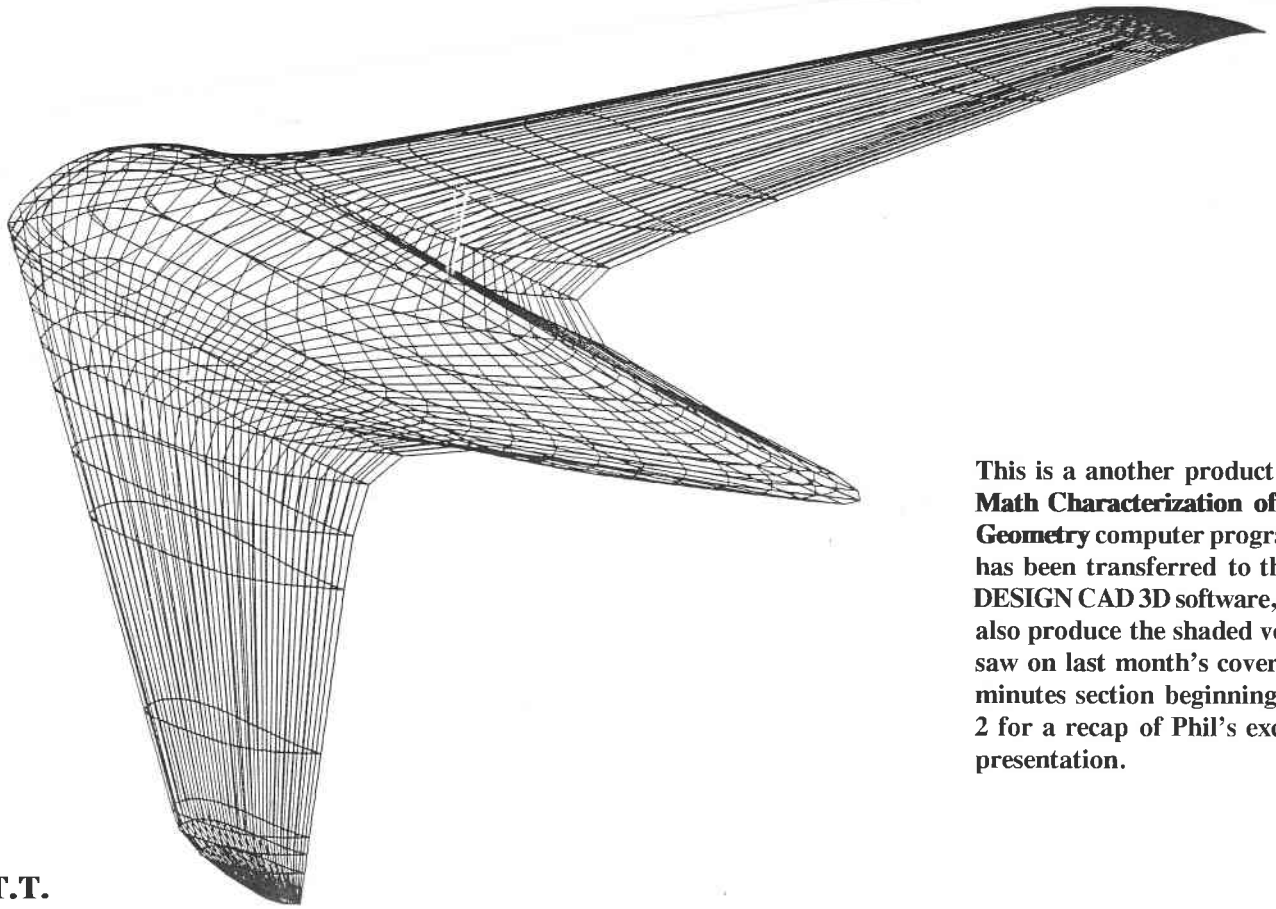
No. 112 OCTOBER 1995

T.W.I.T.T. NEWSLETTER

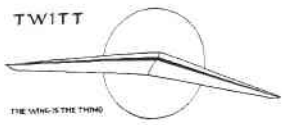


This is a another product of Phil's Math Characterization of Aircraft Geometry computer program after it has been transferred to the DESIGN CAD 3D software, which can also produce the shaded version you saw on last month's cover. See the minutes section beginning on page 2 for a recap of Phil's excellent presentation.

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

The number to the right of your name indicates the last issue of your current subscription, e.g., **9510** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, November 18, 1995, beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, CA (first hanger row on Joe Crosson Drive - East 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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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, east side of Gillespie).

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PRESIDENT'S CORNER

We received some good news from Bill Foshag, who says the Library of Congress has accepted the TWITT Newsletters into the general section of the library. This makes them more accessible to the public which we hope will mean greater exposure for TWITT over the coming years. Flying wing enthusiasts doing research will come across the newsletters as part of the reference system and find they have kindred spirits in our membership. Our thanks to Bill for his efforts in seeing this project through to a successful conclusion.

There is a little bad news. Apparently Craig and Nancy have had some problems with the software being used for the bibliography and they haven't been able to work through yet, plus they are in the middle of moving into a permanent home here in San Diego. I will be getting with them this week to try and resolve the computer difficulties so we can get this project back on track.

From the reactions after the meeting last month I get the impression everyone really enjoyed Phil Barnes' talk of airfoil design. It was amazing what could be done with the use of complex equations to affect the shape of lines and make them reveal an airfoil or fuselage shape that can later be turned into a 2D or 3D image. Although the program he created won't do performance analysis, at least not yet, it goes a long way to helping come up with new airfoils and configurations for tailless aircraft.

