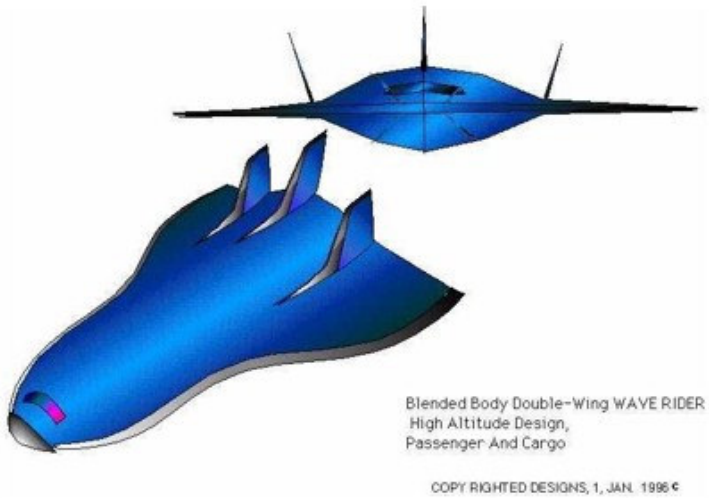
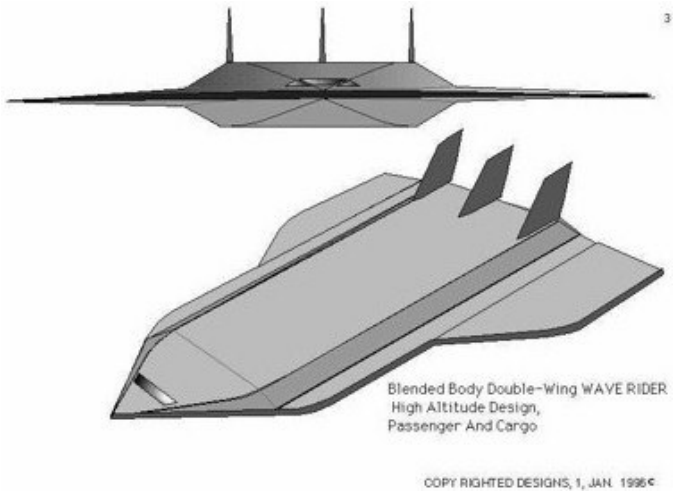
No. 187 JANUARY 2002

T.W.I.T.T. NEWSLETTER



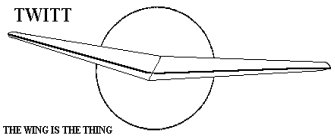


For more on these concepts, see Chuck Bixel's article beginning on page 5.

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., **0201** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, January 19, 2002, 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.

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

President: Andy Kecskes (619) 589-1898
Vice Pres:
Secretary: Phillip Burgers (619) 279-7901
Treasurer: Bob Fronius (619) 224-1497
Editor: Andy Kecskes

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) 596-2518 (10am-5:30pm, PST)
(619) 224-1497 (after 7pm, PST)
E-Mail: twitt@home.com
Internet: http://www.members.home.net/twitt

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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).

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PRESIDENT'S CORNER

The good news for this month is that my ISP has worked out a deal with Excite@Home to extend service coverage through February 2002. By that time the ISP assures its users that they will have alternate services up and running and everyone transferred to the new service. This will probably mean a new URL address for e-mail and the website and I will communicate that change as widely as possible when it occurs. SO if you have trouble getting a hold of me or viewing the website, please give it a little time and keep using a search engine to find us again.

I would like to thank Norm Masters and Chuck Bixel for their input I used in this month's newsletter. Both pieces came at just the right time and contained enough material to fill a lot of pages. I hope you enjoy their insights into these respective areas of aviation.

I would also like to thank Bill Hinote for donating a copy of his videotape he took of the N9M taxiing and flying at Chino. Bill came all the from Atascadero, CA to attend the meeting, which is a long way and we appreciate his effort.

At the time I am writing this I don't know if I have been able to get the technical problems with the print shop worked out. If you have good quality pictures, then we hit on the solution. If not, then we are still struggling to overcome the formatting issues between Word 97 and 2000. This has become a battle between man (me) and machine (the Ricoh copier) and I have vowed to win.

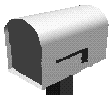
I hope everyone marked their calendar for this month's meeting. This is a very interesting concept model and we should get a good insight as to it's design philosophy and what the team has learned so far from flight testing. The break will feature Krispy Kreme donuts so don't miss this one.

Andy

JANUARY 19, 2002 PROGRAM

We are looking forward to hearing all about the Altrostratus 1/5 scale concept model being tested by Gary Fogel and Chris Silva. Gary will be bringing the model for everyone to see and give us a good slide show on the design and construction of this unique looking flying wing.

This is a very good program to kick off the New Year and I hope as many of you as possible will be able to make it. Don't forget we are going to have Krispy Kremes for the break.



