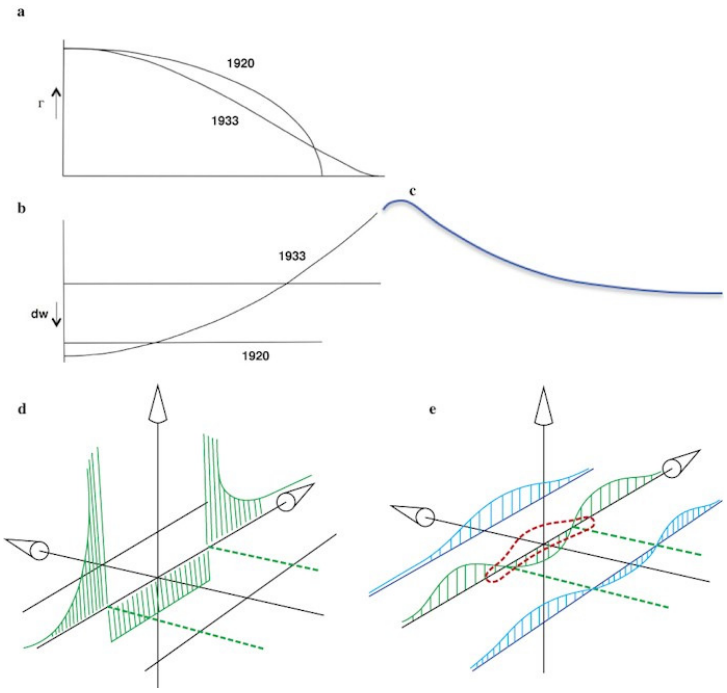

Figure 1. The elliptical and bell spanloads of Ludwig Prandtl.

Figure 1(a) shows Prandtl's elliptical spanload from 1920 and the bell spanload from 1933. The symbol gamma (□) signifies the airflow circulation about the wing. Figure 1(b) shows the matching downwash (dw) of the elliptical spanload (1920) and the downwash of the bell spanload (1933). In figure 1(c) the upwash outboard of the wingtip is shown. Figure 1(d) shows the 1920 Prandtl elliptical spanload downwash and upwash (note the sharp discontinuity at the wingtip, which is the wingtip vortex). Figure 1(e) shows the 1933 Prandtl spanload downwash and upwash (in contrast to the 1920 solution, note the smooth, continuous upwash across the wing and beyond; the wing vortex is now inboard of the tips). A comparison of the flow fields resulting from the elliptical and bell spanloads is shown in figures 1(d) and 1(e). The elliptical spanload wing, figure 1(d), has a sharp discontinuous slope at the wingtip span location in the upwash (this is the location of the wingtip vortex), in contrast to the smooth curve of the new upwash, figure 1(e) with no discontinuity (a weak vortex forms at the point where the downwash crosses the zero line and becomes upwash).

Hello,

I am looking for Backstrom's EPB-1 plans, could you help me out on this? Any kind of additional info is welcome

Many Thanks

Catelan Renato

(ed. – I sent out a request to Jim Marske and Raul Blackstein to see if they knew of any plans and got the following back from Jim. Many thanks to him for closing the loop and providing the documentation.)

Andy:

I remembered that several weeks ago I heard from Dave Rohsner whose father had built a Backstrom Plank still had a set of EPB-1A drawings. I asked Dave if he had a reproduceable set of drawings. Dave was kind enough to send me a PDF copy of these drawings. Truely, a piece of history.

Jim Marske

Jim,

I attached a list of what drawings should be there. We might be missing some of the construction drawings. I am attaching a photo of the Plank N7106, that Dad built. The photo was taken at Clover Field south of Houston in 1969. This was the site of The Houston Soaring Society. I have the modified Plank in our Hanger. I plan to rebuild it. The only thing that was modified was the fuselage. It has always been in a hangar.

Thanks,

Dave Rohsner

Hi Andy,

WOW!I what a great surprise! I had to look twice because I couldn't believe such a great reply. I really appreciate it and I'll be eternally grateful.
Do you know any similar candidate suitable for homebuilding?

Many Thanks again!!