For those of you who haven't ventured into the world of computers yet, it is obviously here to stay and will eventually lead to the design of better and better aircraft over the coming years. The Boeing 777 is a prime example of a plane designed and analyzed completely by computer, without the previous full scale mockup. The low cost of many software programs is making this a viable option for the average homebuilder, which will definitely be to our advantage in designing higher performance aircraft.

Andy

NOVEMBER 18, 1995 PROGRAM

Our speaker next month with by Chuck Rhodes, an avid rigid wing hang glider enthusiast from Camp Pendleton, CA. He will be bringing down several examples of rigid wings and give us an overview of the evolution of rigid wing hang gliders over the years.

This should be a good hands on type of meeting where you can look at and touch actual hardware to see how it really works and is constructed. Sometimes this is much better than just looking at drawings and pictures which only give you a two dimensional perspective.

Make sure to mark your calendar right now for the meeting date so you won't plan something else when you would really rather be at the TWITT gathering of eagles.

MINUTES OF THE SEPTEMBER 16, 1995 MEETING

Andy opened by welcoming everyone to the September meeting and outlining the day's program. After some of the usual housekeeping items, he thanked Chris and Connie Tuffli for the wonderful spread of sandwiches and condiments. He also thank Chris for the contribution of several Aviation Week & Space Technology magazines that contained some tailless aircraft articles. The raffle prize for the day was to be a set of heavy duty automotive jack stands.

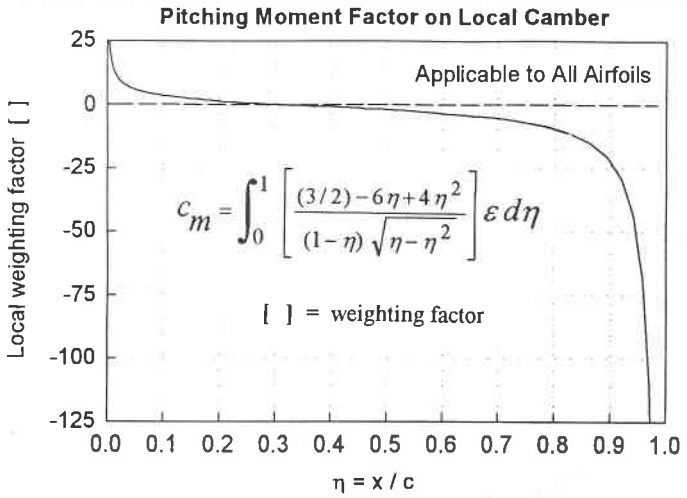
Andy asked everyone to introduce themselves since we had some new faces, along with some of aviation renown, among them Bruce Carmichael, Howie Burr, and Rod Schapel (the designer of his own design flying wing). Larry Nickolson got the award for coming the furthest to attend a meeting having flown in from Ohio. We also had a full compliment of TWITT officers on hand this month, which is unusual, but fortunately no one had any business to conduct so the meeting continued.

The floor was turned over to **Bruce Carmichael** who would explain a little about his new book that is hot off the presses. Titled Personal Aircraft Drag Reduction, it covers the history of laminar flow drag reduction in an attempt to make large gains in performance by greatly reducing the friction drag of the airplane. It covers 13 outstanding aircraft that take advantage of these techniques, talks about drag and performance concepts, natural laminar flow wing data, and suction stabilized laminar flow. It is 207 pages, with 195 illustrations, and 239 references, and sells for $25 postage paid directly from Bruce. *(ed. - We will carry an ad for this book in our classified section if your forget to order it after reading these minutes.)*

The next part of the program was a short section of video showing the flight operations at Harris Hill during the International Vintage Sailplane Regatta held this summer. Doug Fronius narrated the video, explaining what types of vintage aircraft were flashing across the screen. He took his own vintage LK-10 from California to New York for this once in a lifetime opportunity to see, and in Doug's case, fly some of the world's historic sailplanes.

Budd Love was then introduced to tell us about his latest project that he says will really get off the ground because he is actually building it. He has purchased a Lancair 320 kit which was recently delivered to his garage. He is moving along with some of the initial parts preparation, after spending a couple of weeks unpacking the crate and taking a complete inventory of the thousands of parts. One of the things that inspired him to press on with this project was the book Modern Aircraft Design by Martin Hollman which had an article on Finite Element Analysis that was used to design the Lancair. Part of the credit for the article was given to a friend of Budd's and ours, Bruce Carmichael. Bruce asked Budd if the Lancair was this generation's Stutz Bearcat, which gave everyone a good chuckle.

Budd went on to explain a little about the trials and tribulations of building an airplane, including trying not to make mistakes while drilling holes in expensive material that may have to be replaced. He is trying to spend about 40 hours a week on the project but is finding that it is difficult to keep a regular schedule to get the aircraft done within a year, a very ambitious goal.

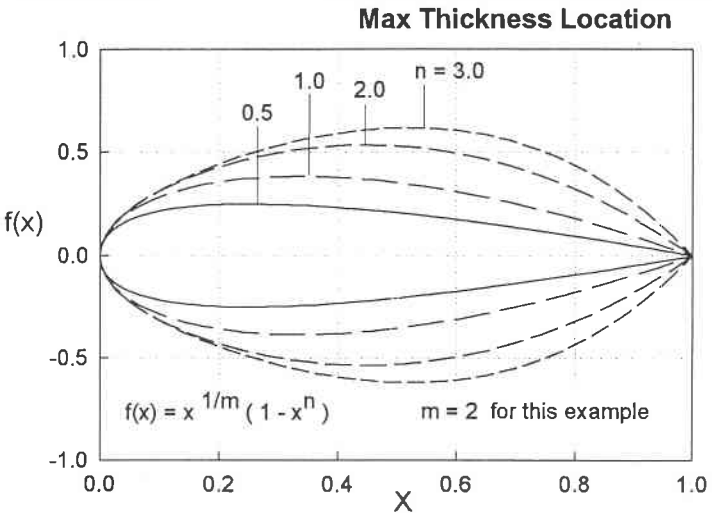


ABOVE: Trapezoidal integration graph on airfoil pitching moment showing the affect of positive camber at the leading edge as discussed by Phil on page 3.