LETTERS TO THE EDITOR

November 30, 2001

TWITT:

Since Stefanie Brochocki mentioned my ideas concerning dynamic stall and superstall and how these two phenomena may explain some of the observed slow flight behavior of the BKB-1, I thought it might be appropriate to elaborate on these lift modes. I've included a few drawings to help with visualization.

Figure 1 show's CL and CD up to 80 degrees. To the left of the shaded band labeled "Unstable range" is the range of AoA at which planes normally operate. Most planes lose some degree of pitch and roll control after the stall (at the left edge of the unstable rang of AoA) and some have lost elevator authority completely. If the plane has a large enough static margin the nose should fall back down on it's own and start the stall recovery automatically but some planforms develop a strong nose up pitching moment when stalled and this moment may overpower the elevator. This is especially true of planes with excessively large strakes. This pitch-up can be quite abrupt and when it happens the pilot very quickly finds himself on the right hand side of the graph, in the AoA range of bluff-body aerodynamics. Note that after the stall lift drops to about a third of steady state CLmax, then starts rising again until, at about 45 degrees, it peak's at 2/3 CLmax. Some planes that have been pushed onto this second lift peak have gotten stuck in an uncontroll-able deep stall while others have regained pitch and roll authority after a sufficiently high AoA was achieved >30 degrees. I believe that the BKB-1 was one of these other airplanes, however, bluff body lift is not what Witold Kasper was describing. He believed the wing was generating a stable leading edge vortex, which stayed attached throughout the descent. On the other hand, bluff-body lift involves the shedding of vortices alternately from the leading edge and the trailing edge.

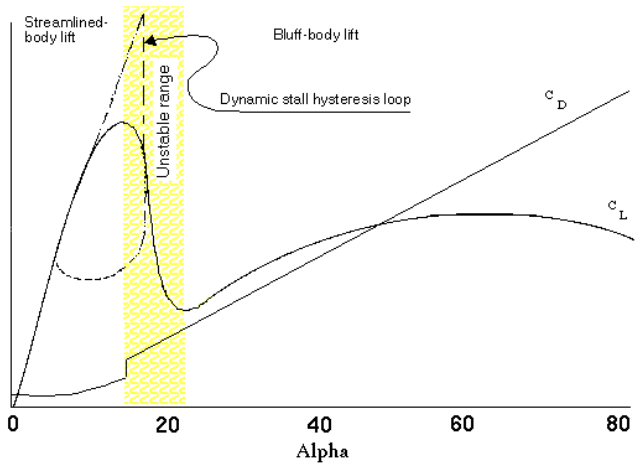


Figure 1

"But wait", I hear you say, "that doesn't account for the phenomenally high CL figures that I've seen in some of the reports!" Well most of the published papers are from journalists who probably misquoted and 3.17 is the highest number that I know was from Kasper. That's pretty good for a wing without any high lift features but not astonishing. However CL=3 is still a lot higher than the second lift peak, so where does that number come from? I think there are two phenomena that may explain the high CL observations without invoking new aerodynamics. The first is simply dynamic stall. I came to this conclusion after reading a statement in one of Kasper's papers that said, "it could hover for eleven seconds". I don't believe for one second that the BKB-1 hovered at all but in a dynamic stall the lift and drag may have worked together to bring the glider nearly to a stop and the time window is about right.

Secondly, as illustrated in figure 2. If the plane is flying on the second lift peak (with alpha=45) and the airfoil reference line is held horizontal, the resultant of the lift and drag vectors assuming L/D=1 is exactly opposed to gravity. Of course, I don't know what the lift to drag ratio of the BKB-1 was at high AoA, but the point is that the resultant is always larger than the lift and, since the objective here is a steep but slow descent, one wonders if a large drag component might actually help. In fact, the

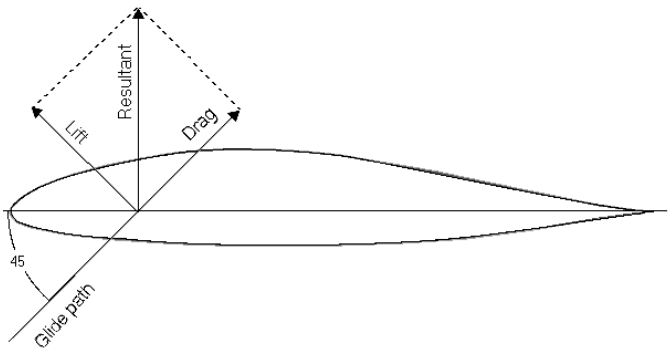


Figure 2

Free Flight modelers have been using a dethermalizing technique that involves kicking the elevator to an angle nearly perpendicular to the plane's longitudinal axis. Apparently this causes the model to descend nearly vertically with the fuselage in a horizontal attitude (just like Kasper described the BKB's "mush mode"). Some time ago NASA modified a Schweizer 1-36 sailplane to do just that, as reported in "NASA-TP-3022". The Schweizer's rate of descent was 4,000 feet per minute, which isn't even in the same ballpark as Kasper's observation of 200 fpm. Although I believe the BKB-1 was probably more efficient than the 1-36 in this flight regime, I don't think the difference could have been that big. From what I've heard elsewhere I'd guess that the BKB's sink rate during superstall was between 600 and 1,000 fpm.

