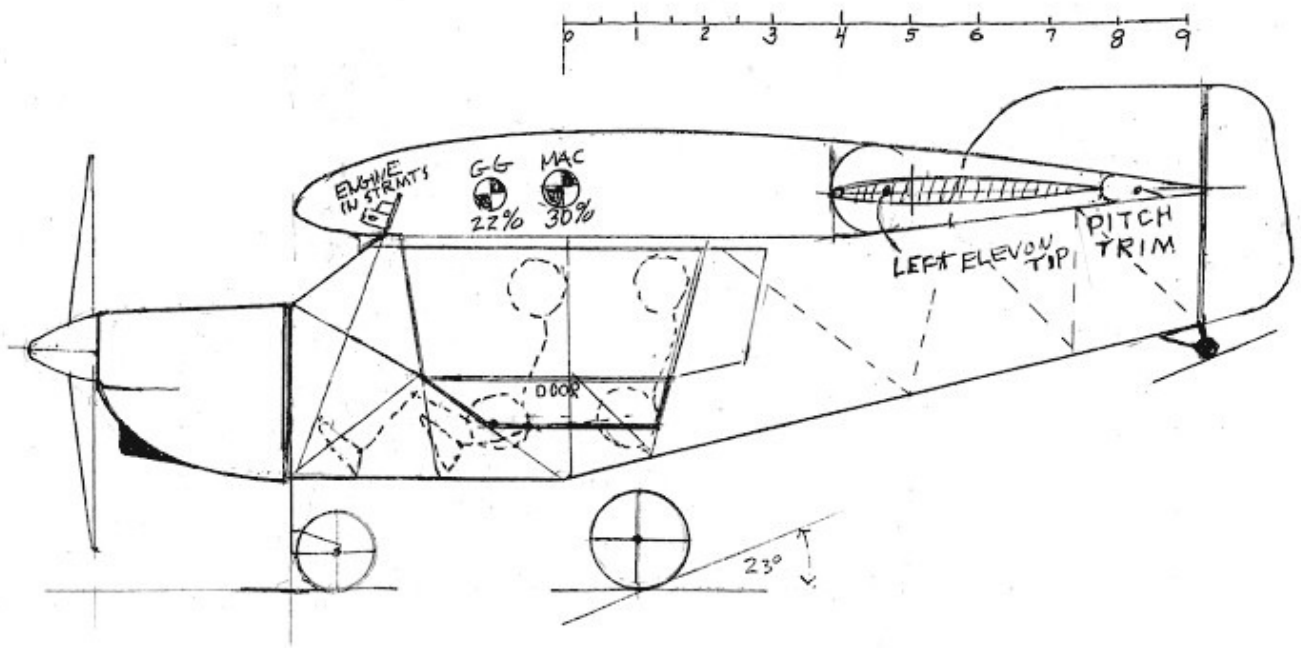
No. 336 JUNE 2014

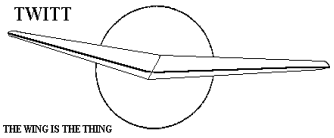
T.W.I.T.T. NEWSLETTER



Loyd Lara MK 12A (See page 5 for more on this concept.)

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., **1406** means this is your last issue unless renewed.



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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Meetings are held on the third Saturday of every other month (beginning with January), at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

It is hard to believe that we are already into June and I don't feel like I have accomplished any of the things I should be doing this year. I did manage to get the first four flights in my 1-26 in May for a total of 4 hours so far. It flies really nice so I just need to learn how to take advantage of its capabilities as I fly it more.

This month we have the continuing comments by John Gibson and Gavin Slater. As I note in the intro to these two view points, we would certainly like to hear from anyone else that agrees or disagrees with either of them or has a completely new direction this discussion should have. So please get your fingers working on that keyboard and let us hear from you.