Andy then introduce **Phil Barnes**, our featured speaker for the day. Phil had produced a 35 page handout that TWITT purchased from him and were available to the membership for $5 a piece. You will see some of the illustrations from the booklet as you read through these minutes. Andy also mentioned that these could be ordered through the mail along with a copy of the audio tape for those members who would like to hear the real thing versus the condensed version in the newsletter. This combination should cost $9 postage paid in the U.S., with the tapes only priced at $4.

(ed. - Through the courtesy of Bill Otto we also have a full video tape of the meeting with Phil's slides on the screen as he describes the basis for his program. The tape only can be ordered for $5 or the tape and booklet for $10 postage paid in the U.S.)

(ed. - The following presentation represents the highlights from Phil's program. Due to its technical nature and the fact that he was relating to charts on the screen for almost the entire time, it would be difficult to adequately describe the total picture at any point in time. For those of you really interested in designing aircraft or who simply like playing with CAD programs to see what you can get, the above tapes and booklet would be a good investment, especially the video combination. The minutes don't really cover all the detailed information concerning his formula developments or and some of the technical material brought out by questions from the audience.)



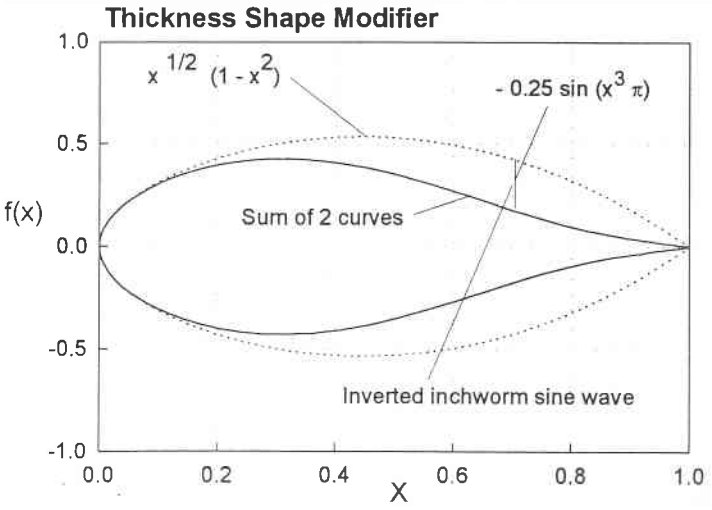
ABOVE: Varinomials for airfoil thickness showing how the arbitrary factor (n) used within an equation moves the thickness point fore and aft on the airfoil.

Phil opened his presentation on the Mathematical Characterization and Visualization of Aircraft Geometry by giving us a brief overview of all the material he would be covering in the next hour or so. He then went into explaining that this computer program uses the standard Q-Basic language available in most MS-DOS personal computers. He also mentioned he hoped to have an affordable version of the program available on disk in the future.

Why math characterize? The reasons given by Phil include:

- ▸ Automate the drafting process - quickly make changes and assess results.
- ▸ Integrate the geometry with aerodynamic and structural analysis software.
- ▸ Implement numerically-controlled machining of wing and fuselage molds.
- ▸ Ensure a smooth airflow path - promote laminar flow.
- ▸ Express your imagination in three dimensions.

BELOW: Graph showing how the inverted sine wave helps to modify the thickness resulting in the beginings of an airfoil shape.



Phil got into the meat of the subject by going over some basic aerodynamics of sections to include section lift coefficients, section moment coefficients, and the numerical integration of camber lines. He felt this was necessary to establish a base line for everyone and layout some definitions and how he used them in designing the formulas for the computer program.

One of the first graphs plotted the lift and drag coefficients for four airfoils, the FX-M2, FX-62, GOE 795 and Clark Y-5.9, which it turns out all have the same maximum L/D of 58 at Reynolds numbers of 150,000. It also points out that increasing camber generates higher lift, forward camber shows the highest lift, and minimum drag varies with thickness. The data was gathered by Dieter Althaus and the airfoils are those used for model aircraft.

Phil spent a little time discussing the area of pitching moment on low reynolds number airfoils and how it is impacted by a camber. Through the integration of several formulas on pitching moments and camber, Phil found that airfoils with positive camber at the front of the airfoil can create positive pitching moments. He felt this could be used to design an airfoil with the proper camber that would minimize the affects of pitching moment.