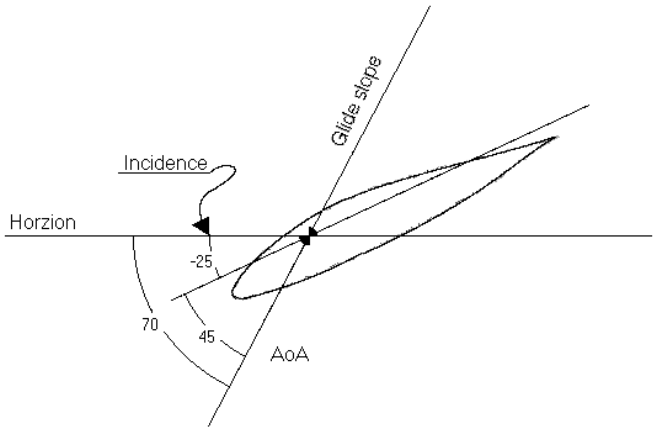


Figure 3

So, to get to the point, I think Kasper's claims were based on faulty observations and exaggerations. Both dynamic stall and the second lift peak had been identified before Kasper received his engineering education so he must have been aware of these other possible explanations for the observed phenomena but chose to advance a hypothesis that hasn't led to reproducible experiments. Of course this is just my opinion. Stefanie still has a lot of people to track down and interview before she will decide who has the real story. As far as I'm concerned, that's what makes her a better researcher than Witold Kasper or me.

ABOVE: Norm Masters relaxing at the TWITT hanger after a day of touring San Diego.

(ed. – I would like to thank Norm for his analysis and the fact that he provided it electronically, which made my job of including it in the newsletter so much easier. I am sure there are others who may disagree with Norm's views and we certainly would like to hear from you.)

December 18, 2001

(ed. – The following was submitted by Chuck Bixel on Flat Airfoil Flight Characteristics. If you have any comments or opposing viewpoints, please write us so they can be shared with everyone.)

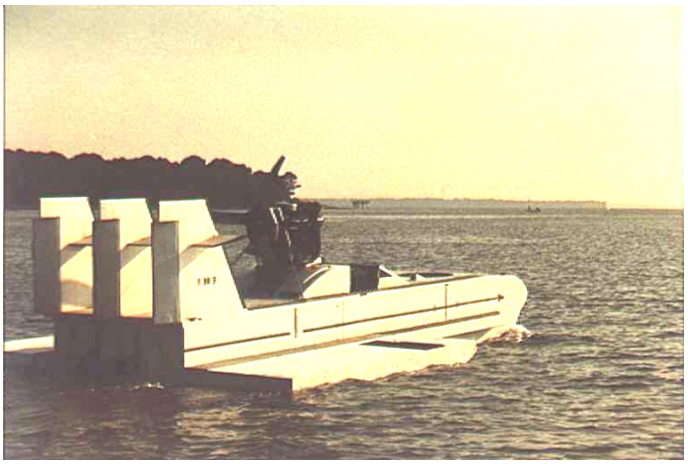
As an old retired military and commercial aviator, aero-marine designer, and itinerant lover of winged flying machines. I recently savored the feelings of being rewarded for my lifetime devotion and a little proud of hopefully discovering an unusual aerodynamic design concept that fulfills some of the less understood theories of flight. I believe, the standardization of aircraft designs while, unconditionally required for worldwide operations and manufacturing, has become a detriment to free thought and wonderment of the mysteries of flight. To unravel and understand a differing concept of flight with practical applications is fulfilling. As simply as I'm able, I'd like to tell of my experiences with flat/ symmetrical airfoils and non standard wing shapes leading up to my findings.

A couple of decades back the, (60 Minutes TV show), produced a presumably humorous fill in story about a young millionaire. He had invested about five grand to compile and publish a book on how to make folded paper gliders. One year later, he had become a millionaire. Our TV program illustrated some of the designs and showing him in a plush high rise office flying his paper gliders. Proof that, with a little ingenuity, thought, and risk, the get rich opportunities still abound. I had bought his book as, I'm sure a lot of us did.

Surprisingly, two weeks later, the young entrepreneur was back on the, (60 Minutes TV show). 60 Minutes reported

they had never received such an enormous mail response from any program they had ever produced.
Most inquiries were about, how and why, the small paper gliders could be so stable and efficient in both, upright and inverted flight, (always returning to level flight no matter how badly launched). Also, why didn't some modern aircraft use the designs? I'm sorry to say it but no one could answer that question. The show had interviewed an engineer from NASA, who had honestly admitted not knowing the answer. They also had interviewed a senior aeronautical engineer assigned to Wright Patterson AFB. He bumbled on, saying that he thought it had something to do with the double layer of folded paper on the underside of the glider's wings. He exhibited a small standard airfoil aircraft model with a notched out portion of the under wings surface, (speed boat/pontoon stepped hull form type or somebody forgot to install the flaps on), for illustration. I built a small styro-foam glider model as illustrated and promptly found out, the under wing notches only degraded the model gliders flight performance.

