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T.W.I.T.T. NEWSLETTER

https://www.uasvision.com/2013/11/18/cassidian-to-fly-sagitta-unmanned-flying-wing-by-2015/

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

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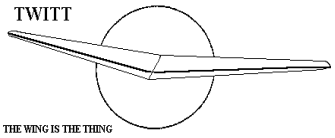

THE WING IS THE THING (T.W.I.T.T.)

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. is affiliated with The Hunsaker Foundation, which is dedicated to furthering education and research in a variety of disciplines.

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

E-Mail: twitt@pobox.com
Internet: http://www.twitt.org
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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).

TABLE OF CONTENTS

PRESIDENT'S CORNER

As you are probably aware of my now there was no June issue this year. I simply did not have enough material to create the necessary eight pages needed to meet printing requirements. I will extend everyone's expiration date by a month and it will show up on your label this month.

There is not much else to cover in this column this month since everything has been relatively slow.

I would like to welcome our new members from Italy and Mexico (I think he is the first we have had from that country) to our group. I hope they enjoy going over the back issues to find answers to their questions.

My apologies for not keeping the back issues page on the web site properly updated with the latest issues. I had a computer software failure that couldn't recover some of the programs I used for things like this, but I should have the problem resolved in the coming weeks.

I hope you are all having a great summer flying season.

Don't forget the upcoming Experimental Soaring Association (ESA) Workshop over Labor Day weekend in Tehachapi, CA. See more on the schedule on http://www.esoaring.com/.

LETTERS TO THE EDITOR

(ed. - This is a continuation of the Nurflugel conversation that was included in the May issue. If you have any thoughts on this subject area, please send them to me at twitt@pobox.com so I can include them in any further discussion. As of our publication date there were no other comments by this group so I am not sure where it will go by the time we get to the August issue of our newsletter.)

There's a big collection of drawings and B&W pictures in the photos section of the group web site:
https://groups.yahoo.com/neo/groups/nurflugel/photos/photostream

Is everyone in the group aware of the Dunne/Wright/Burgess interaction? Poorly documented and publicized, and worth research.

Bob Storck

I also have the .pdf 60MB file of a study of the XF5U, but cannot upload it to the site because it's too big.
Langley Full-Scale Tunnel Investigation of a 1/3-Scale Model of the Chance Vought XF5U-1 Airplane.
It shows a few things that make this plane more of a mystery.

After seeing the Arup fly, Zimmerman settled on very nearly the same aspect ratio, as the most effective to maximize the wing-tip wash-around of the low aspect ratio plan form. After designing to maximize it, the Navy let them build on Zimmerman's flapping-prop idea for some reason, as if to improve efficiency and make it land slower.

They knew that the Arup did not have high induced drag due to wing-tip wash-around while in cruise, and for the navy they wanted to maximize the "parachute drag" effect at high-A flight.

Why is there this confusion between high-drag slow high-A flight and efficient cruise? There's no good answer to why the Navy and Vought thought the planes needed the flappy props to counter induced wing-tip vortices which the design had sought to maximize...

The excerpt from the book shows that before they built the V-173, they'd done tests with normal props working in the opposite direction, inwards at the tip, and there was negligible change except more stability.

The Vought plane did not need the outward-rotating huge flapping props -they handicapped it and they knew it, yet they built it and then built it into the XF5U.

These props-at-the-tips sabotaged the planes. The V-173 was slower than it would have been with 2 normal props normally placed, and the XF5U never made it down a taxiway. If it had been a simple twin, it would have been amazing, as would the Boeing 390 series, as would any follow-on jets.

The book says that they found the Arup-type ailerons were not very effective, so they deleted them after early models and added the detached elevons. To answer a question from an earlier thread, they're partially in the vast flow from under the tips and partially in clean air under/outside the wing-tip vortexes in slow high-A flight, and they're partially hidden behind the wing in cruise when they're not needed as much.

John F.

John,

You could share XF5U file here http://uschovna.cz/en/?set_lang=en and let download pass for group in discussion - only place group e-mail address as address of recipient.

Jeri

...Langley Full-Scale Tunnel Investigation of a 1/3-Scale Model of the Chance Vought
XF5U-1 Airplane

It shows a few things that make this plane more of a mystery.

After seeing the Arup fly, Zimmerman settled on very nearly the same aspect ratio, as the most effective to maximize the wing-tip wash-around of the low aspect ratio plan form. After designing to maximize it, the Navy let them build on Zimmerman's flapping-prop idea for some reason, as if to improve efficiency and make it land slower.