The next area covered was an analysis of

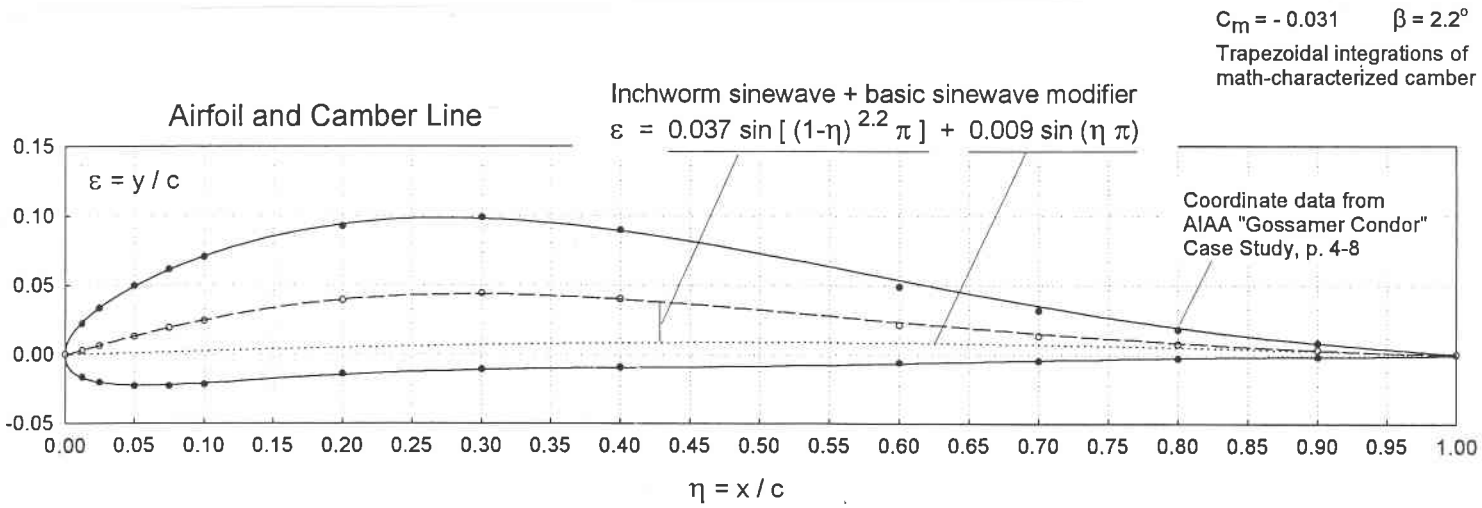
bird flight, especially large soaring birds. Phil felt that in high speed flight, if the these large span birds maintained the camber their wings show at rest, it would cause the distribution of nose down pitching from the shoulder to the tip will try to cause the wing to twist down which is undesirable. He theorizes that the bird really adjusts its trailing edge feathers up to a zero level of camber to reduce the penalty of nose down pitching moments.

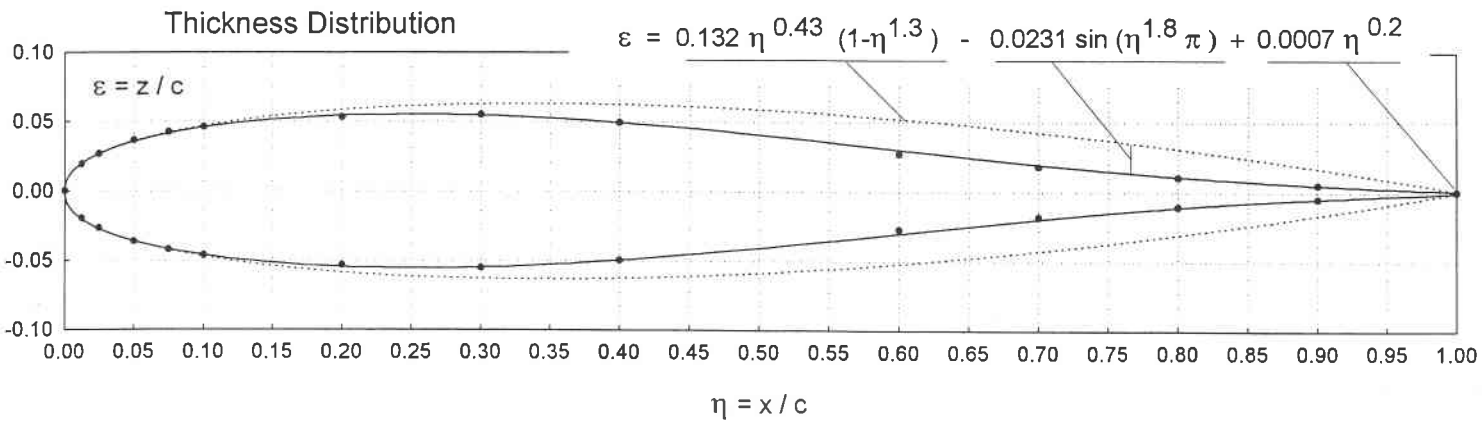
Below: Approximate math model of Lissaman airfoil. The dots represent the actual plotted coordinates while the line represents the mathmatical equivilent.

▸ Historically, math characterization uses a square root function for leading edge radius and other polynomial terms for camber and thickness. Often, two-piece characterizations were used forward and aft of maximum thickness or camber.

▸ The new methods presented in this presentation offer a high degree of control of leading edge radius, camber and afterbody shape, while maintaining continuous derivatives from front to back.

The next section of the talk got into the mathematics rationale for the computer program during which Phil used multiple graphs and charts to show the various components of the





Phil then went over the historical points surrounding his method of designing airfoils. These included:

▸ Math characterized airfoil camber used by the Horten brothers.

▸ Some NACA airfoils characterized with 4th-order polynomials.

▸ 2D and 3D math characterizations for camber and thickness documented by Dr. Ferdinand Gale' in his book Tailless Tale.

equations and how they interact to produce an airfoil or even a fuselage. His established ground rules for math characterization are:

▸ Minimize complexity.

▸ Accommodate airfoils of any scale.

▸ Accommodate full range of classical and contemporary airfoil shapes.

▸ Ensure continuous 1st and 2nd derivatives from front to back.