Renato

(ed. – If there is anyone else out there that would like to see these drawings and the other material let me know. I can add them to the website and provide you with the necessary link which will be better than sending you multiple e-mails with the attachments since some may exceed your ISP's limitations.)

(ed. – For those of you who are members of the U-2 Yahoo group and haven't been getting messages over the past couple of weeks, I am including this item from the moderator so you can sign on and make any necessary changes to your account information.)

We've had a bit of potentially dangerous SPAM posted recently to the U-2 Yahoo group. In an effort to be able to control this a little better I've decided it's time to clean up the membership roster. There are currently about 170 e-mail addresses that are bouncing e-mails.

I'd like everyone to log on to the U-2 group and double check your settings and up date your information as you see fit. After approximately 2 weeks from this date (March 16, 2016) I will go through and delete the members with e-mail addresses that are bouncing. If this action unintentionally removes you from the group I apologize in advance. If this happens to you PLEASE reapply and we will get you re-approved in a timely manner.

Also as many of you know Yahoo, under Maryssia Myers fine leadership, may soon be under new ownership. If this happens it's conceivable that these groups will be eliminated and our archives lost. If any of you have any ideas how to efficiently download and archive this groups posts and files please speak up!

Leon McAtee
Moderator

The SA228 plane is new to me.

https://youtu.be/BjbBH-M0Ic0

Here is a build log:

http://www.rcgroups.com/forums/showthread.php?t=1768409

Nick Sturm

(ed. – For those of you not familiar with this flying wing here is a link to information we have on the TWITT website along with pictures of it on display at the Planes of Fame museum in Chino, CA.
The video is stunning in terms of how well this model flies doing aerobatics. The pilot is obviously very good at keeping his orientation of the model.
The following came in from Norm Masters showing its condition and that it had been moved to Valle, AZ. The photos came from the Airport-Data website shown in the link.)

The last picture I saw of it was outdoors "wrapped" in the remains of a tarp. When I saw it in Chino I was able to get close enough to see cracks in the leading edge skin. It was in much better shape then but still not airworthy. I am surprised they would leave a plastic airplane out in the sun.

http://www.airport-data.com/aircraft/photo/000702325.html - morephotos

Norm Masters

Does anyone know if Rod Schapel is still around? I'd love to know more about his project and some of the challenges he encountered while designing, building and then flying the plane. For instance, why was the project eventually stopped? Was it related to performance, lack of funding, or interest?

If he is still around, maybe he could share on this board some of his insights...

Alain Olsen

(ed. – This is the obvious question and we don't have an answer to it that is current. A number of years ago he liquidated his hangar at the Ramona airport outside of San Diego, CA and was moving to Texas we believe. The SA228 was a prototype for something bigger and was sort of a clandestine project since it was hard to get information about future plans from Rod. Perhaps someone in the Nurflugel or our group might have a final answer.)

(ed. – From this shot you can see why the model went to a jet engine versus a reciprocating one in the original design.)

Nurflugel Threads

Hi everyone, I'm new to this list. My background: software engineer and RC helicopter (not multicopter) pilot. I wrote payload control software for my university's UAV lab before graduating a few years back.

I got interested in flying wings after seeing Al Bowers speak at the 2016 AMA Expo. Now I'm trying to learn as much as I can about aerodynamics (not easy). My goal is to build a model similar to Al's Prandtl-D models, then see what I can do with subsequent iterations (faster, smaller, payload bay/fuselage, data collection with Raspberry Pi, etc). Probably going to use EPS foam coated with fiberglass.

While waiting for Al's 19-paper to be published, I have picked up a couple of books from b2streamlines (to answer the question "How do airplanes fly, really?"), and went searching for any concrete geometry. I found the Panknin twist formula, but it seems less scientific than Horten's bell-shaped spanload, which I understand to have a non-linear washout. Then I ran across the Nest of Dragons website and found a spreadsheet describing a wing that Al brought to the AMA Expo (DragonWing white edition).

I would appreciate any general feedback for this stage of my learning. My specific questions today are related to wrapping my mind around the DragonWing spreadsheet:

- I notice that an E193 airfoil section is used for the lifting part of the wing, while a zero camber section is used for the "horizontal winglets". Is this transition described in the spreadsheet? Should I assume it's linear from root to tip?