The other thing I can always use are new or unusual photos to use on the cover of each issue. I generally do a Google search and scan through the various images trying to find something that won't be a copyright issue, but it is getting harder and harder to find these. This month I am using one part of Jim Loyd's 3-views he included in his package. So if you run across something good please send me the link or the image and I will see if I can legally reproduce it. Thanks for your help.

Andy

LETTERS TO THE EDITOR

(ed. – The following additional comments came in from John Gibson in response to Gavin Slater's comments to an earlier article by John. Since there was time Gavin has also provided further clarification of his position on this subject. If anyone else has an opinion on this topic we would be pleased if you would contribute to the discussion.)

Circulation and Glauert's book

My reply to Gavin Slater's March 2014 article was written without access to Glauert's renowned 1926 book, but I now have a copy. It was easy to confirm it is devoted to the circulation theory of lift. Far from supporting the notion of a wing pushing air down to produce lift, the notoriously incorrect Newton "sin squared alpha" momentum equation of lift on a flat plate at small angles is given on page 5, but is dismissed with a comment that the result is "too small". It certainly was. Langley's 1890s measurements found 20 times more lift at 5 degrees angle of attack than this theory claimed. No wonder that fixed wing powered flight ideas were ridiculed by serious scientists for most of the 19th century. Newton was later blamed for this, but unfairly because he did not write the equation, although it was correctly based on a faulty hypothesis of his. Until about the 1930s aerofoil design relied almost exclusively on the Joukowski conformal transformation from circles coupled with circulation theory as described in the book. Circulation remained the main basis of aerodynamic theory until the 1940s, when transonic and supersonic theories drew the main attention, but it is now greatly advanced and is still in use for low speed aerodynamics today.

Gavin has misunderstood his Figure 1 (Figure 53 in Chapter 7 on page 81). This is not a calculation of the lift on a wing but the start of proof of the Kutta-Joukowski lift theorem on page 85, "lift equals speed x density x circulation strength" still taught today. Its truth is taken for granted and circulation theory is applied directly to the surface flow conditions to calculate the velocities and pressures, and hence the lift, via the Bernoulli Theorem from the 1750s. It looks to me as if Glauert was simply expounding Joukowski's development of the lift theorem which was published in 1906, four years before the Joukowski aerofoil design theory was published in 1910. Chapter 7 continues on to the more advanced thin aerofoil theory used later when it could be solved more easily, but it is still based on circulation.

Figures 1 to 5 illustrate the power of circulation to create lift. Figures 1 and 2 are from Glauert Chapter

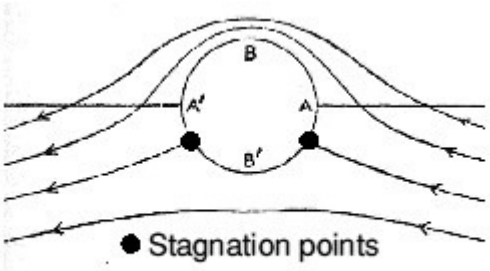


Figure 1 - Moderate circulation

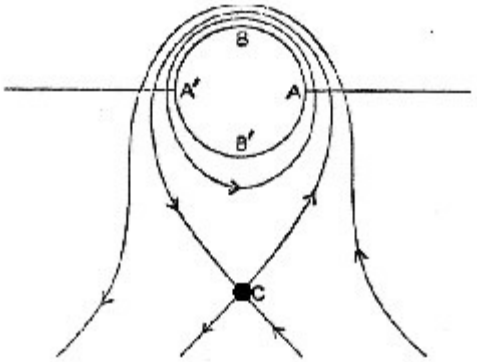


Figure 2 Very strong circulation

4, but similar figures are available from many sources. They show the Magnus effect where flow is inviscid with no viscous friction and no boundary layer to separate, and so are symmetric fore and aft. With the free airstream flowing from right to left, a vortex is assume around the cylinder in the anti-clockwise direction which in reality would be caused by rotation of the cylinder. In Figure 1 there would be separation on the left-hand side. In Figure 2 there would not because the surface velocity is more than four times faster than the free stream flow and the boundary layer does not slow to a stop anywhere around the cylinder, the critical factor in causing separation. Also the two stagnation points have moved together and lifted off the surface, the air between it and the cylinder continuing to circulate anti-clockwise. Note the vertical flow to and from the cylinder lying across the free stream flow. If this seems unlikely, Figure 3 shows this condition approached with a surface velocity of about three times the free stream (here going left to right), not quite enough to prevent separation on the right side, but it has been photographed achieving it with a faster circulation. The lift in this condition is about seven times greater than is possible with a