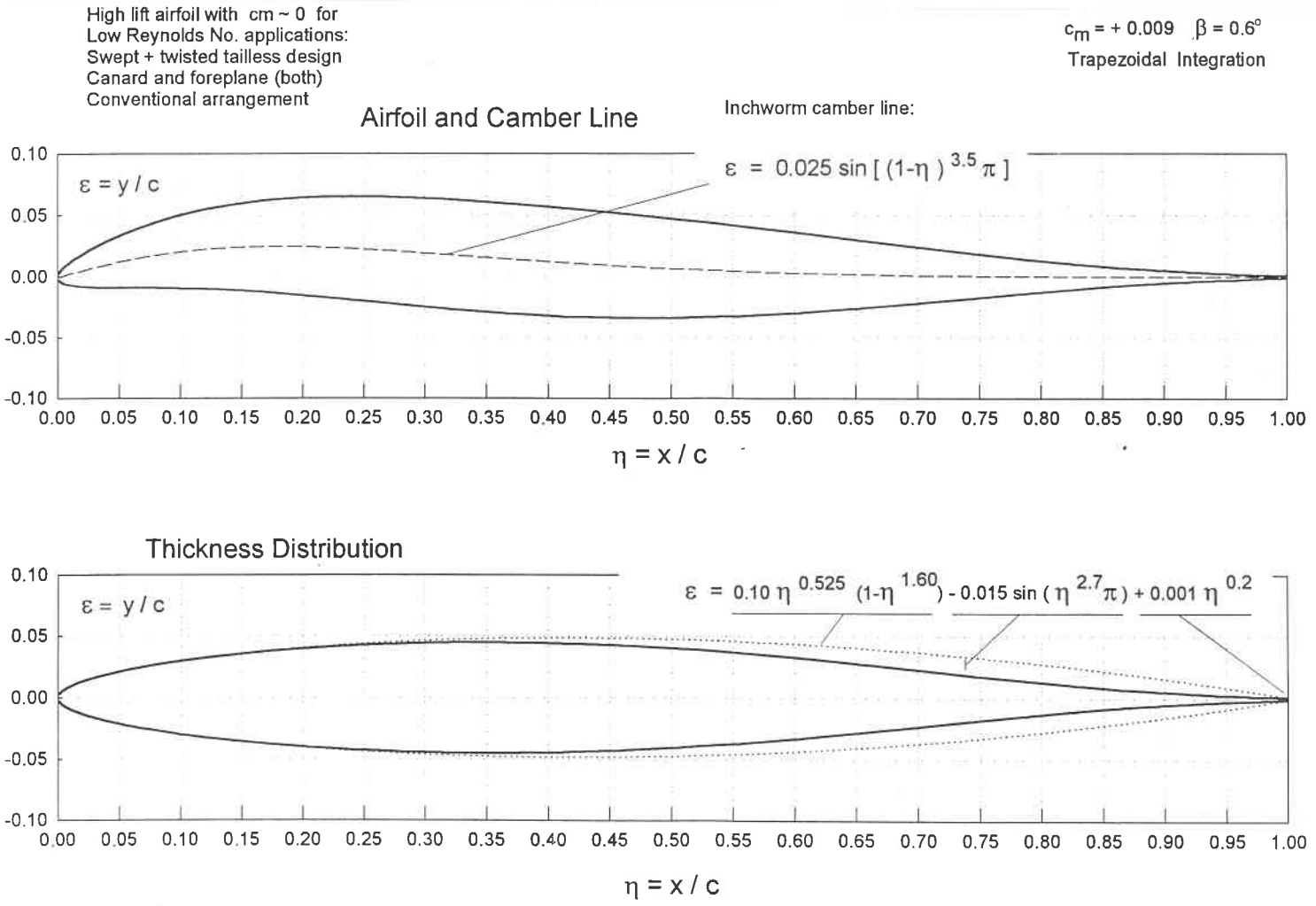
▸ Provide independent control of -
Maximum camber, max camber location, camber distribution, and reflex.
Leading edge radius.
Maximum thickness, location of max thickness.
Trailing edge thickness.
Trailing edge cusp effect.
▸ Numerically integrate camber from front to back.
▸ Use "local camber weighting factor" derived from Abbott & Doenhoff.
▸ Integrate from x/c=0.0001 to x/c=0.9999.

As part of the mathematics descriptions Phil warned that if you work with this stuff, make sure you don't ever have the computer try to find the square root of zero or square infinity. He also mentioned he doesn't yet have the words that go with this program down on paper yet since he has been spending all of his time documenting the methods.

He then covered a number of charts showing the various components of the equations a what each does for the design function. They are:

▸ Modified half sine waves - airfoil camber and, fuselage & wing shape modifiers.
▸ Skewed and reflexed half sine waves - airfoil camber lines, and fuselage camber.
▸ "Varabola" (his new term) curves, inverted and curved - airfoil camber lines, and plateau-shaped functions.
▸ Varinonials for airfoil thickness - multiply the resultant function by an arbitrary factor which obtains the desired maximum thickness.