Copying the paper glider wing profiles, I cut three different large glider wings from one-inch thick styro-foam sheets. These larger wing area gliders had lengths up to eight-ft. and wing spans of four-ft., six-ft, and eight feet. We played with



the gliders on and off for weeks, experimenting and fine tuning their balance and rudder areas. Trying to better understand the nature of their unusual flight characteristics. We (mostly old military and airline pilot friends) were able to fine balance the gliders until, very little or no pitch control or elevator trim control was needed for safe flight.

We determined;

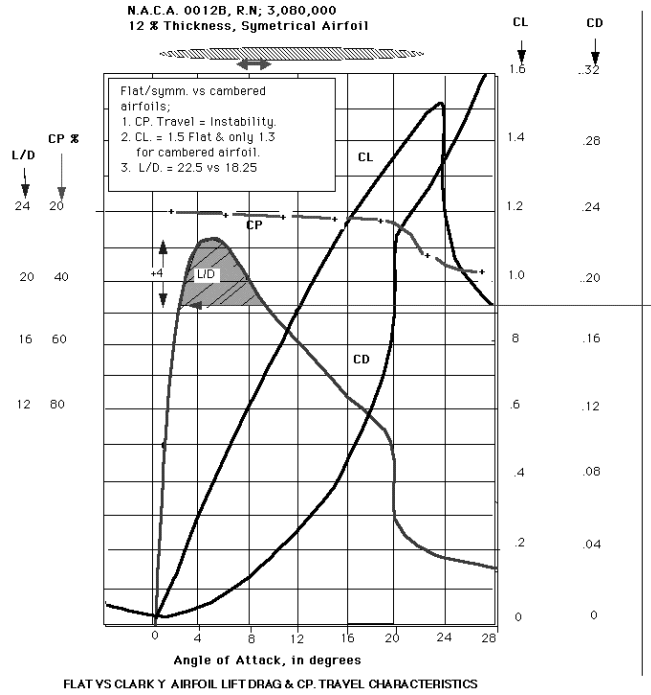
1. The properly balanced flat airfoil tail less (no elevator) paper glider type wing profile designs flight characteristics and performance were roughly identical upright or inverted.

2. **FLAT AIRFOIL FLIGHT CHARACTERISTICS**

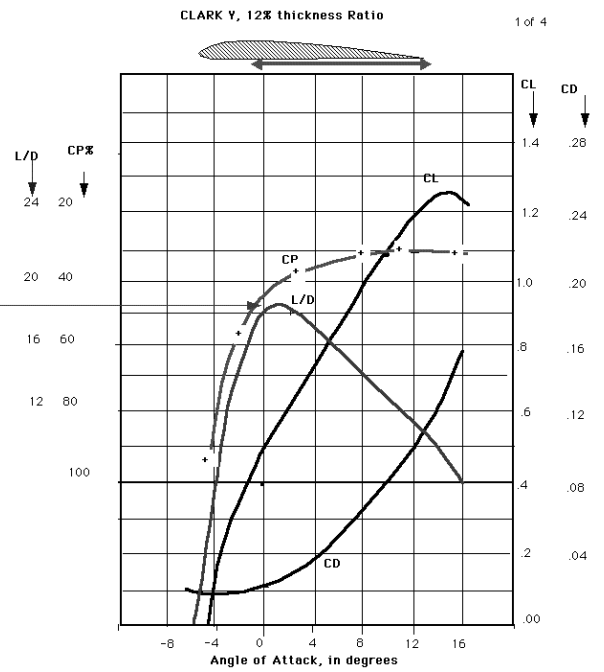
The Low and very Low Aspect Ratio Flat Airfoil Gliders Lift performance does not increase or decrease with airspeed changes like standard airfoil wings. Catapult launched at very high relative speeds the gliders flew perfectly straight and level tracks. The gliders slowly increasing their initial minimal flight angles as they decelerated, compensating for the decreasing flight speeds loss of lift efficiency. The paper glider type, flat airfoil wing profiles characteristically produce only the minimal lift required for level flight over their full speed range. When launched at a fifteen to twenty degree climb angles the gliders flew straight tracks while decelerating to their normal glide speeds where, the flight angles smoothly decreased to their typical glide angles and they glided back to the surface. Higher launch angles (45 + deg.) produced typical stall characteristics, generally followed by high angle dives back to the surface. When the gliders stall recovery nose down angle was minus fifteen degrees or more it would remain at that nose down angle accelerating until contacting the surface. At stall recovery angles less than minus fifteen degrees the gliders normally corrected their decent angles for normal glide performance. The normally slower glide speed characteristics and flight efficiency (glide ratios) of these large flat airfoil design gliders appeared to be as high as, and maybe even a little higher, than standard high performance R/C model sail planes. The largest foam glider built with the lowest wing loading exhibited some not before seen stall characteristic. This model, when launched at a fifteen to twenty degree nose high angle, would decelerate along this track angle until it fully stopped in mid air. It then slowly flew/slid backwards downhill for about six feet while the nose gently lowered to its preferred glide angle, reversed direction again, resuming normal forward gliding flight. This lightweight foam models glide speed was unusually slow,
(about five mph), reminding one of floating balloons or a gliding butterflies flight, just wobbling along reacting to the mixing light air currents. Adding lead weights to the gliders CG position produced compensating glide and stall air speed increases.