simple unflapped aerofoil with a chord equal to the cylinder diameter. (Look up the Flettner Rotorship too.) Figure 4 and 5 show an aerofoil with a highly deflected flap, first at a moderate AoA with total separation and high drag behind the flap though with substantial lift indicated by the streamlines, and then at zero AoA with compressed air blowing on to the flap leading edge with no separation and with huge lift indicated by the streamlines. Remember that the only force on the wing itself results solely from the pressures on its surface.

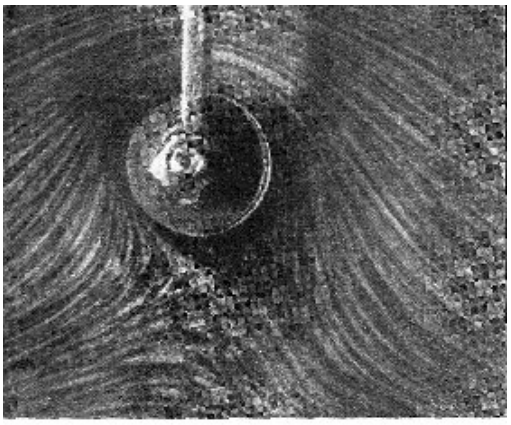


Figure 3 High circulation

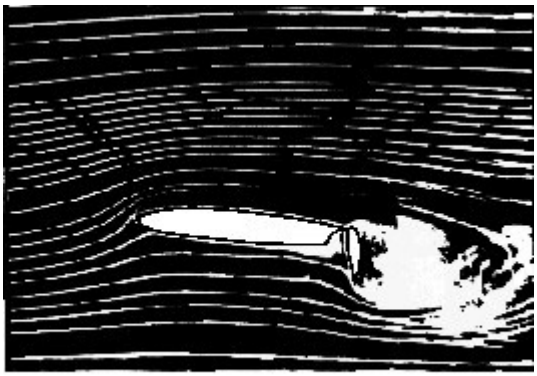


Figure 4 No flap blowing

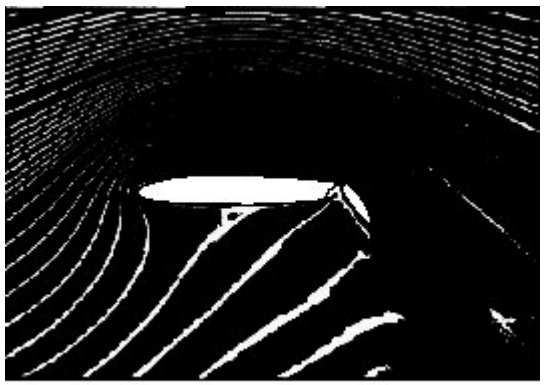


Figure 5 With flap blowing

John Gibson, 21st April 2014

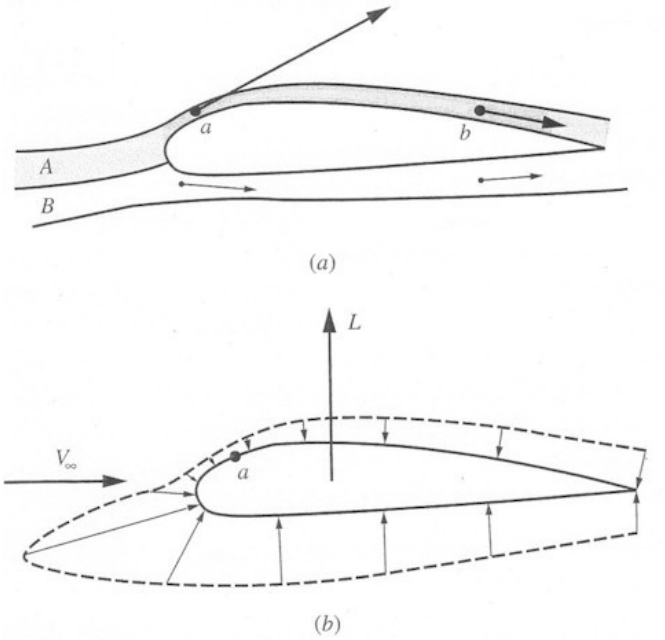
Momentum

I was unfamiliar with the books by Prof. John Anderson until John Gibson made reference to his A History of Aerodynamics. Prof. Anderson has written many books on aerodynamics and related subjects. He is Curator for Aerodynamics at the Smithsonian and Professor Emeritus, University of Maryland and a Fellow of the Royal Aeronautical Society.

One of Prof. Anderson's texts is Introduction to Flight. It includes technical and historical material. The later editions include a section titled; *How Lift Is Produced--Some Alternative Explanations*. The section runs to several pages. Below are some quotes.

> "It is amazing that today, over 100 years after the first flight of the *Wright Flyer,* groups of engineers, scientist, pilots, and others can gather together and have a spirited debate on how an airplane wing generates lift. . . . . However, because the literature is replete with various different (and sometimes outright incorrect) explanations of how lift is produced, you need to be aware of some of the alternative thinking.
>
> "First let us consider what this author advocates as the most fundamental explanation of lift. It is clear from our discussion in [an earlier section] that the two hands of nature that reach out and grab hold of a body moving through a fluid (liquid or gas) are the pressure and shear stress distributions exerted all over the exposed surface of the body. The resultant aerodynamic force on the body is the net, integrated effect of the