After this detailed section, Phil moved on to showing actual airfoil plots using math characterization techniques. These were done to demonstrate the power of the program to adjust the plots to come up with any variation of airfoil. Each airfoil contains two components, one that produces the airfoil and camber lines, and another that plots the thickness distribution which is integrated into the first equation to produce the actual airfoil coordinate plots. The airfoils he duplicated included the:



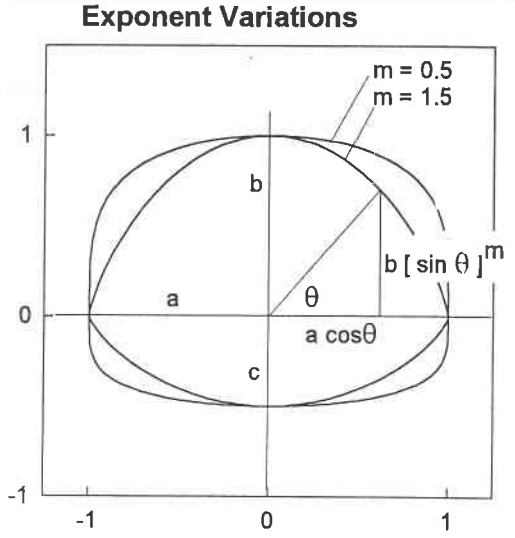
ABOVE: Math characterization of PMC-I9A airfoil. Phil has made a small model test section of this airfoil that will be wind tunnel tested later this year.

- Fauvel F2
- Eppler E-211
- PMC-I15 *
- Wortmann FX05-H126
- Wortmann FX 62-K-131-17
- Roncz 1046
- Lissaman
- PMC-I9A *
- NLF(1)-0414F

* - PMC = Phil's Math Characterization

At this point he deviated from airfoil design for a while to show how math characterization can be used to design very nicely shaped fuselages and extract the data necessary for canopy areas. This then led into taking the data produced through math characterization and importing it into other types of commercial software that allows for 2 and 3 dimensional presentations of the design. The line drawings shown below are the results of having the coordinates programmed in QBASIC and importing it into SIGMAPLOT for Windows for graphing. The top one is a side view of the Horten style flying wing, and the bottom one is a trimetric view.

Another program that Phil has used is DESIGN CAD 3D, which produced the wire frame view seen below. From this data the wire lines can be optionally removed to show just the top surface or the figure rotated to view the bottom, with or without lines. The software will also take all of this information and create the type of shaded perspective printouts like that seen on the September 1995 newsletter cover.



ABOVE: "Vellipse" variations which can be used for fuselage design.

The software Phil has been using are available directly from the manufacturer or you may be able to find them at some specialty retail shops in your area. If you are interested in talking with the companies they are:

SIGMAPLOT by Jandel Scientific
Programming and graphing for Windows
Cost: Up to $500 but discount may be available (see note below)
1-800-874-1888

(Note: Phil has a coupon that may be usable for obtaining the software at a discount, but it will probably involve doing a group buy verses buying it individually. If you are interested, please let Phil know as soon as possible so he can get an idea of the demand.)

DESIGN CAD 2D and DESIGN CAD 3D by
American Small Business Computers
Hidden line removal and rendering
DOS or Windows
Cost: From $100 to $300
1-800-825-4844

Pelican Aero Group (affordable software in development) Phil Barnes' commercial venture.

QBASIC programs for 3D fuselage and wing visualization geometry (QBASIC is included with DOS and Windows).

SIGMAPLOT programs for rapid airfoil geometric and aero design.

DESIGN CAD 3D BASIC programs for automating 3D CAD geometry.

Performance calculation for model sailplanes - separate modules for conventional, tailless and canards.

Cost: Unknown at this time
1-310-833-8083 (toll call)

After we all thanked Phil for an excellent program, Andy conducted the raffle drawing which was won by Bernie Gross (he is the proud builder and pilot of the Deaf Hawk, a Marske Pioneer II flying wing). With that, the meeting was adjourned.

LETTERS TO THE EDITOR

9/8/95

TWITT:

Yesterday I sent you all the building plans that I have of the Horten 4a. They have been sent to the hanger - I hope someone will be there to receive them. Many of the drawings are in two or three parts that should be taped together. They are in order.

If you are thinking of building it, I strongly recommend going to Munich Oberschleissheim Airfield where the fourth of the four Ho 4's built is being restored for static exhibition only in the museum there. One of the two people working on it is Peter Hanickel, Deutsches Museum, Effuerstrasse 18, 85764 Oberschleissheim Germany. He writes and speaks perfect English.

The absolutely spin free and stall free safe flying characteristics of the Hortens depend on their "bell shaped lift distributions" over their wing span from tip to tip. The point of highest lift is the center. The two centers of pressure are at their most reflex in the

center, therefore the cockpit canopy mast blend into it. Reimar had a rule: Max thickness of the profile must not exceed 15% of chord. Therefore, for the Ho 4a it might be prudent to slightly increase the center section chord, but without upsetting the C of A position which is very critical.

The two inner elevons on each wing are driven by the out and back movement of a single tubular push rod. By pulling it towards the center of A/C, the middle elevon goes up further then the inner elevon. By moving the tube push rod outwards I think the middle elevon lowered more than the inner elevon. The outer elevon is driven by a separate tube push rod but both push rods are connect to the extremities of a plate which has two hand horns for the pilot to rotate around and move backwards and forwards along a tube running along the center line and aft of A/C. This is for elevator and aileron control. Therefore for every position of the plate the six control surfaces have different positions. The push rods run through roller bearing in some of the wing ribs.

The Uden drawings are new and not accurate. P. Hanickel has made new drawings for the center section.

Note: Uwe Schmidt and a team at Dernerstrasse 126, 59174 Kamen Germany are building a Ho 4a to fly.

All the best

Chris Wills
"Wings"
The Street
Eweline
Oxen OX106HQ England

(ed. - Chris included several sketches of the wing profiles and control system layout in the cockpit but they wouldn't reproduce very well since they were buried within the text material. For those of you interested in the restoration project, perhaps a letter to Peter Hanickel will yield more information on its progress. If you do get anything that would be of interest to the membership, please send it along so we can share it.)