3. Reviewing my old 1948 airfoil catalogs, I searched for any major differences between the Cambered and Symmetrical airfoil flight performance data. I first discovered a number of symmetrical airfoils so thin there was no reason not to call them flat airfoils. I remembered that, back in those days they taught us to never use flat airfoils in our designs. I don't recall the exact reasons however, I do recall that Flat Airfoils were only supposed to be used as a standard base line for determining cambered airfoil wind tunnel lift and drag data. Reviewing the airfoils as types, it was evident that the majority had nearly matching Lift/ Drag curves and values. The values essentially being relative to their airfoil thickness ratio. The typical cambered airfoils normal flight angle range is from -4 degrees to +12 degrees while, the flat airfoils flight angle range is from +0 degrees to around +27 degrees. The cambered airfoils most efficient flight angle is in the one to two degree flight range and the flat airfoils best flight angle is always close to four degrees.

Comparing both airfoil types with, the same thickness ratios, the flat/symmetrical airfoil's Lift/Drag values exceed the cambered airfoil's values by nearly ten percent. Many of the cataloged symmetrical airfoils reviewed had much lower thickness ratios than the cambered airfoils. Comparing a thinner (5 %) flat/ symmetrical airfoil to a standard (12 %) thickness ratio standard airfoil indicated a marked improvement in its



FLAT VS CLARK Y AIRFOIL LIFT DRAG & CP. TRAVEL CHARACTERISTICS



notes for very low Aspect Ratio Double-Wing designs;
1. Reversed CP travel characteristics between flat and standard airfoils
2. Higher L/D ratios for flat airfoil plus, higher stall and flight angles.
3. CP travel on flat/symmetrical airfoil constantly corrects pitch Angles to match airspeed.

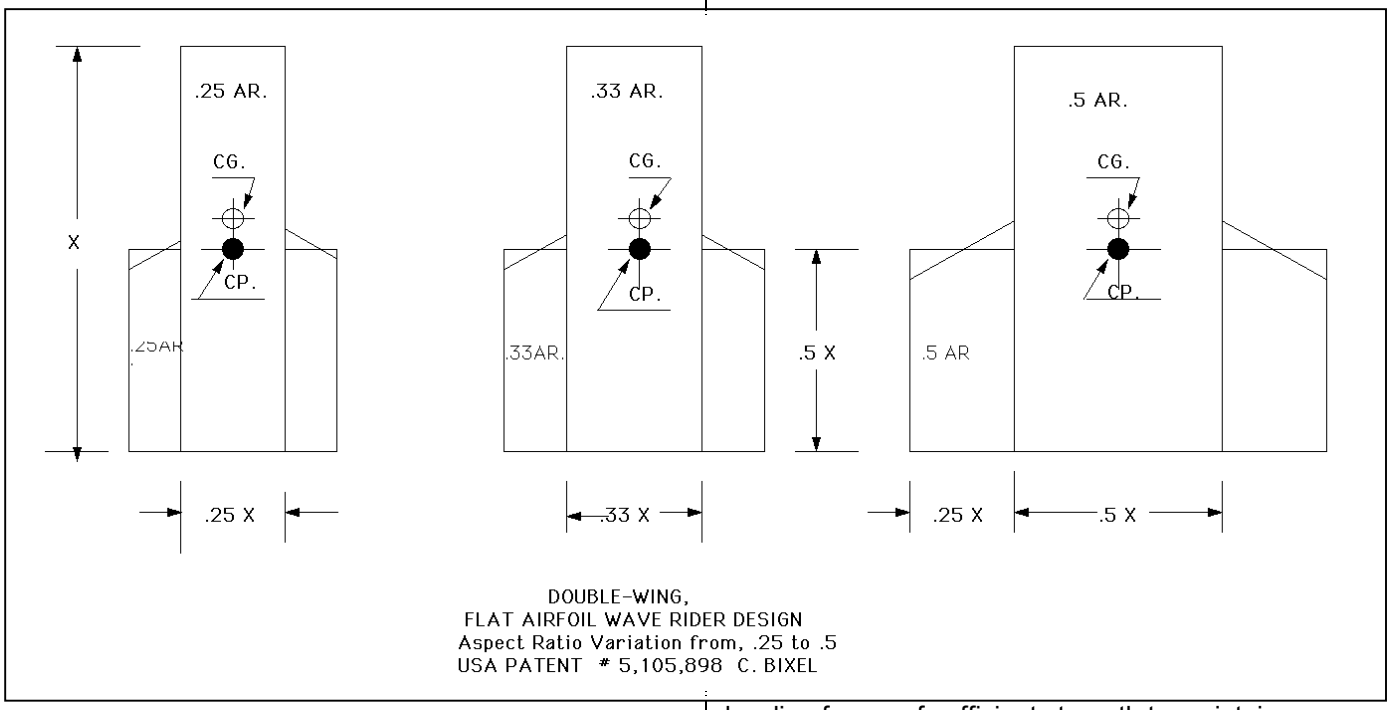
cruise flight efficiency. The main difference between the two airfoils is their reversed Aerodynamic Center of Lift (CP) travel directions and response characteristics. I don't pretend to understand why their CP travel directions are reversed however, this is the major defining difference in their general flight characteristics. The typical cambered airfoils CP travel ranges are from near 20% to 100% of its wing chord. Traveling full aft rapidly as the airspeed increases above design cruise values and the Angle of Attack decreases to minus values. The low Aspect Ratio cambered airfoil, with a larger wing chord, produces correspondingly increased CP travel distance and reaction forces, greatly increasing the pitch up or pitch down forces at its performance envelopes minimum and maximum airspeeds.