They knew that the Arup did not have high induced drag due to wing-tip wash-around while in cruise,

Normally you wouldn't, at higher speeds, induced drag decreases for any airplane, regardless of aspect ratio.

'and for the navy they wanted to maximize the "parachute drag" effect at high-A flight.'

Why is there this confusion between high-drag slow high-A flight and efficient cruise? There's no good answer to why the Navy and Vought thought the planes needed the flappy props to counter induced wing-tip vortices which the design had sought to maximize...

The high induced drag (the drag due to the production of lift, which tends to be very high for low aspect ratio wings at low speed and/or high-G) can be an advantage on final approach if you're trying to hold a very steep glide slope angle without picking up airspeed. With power off, such an airplane would have massive drag and a very steep approach, but if the props had the effect of canceling out the wing tip vortices when power was applied, it would reduce the amount of power needed to arrest the descent rat for touchdown, or to do a go-around. Meanwhile, efficient cruise is necessary for things like payload and range. Any kind of drag is bad for those things, but induced drag (the drag from those wing tip vortices) decreases as you go faster, so the very high induced drag of a low aspect ratio plan form would be less of a problem at the higher speeds, where parasite drag dominates.

I think you're neglecting to look at what the PROPS needed. Also, those wing tip vortices HURT the plane's induced drag and efficiency, and the only reason to maximize their intensity would be if you WANT high drag (such as landing approach), or so you could then recover that energy by some means, such as with the outward-turning props. Even so, the amount of energy lost in the vortices will be greater than what can be recovered by the props (or winglets, or BSLD, or whatever), so too much energy going into those vortices will make the plane unviable from an overall efficiency standpoint. That's mostly the fault of the overall concept, not the prop details. The plane was a failure because in at least that application, the low aspect ratio plan form was simply not as good as a more conventional layout from the standpoint of how well it could perform the complete "mission profile".

The excerpt from the book shows that before they built the V-173, they'd done tests with normal props working in the opposite direction, inwards at the tip, and there was negligible change except more stability.

That would depend on the exact flight condition being tested. To get enough swirl in the propeller slipstream to cancel out the wing tip vortices significantly, it would have to be a flight condition with very high disk loading (so high power and low airspeed). The results you quote suggest they were using low disk loadings, so the swirl in the propeller slipstream was not having much effect on the intensity of the wing tip vortices.

The Vought plane did not need the outward-rotating huge flapping props -they handicapped it and they knew it, yet they built it and then built it into the XF5U.

So you are claiming they were "intentionally stupid". No, there is more to it than that.

Why do you say "...they handicapped it and they knew it..."? Did that analysis include all aspects of the mission profile, or just a coupe of points that looked only at one criterion?

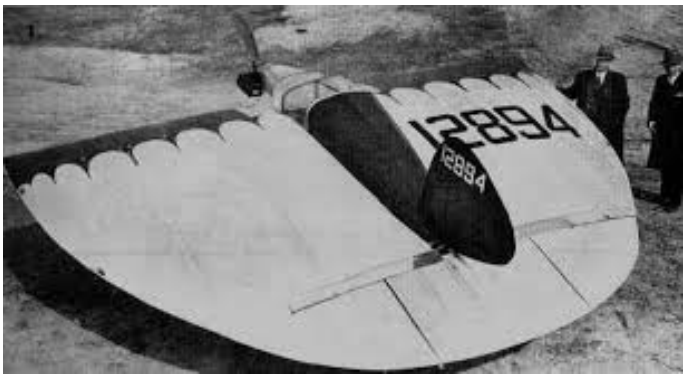
These props-at-the-tips sabotaged the planes. The V-173 was slower than it would have been with 2 normal props normally placed, and the XF5U never made it down a taxiway. If it had been a simple twin, it would have been amazing, as would the Boeing 390 series, as would any follow-on jets....

You're assuming the slower speed was because of the direction of rotation, and/or the hinging of the blades?

Based on what? Or because they were at the tips? If anything, that should have helped prop efficiency and thrust. However, if the props' aerodynamic design was optimized for high power and low speed, then they may have had to compromise high speed thrust to get that. The main detriment for having the props at the tips would be failure modes, since loss of power to one prop would have resulted in loss of control when under power, which would have required a heavy, redundant drive train (the V-22 has that same issue). But as far as reducing top speed? Not likely, other than the weight of the drive train. If high speed was the primary criterion, the design of the propeller blades could have been altered to provide that. It appears they were looking for something other than max speed. Also, for high speed a low aspect ratio can be bad, because it takes more wing area from a low aspect ratio plan form to get a given amount of lift. At high speed, that extra required wing area shows up as additional skin friction and profile drag.