9/15/95

TWITT:

My progress on my flying wing has been rapid. I have built almost all of the control systems hardware, cockpit, instrument panel, spars and ribs are all assembled, and the nosegear is all hooked up and working. The main gear is ready to bolt on when I put the skin on the bottom. I have started putting skin on the top already.

I intend to sell plans, complete with illustrations, photographs and, rib and spar stencils for $300 when it is finished. That should be no later than next spring. I shall call this wing the YV-49.

My YV-49 is designed to a strength in excess of ± 12 G's, it has two seats (side by side), uses a Lycoming O-320 engine, C-172 or C-182 nosegear and Ercoupe main landing gear. I have decided not to use retractable gear because it would cost an extra $6,000 in parts and would add less than 19 kts and probably less than 10 kts to the top speed - and less to the cruising speed. The Glassair makes one plane in the 230 mph range in either fixed or retractable gear and the difference is only 12 mph. If someone building a kit insists upon the Wagnarian ritual of raising and lowering the gear, we can work with Infinity Aerospace in El Cajon, CA. They can re-engineer the appropriate ribs to take one of their retractable gear systems. However, my mounts for the main gear have a strength of 9000 pounds each in case of a very hard landing.

Gilbert Davis has been helping me with this project and giving me advice. So too has a structures PhD. engineer, Dr. Jones from Emery Riddle, and Dr. Sears has been kind enough to advise me on this, since the wing is a scaled down YB-49 with only one flow fence on each side. Max Stanley and John Meyers told me how to test fly it and they have all assured me that with a CG forward of 26% MAC it will have well housebroken stall characteristics. (Both test pilots say they believe the N9M crash and the YB-49 crash involved a rearward CG much over 26%.) It should be cheap and simple to build... for an airplane.

On my prototype I am using Moon dragster pedals for rudder pedals. I certainly like this system better than the ugly, uncomfortable Cessna pedals, the latter of which will work just fine for anyone building from my plans.

I would be astonished if nobody in TWITT would consider building one of these pulchrotudeuous flying wings of a design that I trust the Maestro (Northrop) would approve.

Respectively yours,

Barney Vincelette

(ed. - Barney sent along a picture of the project showing the wing with top skins and the nose gear installed. He phoned me a week or so ago to say the bottom skins are going on soon and was the main gear.

As you can tell from his letter and we can see from the picture, he has put his hands where is mouth has been and is building his dream machine. It is based on Gilbert Davis' design which is patterned very near the Northrop YB-49 in terms of scale, airfoil profile, etc. It sounds like he has done his homework with people like Stanley and Meyers for when the flying actually begins.

Barney assured me he would be sending more pictures and keeping us informed of his progress. We will publish the current picture and others he sends as soon as we have enough to put together a sheet for doing half-tones.

He also sent along a copy of the August 7, 1995 Aviation Week & Space Technology article on the Airbus A3XX flying wing transport we showed last month. It seems everyone is running across this material, and I thank all of you who thought to send it along.

We wish Barney continued success is completing his project before the east coast (he live in Delaware) weather closes in and his epoxy won't be able to cure.)

8/8/95

TWITT:

I am writing to join TWITT. As a keen flying wing enthusiast, I would like to be part of your society and to keep up to date with the latest developments in flying wing technology.

I'm also very interested in the history and development of flying wings around the world, and also with flying wing models (both static scale and flying scale).

I've enclosed $22 to cover my first year of membership and look forward to receiving the newsletter in due course.

Perhaps you can also help with an inquiry. I am trying to obtain the following books:

Winged Wonders by E.T. Wooldridge
The Delta Wing by Dr. A. Lippisch

Could you put an advertisement in your "wants" section of the newsletter for me? Perhaps a TWITT member has copies that might be for sale or possibly provide photocopies?

Many thanks,

Nigel Parry-Jones
16 Stoke Meadows, Brook Way
Bradley Stoke
Bristol, AVON BS12 9BG ENGLAND

(ed. - First of all, I would like to welcome Nigel to TWITT and hope that he enjoys his membership. We now have several members in the UK, and are looking forward to finding more over there that are interested in flying wings.

Second, it appears that Bob has sent you some information concerning the two publications. However, it may hard for Nigel to obtain copies from US sources, so if there is anyone out there that could help him, I am sure he would be grateful. I am not sure about Lippisch's book, but I know that photocopying Wooldridge's is not an option since there are many historic photos that just wouldn't come out very well.

If you know of any flying wing activity, either full size or model going on in the UK, please drop us a note and pictures, if possible. As you will see in the newsletter, our membership has a variety of interests when it comes to flying wings.)

8/14/95

(ed. - In addition to the material Robert Marriott sent us last month on the problems he was having with airfoil design software, he also sent the following comments.)

If possible, please send me a copy of the airfoil design software that Phil Barnes will lecture you about at the next meeting. This software maybe proprietary (I don't know) or it may cost a squilion dollars which I don't have. So if its available and inexpensive, please send it with the rest of the stuff and bill/invoice me for it. If it is available but expensive, please don't send it, but inform me of the cost.

(Note: Prefer software on 3½" 1.44 mb disk, but 5¼" 1.2 mb is okay. ed. - I assume he is working in an MS-DOS environment.)

I have purchased the airfoil design/analysis software caller Airfoil-ii, over one year ago. I have had monumental problems getting the program to work properly, I sent a massive swad of printouts and explanations back to the vendor who, 7 months later, returned an updated version. This fixed some problems, but created others. I have returned yet another huge swad. This is frustrating.