Low AR (short wing spans with large wing chords) cambered airfoil designs require larger tail control surfaces, and or longer tail moment arms to control the CP's increased forces and travel distances. The flat airfoil charts show its CP travel characteristics are reversed to the standard airfoils. The flat airfoil CP remaining nearly stationary (slowly creeping aft) from high speed to normal cruise flight angles. During slow speed high angle (+ 15 to + 26 deg.) flight the CP rapidly moves aft to reduce the angle of attack and resist stalls. The reversed CP travel direction and differing flight reaction characteristics are the primary reasons, all flat airfoil aircraft posses strong level flight stabilizing characteristics.

Notes:

a. Standard airfoil catalogs only report wind tunnel performance data for small model wings with Aspect Ratios of 6 to 8. (I would really love to see some charts for some very low AR cambered and flat/symmetrical airfoil wings like the paper glider and current wing-ground-effect (WIG) designs). Why you may ask? It appears that a near perfect flight leveling aerodynamic balance control may exist between, the FLAT AIRFOILS reversed CP travel, and some very low AR. wing planform/layout designs.

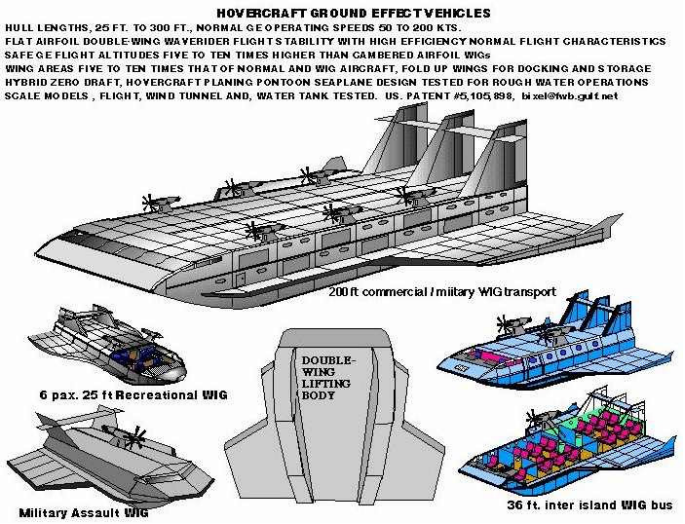
b. The barely flying light and ultra-light aircraft have such low airspeed envelopes that the cambered airfoil CP travel problems may barely exist.



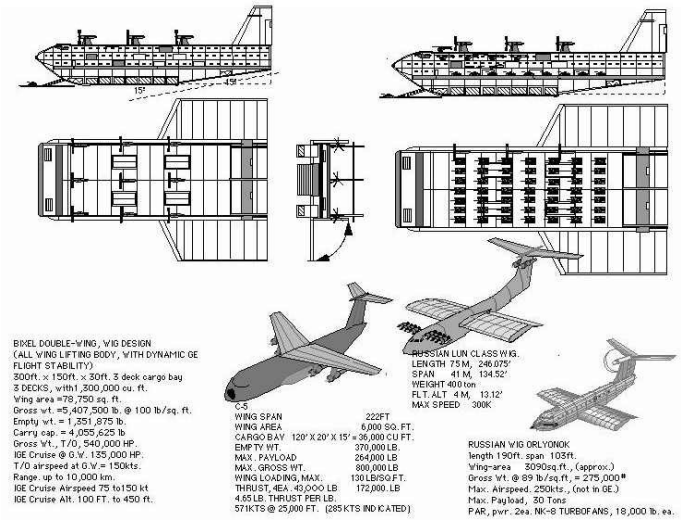
proportionally improves its already exceptional flight stability. The increased CP travel distances produce flight

4. WING IN GROUND EFFECT FLIGHT PROGRAMS

The past and current concepts of shortening the wing span and increasing the wing chord of standard airfoil WIG aircraft designs has yet, to improve the aircraft's flight efficiency in or out of WIG flight. The WIG aircraft's increased pitch sensitivity, loss in flight efficiency, and the