pressure and shear stress distributions on the surface. Because the lift is the component of this resultant force perpendicular to the relative wind and because the pressure on the surface of an airfoil at reasonable angles of attack acts mainly in the lift direction whereas the shear stress acts mainly in the drag direction, we are comfortable in saying that for lift the effect of shear stress is secondary and that lift is mainly due to the imbalance of the pressure distributions over the top and bottom surfaces of the airfoil."
>
> [Note: Several paragraphs are devoted to discussing flow over a wing depicted in Figure

5.74 as well as other topics. We continue with:]



Note: The length of the arrows denoting pressure is proportional to $p - p_{ref}$, where p_{ref} is an arbitrary reference pressure slightly less than the minimum pressure on the airfoil.

Figure 5.74 (*a*) Flow velocity on the upper surface is on the average higher than that on the bottom surface due to squashing of streamline A compared to streamline B. (*b*) As a result, the pressure on the top surface is lower than the pressure on the bottom surface, creating lift in the upward direction.

"There are several *alternative* explanations of the generation of lift that are in reality not *the fundamental explanation* but rather are more of an *effect* of lift being produced, not the *cause.* Let us examine these alternative explanations.

"The following alternative explanation is sometimes given: The wing deflects the airflow so that the mean velocity vector behind the wing is canted slightly downward, as sketched in Fig. 5.77. Hence the wing imparts a downward component of momentum to the air; that is, the wing exerts a force on the air, pushing the flow downward. From Newton's third law, the equal and opposite reaction produces a lift. However, this explanation really involves the *effect* of lift, not the cause. In reality, the air pressure on the surface is pushing on the surface, creating lift in the upward direction. As a result of the equal-and-opposite principle, the airfoil surface pushes on the air, imparting a downward force on the airflow, which deflects the velocity downward. Hence the net rate of change of downward momentum created in the airflow because of the presence of the wing can be thought of as