No, the hinging of the blades would not cause a loss of thrust, in fact possibly the opposite.

One problem with the ARUP and its offspring was they needed gobs of angle of attack to get to max lift, to minimize landing speed. This is fairly characteristic of low aspect ratios. And a high angle of attack for the aircraft also means a highly skewed inflow angle to the propellers.



The consequence of that is different angles of attack for the blades on one side of the disk than the other, and more importantly a difference in local airspeeds between the two sides of the disk. This is the cause of that infamous "P-factor", because of more lift produced by the blades on the down-going side of the disk when in a high nose-up attitude.

However, this same phenomenon also causes more drag in the blades on the down-going side, which results in a net upward force in the plane of the prop disk. This supplements to the lift of the wing, using propeller forces to help support the weight of the plane. For example, when the V-22 is halfway through the transition between helicopter mode and airplane mode, the airspeed is still too low for the wing to provide enough lift. With the rotors at around 45 degrees tilt, this "in-plane force" from the rotors is supporting much of the total weight of the aircraft. In the case of the ARUP family, this would have provided a significant decrease in the required final approach airspeed.

Large diameter props will enhance this effect.

Also, the outward-turning props would have reduced the induced drag from the wing vortices, which is massive on a low aspect ratio layout at low airspeed and/or high-G. While high induced drag and the resulting low L/D is not an issue on landing (they probably needed drag there), it is a potentially serious problem for "retaining energy" during maneuvering flight.

A major down side of that highly skewed inflow into the props is a high one-per-rev vibratory stress on each blade root, very possibly high enough to cause very rapid structural fatigue. It also results in high vibratory stresses transmitted to the airframe (for a 3-bladed prop it would be a 3-per-rev), which could cause a whole "Pandora's box" of structural problems, and a very uncomfortable ride for the pilot. Would you like to ride a plane down final approach that's shaking like it's a chew toy in the jaws of our rat terrier?

Hinging the blade roots, as is done on helicopters, reduces those vibratory stresses dramatically. It tends to even out the inflow into the blades. The net result is a substantial lessening of the vibratory stresses, albeit at the cost of some of the in-plane forces. The more perpendicular angle between the disk and the inflow also significantly improves efficiency, which means more thrust for a given amount of engine power, which

means more energy available during high-G maneuvering. In level flight cruise, the larger props may or may not result in better efficiency, depending on the details (RPM in particular).

So, your concerns about the large props, with hinged blade roots, do not necessarily apply here.

Don Stackhouse

Both the V-173 and the Waterman Aerobile were stored at NASM's Silver Hill Facility. I'd suspect they are on loan from the Smithsonian. Cheers,

Bob

It still makes no sense to build in the extra complexity of the huge props (diameter and speed specifically designed to interact with the wing-tip vortices) when they first designed the plan form to maximize those vortices.

You do not in any way want to minimize those vortices. If you don't want STOL and the Vortices which allow it, don't build the low-aspect ratio.

In no way does it make sense. They knew early in the design process that it was not necessary and didn't work in any case.

If the supposed rationale for countering the vortices is cruise drag, it's stupid it's not present at cruise. Attempting to counter the vortices at low speed is equally stupid. It was designed to maximize them. If it had worked at countering them, it would have hampered the STOL performance they designed for.

The props kept it slower than it would have been with props chosen normally for the engines. Normal props for 80hp engines don't look like that, and they hampered its speed, being designed in the forlorn hope of stopping the vortices which they'd designed to maximize.

The extra complexity of those flapping props did it no favors, and they and the power distribution system associated with it killed the XF5U, while a simple twin prop design would have been a successful and impressive plane.

They knew the props did not help the V-173 in efficiency or control or speed, yet they built it anyway, and then they built the same thing into the XF5U. That says they hampered the design with unnecessary bells & whistles, in a useless exercise.

Maybe if a follow-up to the XF5U had good enough engines and the drive train worked out, they might have approached Zimmerman's toy VTOL, yet they had no hope of dong so, and they hindered it.

John F.

Marc de Piolenc wrote: "It makes sense to me to build a body with good low speed flight characteristics, and add propellers which, at cruise, will eliminate the resulting induced drag and give the wing a virtual span that is about double its physical span."

The vortex drag did not exist at cruise. The Arup did not exhibit it, it was very efficient and slick to the air. The vortex only is present at very low speed very high AoA. The Arup had very light wing loading, very high climb rate.