You can see why I'm looking for other airfoil design software, yes??

Robert Marriott
P.O. Box 194
North Strathfield
Sydney 2137
AUSTRALIA

(ed. - Unfortunately, Phil does not currently have copies of his design program available for distribution. He has indicated it will be available in the future, but cannot give a specific date. Perhaps now that you have read the recap of his presentation you are not interested in what it does, however, if you are I suggest you correspond directly with Phil concerning getting an early copy when he gets it into publication. His address is:

Phil Barnes
982 W. 11th Street, #5
San Pedro, CA 90731

Jim Martyn just sent me an E-Mail also asking about the availablility of Phil's program. Jim, perhaps you might want to hear or look at the material Phil currently has produced, then make a decision about contacting him. -

It would be interesting to see how many of our members have tried the Airfoil-ii package and experienced the degree of difficulties you are facing. Note: We received an update from Robert right at publishing time that we will include in next month's issue.

I hope we get everything worked out, and that someone has contacted you with some answers to your questions from last month. Please stay in touch and let us know how you are progressing with the various pieces of software and what types of interesting airfoils you come across that might work well in the flying wing arena.)

WHAT'S UP IN TAILLESS TECHNOLOGY?

Chris Tuffli has given us copies of articles from Aviation Week & Space Technology magazines that cover a number of different applications of tailless technology in future aircraft or aerospace vehicles. These are:

August 18, 1995 - "DC-X Holds Promise; Big Questions Remain," by Michael A. Dornheim talks about the McDonnell Douglas/NASA project for a space reentry vehicle. Pictures show a triangular shaped craft lifting off vertically, transitioning to near horizontal flight and

then transitioning back into the vertical for a power assisted landing on the original launch pad.

July 31, 1995 - "New UAV Force Forms at Nellis," by David A. Fulghum provides some basic information about the Tier 2 Predator UAV and where it may be stationed when it becomes operational.

August 7, 1995 - "Flying Wing Under Study," by Pierre Sparaco covers Aerospatiale's 500 seat Airbus A3XX large flying wing transport.

August 21, 1995 - "News Breaks" showing a picture of the Pathfinder solar-powered aircraft entering the second phase of testing in preparation for its high altitude reconnaissance mission.

September 4, 1995 - "NASA/Langley Tests Waverider Design" briefly shows the .062 scale waverider wind tunnel model in the NASA/Langley low speed wind tunnel. This aircraft is designed to "ride" on its own shock wave, but the tests verified that the design's basic configuration is "aerodynamically sound" within the low speed regime.

LIBRARY ADDITION

Alex Kozloff has contributed a copy of Australian Gliding, August 1991, published by The Gliding Federation of Australia, which has an article on pages 8-9 titled "Horten Wing is Flying in Australia," by Ray Ash. The article contains the following information:

"A 15m span Horten-designed flying wing sailplane has been flying in the Sydney area for nearly a year. With an empty weight of only 50kg, it has been built and operated as a hang glider and to date has made nearly 100 flights.

"Sometime ago, I (Ash) heard rumors that a 'Horten flying wing' was being test flown by Bill Moyes, who will be recognized by most people as the great pioneer of hang gliding, not only in Australia, but around the world.

"The wing is in two pieces and is made of composite materials, i.e. glass and carbon fibers, foam and aluminum. The main spar is of I-section, curved from about a meter or so out from the root so that the two halves meet one another at the center.

"The wings are joined by simple metal straps and two horizontal pins about 20mm diameter.

"The torsion box leading edge is a foam/glass sandwich and the trailing edge is only a wire cable.

"The wing is covered with a sewn sleeve made of Dacron sailcloth, similar to that used on ultralights.

"Control is by a single stick, operating elevons near the wingtips for both lateral and longitudinal control. No spoilers or vertical rudders are fitted.

"The aircraft if apparently very stable in flight and Bill Moyes estimates the L/D at about 30.

"With this gliding angle, foot launching and landing has proved difficult so most of the flying has been from water, with launches behind a ski-boat, using a surf board for flotation.

"The glider has some controllability problems, the adverse yaw in a turn being so bad as to limit the turns to about 150m diameter.

"Bill aims to improve the controllability by the addition of either spoilers or wing-tip rudders, and then progress to land-launched flights and hopefully some soaring."

(ed. - Although this was in 1991, perhaps one of our Australian members could contact Bill Moyes and find out if the aircraft still exists and whether or not the improvements were made and further tests conducted. Bill Moyes was at the 1994 SHA Western Workshop with several of his other ultralight designs, but unfortunately we didn't know that he had this type of involvement in flying wings.

It is interesting that Bill took the Horten design and built it in composites. Apparently the plans had been made available to two German modelers by Dr. Horten, and Bill was able to obtain them from the Germans.)

AVAILABLE PLANS & REFERENCE MATERIAL

Tailless Aircraft Bibliography

by Serge Krauss

4th Edition: An extensive collection of about 2600 tailless and over 750 related-interest listings. Over 15 pages of tailless design dates, listing works of over 250 creators of tailless aircraft, and the location of thousands of works and technical drawings for the Ho 229 (IX), Me 163, & Me 262.

Cost: $23 (Domestic)
$32 (European destinations)
$35 (Asia/Australia destinations)

Order from: Serge Krauss
3114 Edgehill Road
Cleveland Hts., OH 44118

Tailless Tale, by Dr. Ing. Ferdinando Gale'

Consists of 268 pages filled with line drawings, tables and a corresponding English text. It is directed towards modelers, but contains information suitable for amateur full size builders. Price is $38, postage and handling included (also applies to Canada and