- On the Wingdata sheet, is it a mistake that the zero lift angle at each section is zero, or is that correct?
- Does "dihedral" effectively mean "angle of incidence" on a flying wing with such high aspect ratio and sweep?

- Is it safe to assume that a pure Horten wing cannot be aerobatic without a tail section? This is an intuitive conclusion on my part; seems like the sharp pitch/roll changes could ruin the proverse yaw granted by upwash at the tips.

Thanks,

Jacob Marble

http://nestofdragons.net/media/44505/2016-02-15-dragonwing-shared-information.xls

You're in luck, Jacob--

XFLR5 has recently added a sin^n curve to the <Show Target Curve> option in the <Wing and Plane Design> window. If you can read German the nurflugel software has been able to do it for some time it can be downloaded here http://www.flz-vortex.de/ . There are also versions of nurflugel with partially translated interfaces in English and French. The spreadsheet you posted looks quite a bit different than the one I got from Koen's site a few days ago. Did you download it from this page http://www.nestofdragons.net/weird-airplanes/flying-wings/flying-wing-designer/

BTW There is an article about Marko Stamenovic's flying wing designer spreadsheet in this month's Radio Controlled Soaring Digest.

http://www.rcsoaringdigest.com/highlights.html

Norm Masters

Excellent link Norm. This has some fascinating stuff in it. The design program article, one on the AK-X design, and one on 3D printing, among others. A very nice magazine.

Arch

Norm,

Thanks for these tips. I have been working with XFLR5 lately, will try the sin^n target curve feature. I'm using the version available from xflr5.com.

I think Koen clarified the link confusion. Also, thanks for the RC Soaring Digest link. This is a very niche topic, and I'm surprised by how tight the community is.

Jacob

Hallo Jacob, Koen here, the DragonWing guy. :)

I try to answer your question. Norm, the spreadsheet he mentioned is not the same as the spreadsheet Marko developed. Jacob was referring to the data of the DragonWing project of me. It has all the data needed to make a fine 3.75 m RC model or ...the 15m hangglider. :)

Jacob, the transition from wingtip airfoil to root airfoil goes in steps like the span. I am not sure how you are planning to create those transitions, but i used a 3D program. I drew a non-twisted wing with the intended sweep and the intended taper. I placed wingtip airfoil and root airfoil. It became a solid which i cut in 10% parts. Each cut gave me a new airfoil which i intended to use on that same % of span. But ...i first needed to add the needed twist. So ...the transition from tip to root is not such a problem. I just wonder ...how did they do it when 3D software was not there? Did they use the coordinates, calculate the difference in Y in each X location and divide that difference in 10%'s? Is that the way they calculated the new airfoils for the steps between tip and root?

Al Bowers did use Cm neutral airfoils for this design. It made the twist become less in total. So, yes, zero lift angle is zero.

Dihedral is the angle that make the wings go up in a V. That is the easier explanation i can come up with. And yes ...it is really really small. Use a bigger one and ...you are bound to have trouble with extreme adverse yaw. Go see my videos of the RC DragonWing to be convinced. It crashed several time before we changed the dihedral to 2°.

Even using the right dihedral didn't take away the crashed caused by trying to fly to get it unstable. Once, it made a 250m drop. VERTICALLY! No kidding. We had GPS coordinates of that flight.

Reason: the glider was angled at 90° in a wingover and at the top of the wingover it had zero speed. So ...it fell like a knife. Near the ground it was getting the right position to recover, but it was already too low. It hit the ground with its belly hard. Remember ...this was a 1/4 scale model. In real life it would have been a drop of 1 km!!!

About the proverse yaw. As long as we had small deflection, it was all ok. Use rapid, large deflection and you get adverse yaw.

I hope this helps, Jacob. Sorry for my late reply.
Keep that brain spawning wings,
Koen (pronounced as racoon without ra)

Koen Van de Kerckhove

Dear friend Koen,

Not for widespread distribution: the report is published! Please see attached. We will have a public ceremony (in about a month) after which we can send out to everyone. :-)

Best regards good friend!

Al Bowers

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.

Serge Krauss, Jr. skrauss@ameritech.net
3114 Edgehill Road
Cleveland Hts., OH 44118 (216) 321-5743

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
Add: $ 2.00 for foreign postage

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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