Induced drag is much reduced at cruise, it does not go away if lift is produced. What do you base your claim of Arup climb rate?

Murry Rozansky

Apparently you still think that they all were stupid. Do I have that right? What about intended vertical flight research remains unclear?

Serge Krauss

I am thinking that the apparent contradictions can easily be resolved by considering different flight phases.

The peripheral vortices and the resulting cross flow will

act to delay separation, which is good for low speed flight characteristics, but...those vortices are also a source of induced drag.

It makes sense to me to build a body with good low speed flight characteristics, and add propellers which, at cruise, will eliminate the resulting induced drag and give the wing a virtual span that is about double its physical span.

Best,

Marc de Piolenc

Marc de Piolenc wrote: "It makes sense to me to build a body with good low speed flight characteristics, and add propellers which, at cruise, will eliminate the resulting induced drag and give the wing a virtual span that is about double its physical span."

It is unclear why they abandoned the very promising capabilities of he Arup, while diverging off to the VTOL research, which could not have worked with the power levels available to the plane. It could not have possibly stood on its tail in mid air like the little models did. It was questing after that which killed the design. The props caused it to be too slow for the power level, and the excessive complexity of the gearing train prevented the XF5U from even doing a fast taxi, let alone flying.

They disposed of study of the good qualities of the Arup which would have made a good design, by adding the extra complexity which it did not need and could not make use of.

It's apparent they totally discounted the value of the Arup. It would have been developed into a good navy STOL plane that was fast and had good range and payload. It would have served exactly the purposes the Navy wanted in a remarkable serviceable plane.

Is it "stupid" to sabotage an exceptionally good thing by trying for something which could not have worked, when their own starting data showed that the Arup design did not need it? They hindered it with the quest for Zimmerman's VTOL which could not have worked.

They disposed of all R&D which could have gone into what the Arup demonstrated by digressing into showing that the Zimmerman VTOL thing could not work. They didn't build a real study of the very promising precedent set by the Arup. Is this stupid, or at least short-sighted and self-defeating?

The Arup showed that it did not suffer excessive induced drag. They did not display bad handling in cruise or low speed. In the '80s Hatfield built his follow-on "Little Bird" which proved this all over again. It was efficient in normal cruise, while being able to take advantage of the high AoA slow speed landing.

John F.

I am a big Arup fan and never have doubted its short field performance, having seen the Bendix Field films, watched Milt Hatfield with his ultra-light versions in the 1980's, and done some rudimentary math, based on Zimmerman's later NACA reports. We know that Charles Zimmerman was inspired by the Arup, or at least the Snyder patent, and probably by Richard Burton Johnson's "Uniplane." However, I don't think we should judge his projects too harshly, as the VTOL concept was explored even later by Ryan, Convair, and SNECMA, among others. Based on his own words and elementary theory, I don't think Zimmerman ever questioned low induced drag at cruise, which had to have been basic knowledge, even before his NACA data was amassed. -

Serge

Hallo!: there's an interesting report about a derivative of Arup planes in Sport Aviation, March 1987 issue: 'Milt's little bird', a homebuilt downscaled version, designed for prefab composite construction.

You know 'Sport Aviation' is the official magazine of EAA, and that the less than $50 a year membership fees will grant you the free use of a very advanced CAD software, besides the magazine. Hard to find a better bargain.

I became a member of the Spanish AAE, but before thinking in homebuilding, the building and materials theory must come first to handicraft, you need having a pilot's license, be it ultralight or aero club civilian pilot.

There are contests here for big size model airplanes, I watched images of a 4 m wingspan Bucker biplane trainer flying model; going to 'man carrying size' machines is a little step after this, regulations are reasonable.
Thanks. Have a good season. Regards. Salut +

Jose Gros-Aymerich
E-28033 Madrid

The navy had a great interest in a fast vertical takeoff aircraft and was willing to invest in basic research. What killed the V-173/XF-5U was that the military was moving into the jet age not the complexity and power limitations of the time. Both the power and complexity problems have been solved as evidenced by the AV-8B and V-22. Well the complexity has sort of been solved, the Osprey is a maintenance nightmare but the fact that it exists at all says something about the need to get into and out of tight spots quickly.

Norm Masters

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VIDEOS AND AUDIO TAPES

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

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
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An Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Meeting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio cassette tape of Alex's presentation explaining the material.

Cost: $5.00 postage paid
Add: $1.50 for foreign postage

VHS of 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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