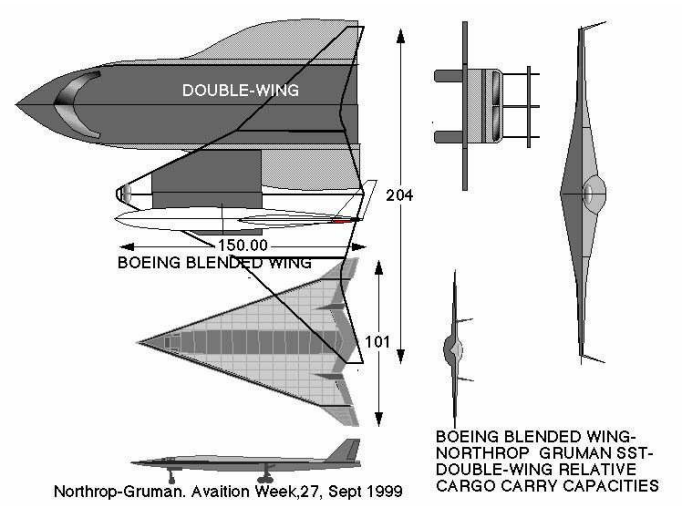


obviously dangerous low-level flight altitudes required leaves few WIG aircraft crash free to have normal life spans. Doubling the wing chords length proportionally doubles its CP travel distance requiring, greatly increased area horizontal tail/canard high drag pitch control surfaces and longer not shorter tail moment control arms. How-ever, increasing a flat airfoils wing chord five to eight times leveling forces of sufficient strength to maintain established GE flight angles that produce WIG wave rider flight, allowing hands off WIG flight control. Some current flat airfoil WIG designs have increased wing/lifting body design layouts with, up to ten times the effective wing area of the short wing span WIG modified standard aircraft wing area and airfoil designs. The larger wing areas produce proportionally increased aerodynamic lift and increased



volume GE reaction cushions. The increased volume and depth of the GE cushion allows WIG flight altitudes ten times higher than any current WIG designs. Only the very low AR flat airfoil WIG designs have produced WIG aircraft capable carrying many times the volume and weight of our largest modern cargo aircraft. The design has the operational probability of only requiring half the aerodynamic lift required for normal flight when riding on the GE cushion. Unlike, most

pervious WIG modified standard aircraft designs that produce only a very small speed envelope (sweet spot) for GE flight. The flat airfoil's



Northrop-Gruman. Avaition Week,27, Sept 1999

GE performance extends over its full air speed range. The increased wing area, lighter structured, and reduced wing area loading, flat airfoil designs also provide increased normal flight altitudes, flight efficiencies, and lower take off speeds. The Double-Wing Lifting body WIG designs performance is similar to most Flying Wing designs. Like the Flying Wing it is all lift but without the aerodynamic Lift/Drag consequences from the wings span wise twist designs, and high speed flight limitations. The Double-Wing Lifting Body design is fully capable of going into more economical true flight to over fly landmasses for access to inland rivers and lakes.

5. The design concepts for symmetrical airfoil Delta and Double Delta larger wing area high altitude Mach II and Mach III reconnaissance and airline aircraft are well established. These aircraft while being, super fast, are undeniably not efficient. They use their tremendous power and increased wing area to reach exceedingly high altitudes and flight speeds. However imagine, how much more flight efficient a lighter structured, non-pressurized WIG SEAPLANE with ten times the lift capacity of the worlds largest standard aircraft could be if it produced half the aerodynamic lift required for normal flight from its Ground Effect reactions.

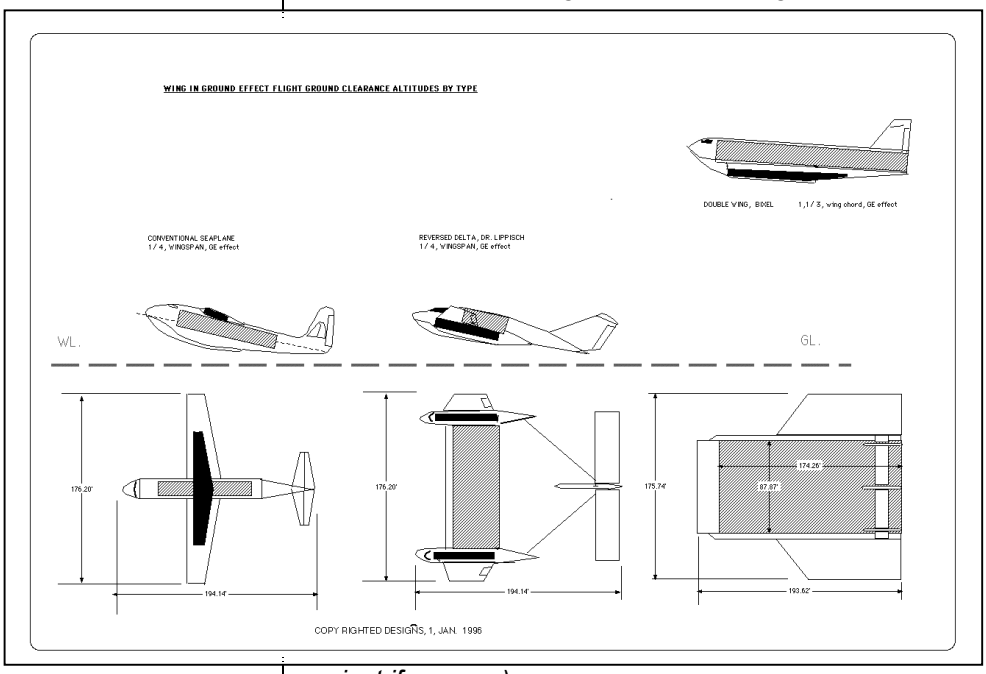
December 19, 2001

Hello All who are part of TWITT:

My name is Maziar Sefidan. I am a Mechanical Engineer at UCSD (University of California San Diego). I am also a member of AIAA. As a student and member of AIAA, I (as well as a good number of other students) have entered the AIAA sponsored Design/Build/Fly competition. This is our third year entering the competition, and we have done fairly well the last two years. This year, as a challenge to ourselves, we are building two planes for the competition. We have started the construction of the first plane, however we are still designing plane #2. We wanted to explore our options in the FLYING WING area. From your website I gather that you guys know quite a bit about flying wings. What I wanted to ask you (anybody who is interested in helping us out) is if we can possibly come to one of your meetings or get together with one of you and ask you a few questions regarding the feasibility of designing a flying wing aircraft. Thank you very much for your time.

Maziar Sefidan
msefidan@ucsd.edu

(ed. – I responded to Maz and let him know he was welcome to the meeting and to come by the hanger at any time and discuss flying wings with Bob or anyone else who might be around at the time. I got the following back from him and we look forward to meeting him and assisting his team with their project if we can.)



Thank you very much for you response. I was quite happy to hear back from you in such a quick time span. I'm very much interested in coming and talking to you and anybody else in your club. I'm the project manager for the team this year along with Josh Adams jaadams@ucsd.edu . The flying wing is a big consider-ation for us, particularly

because of the fact that other flying wings at the competition last year had much difficulties. We feel, however, that a flying wing, designed properly, can meet and even beat our expectations. Unfortunately, because of the upcoming holidays, I will be out of town for a short while, but upon my and Josh's return, I will come down to the hanger to meet TWITT.
Thanks again for your time and interest.

November 30, 2001

TWITT:

Hi I am Carl Trautvetter, the guy who asked you about the status of the Bill Horton / Hughes Law suit concerning the patents of the "flying wing/car" and if the plans and specs are available. You indicated that you might have your contacts name and address. If you do could you forward the info to me?

Secondly, who would have dimensional and materials plans for some of the Horton Flying Wing planes and might they be available? Also what is the status of the Terry Baxter concepts as pictured in the December 1999 TWITT Newsletter?

Thanks in advance.

Carl W Trautvetter
mersea2@cox.com

(ed. – First of all I need to apologize to Carl for not remembering his name as the person who asked the group for information concerning the Horton design (Bill Horton's Wingless vs. Horten's famous aircraft). I put Carl in touch with Russ Eckre who has a lot of information on Horton and the status of his Wingless project. Carl later told me he was meeting with Russ and it looked like he was going to get some of the information he needed. Carl also noted that his white paper on this subject had been approved by SPAWARS and now includes a small reference to TWITT as a source of information for the paper. We thank Carl for the inclusion and wish him good luck with the proposal. We may be able to hear more about it later depending on how it is classified during the remaining parts of the review process.)

November 25, 2001

TWITT:

I was given this site to help me find the CG of any given delta, but I didn't see anything about that. Do you have a formula that is in plain English that I could use. I've been playing around with coroplast models. So far I've built 3 complete planes and one fuse out of the stuff. Now I'd like to try a delta so I need to know how to figure the CG. Any help will be appreciated.

R.C. Nutt
BatmanDLB@aol.com

(ed. – I didn't have an answer for him in our archives so does anyone out there no of a quick and easy way to determine the CG of a delta wing? You can write to us and we will pass it along or send him an e-mail direct – if you do include us as an addressee so we can add the information to our archives.)

November 28, 2001

TWITT:

I finally got around to getting a foamie egg carton to make one of those flying-wing models, but now I can't find the website. The URL in the models section of the TWITT website doesn't connect me even though there's a picture of the egg-carton model at the link to tempt me. Can you help??

Thanks,

Bill Hinote

(ed. - As I went back and looked at the website, I see where the confusion may be. There are two links indicated in the text, but the real link to the actual construction article is on the picture of the glider. I passed this along to Bill and hope that he has now had success in constructing one. For those of you interested the site is: http://www.eecs.umich.edu/mathscience/funexperiments/flyingwing.html)

BKB-1 Paper Glider

When I set up the BKB Paper Glider page on the website, I also included a hit counter to see how many people visited the site. The counter is now at 410 so there has been a lot of interest in the page. However, I have not heard back from anyone on how well the model worked for those who took on the task of actually building one.

So if you are one of the 410 and you built one, please let us know how it turned out. If everyone had a good time with it and it flew well, then perhaps Pat would do one of a Marske or Backstrom glider for more fun.

Looking forward to hearing from some of you.

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