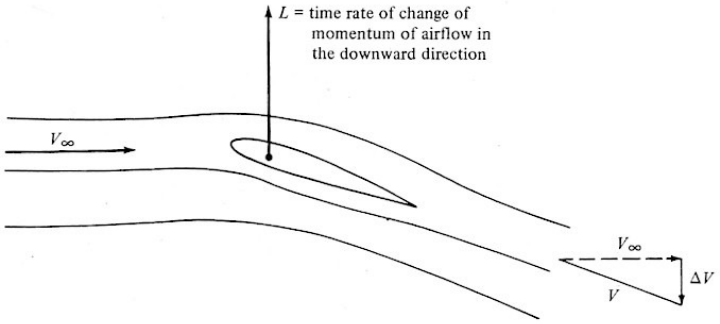


Figure 5.77 Relationship of lift to the time rate of change of momentum of the airflow.

an *effect* due to the surface pressure distribution; the pressure distribution by itself is the fundamental cause of lift.

"A third argument, called the *circulation theory of lift,* is sometimes given for the source of lift. However this turns out to be not so much an *explanation* of lift per se, but rather more of a mathematical formulation for the calculation of lift for an airfoil of given shape."

[Note: A short discussion of circulation theory follows but is not covered here.]

"Again, keep in mind that the actual mechanism that nature has of communicating a lift to the airfoil is the pressure distribution over the surface of the airfoil as sketched in Figure 5.74*b*. In turn, this pressure distribution ultimately causes a time rate of change of momentum of the airflow, as shown in Fig. 5.77 – a principle that can be used as an alternative way of visualizing the generation of lift. Finally, even the circulation theory of lift stems from the pressure distribution over the surface of the airfoil because the derivation of the Kutta-Joukowsky theorem [the lift equation is cited] involves the surface pressure distribution. Again, for more details, consult Anderson, *Fundamentals of Aerodynamics,* 4th ed., McGraw-Hill, 2007."

I think that the clear statement of Prof. Anderson regarding Newton's law of action and reaction and the downward force on the airflow is counter to the view expressed by John in his original article.

Finally, John in his response to my article seemed to imply that I stated that circulation does not exist. If this is true can he indicate where I said this.

Reference: Introduction to Flight, John D. Anderson, Jr., 6th ed., 2008

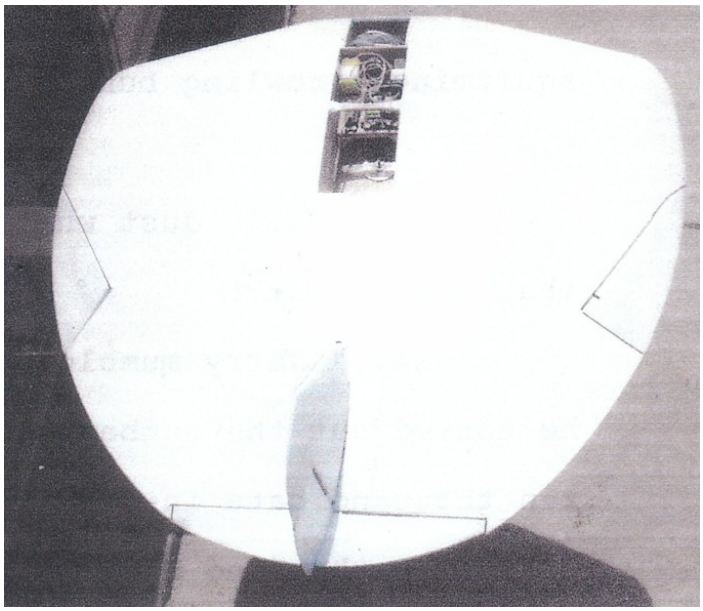
(ed. – The following is only part of the material Jim Loyd sent me back in February for publication. I set it aside at the time and sort of forgot about it until recently, so my apologies to Jim for the oversight. He commented about serializing it, which is what I plan to do over the next several newsletters.)

Hi Andy, I am heeding your call for more TWITT info. This is a collection of info and photos of my Low Aspect Ratio Airplane. I have put numbers in the upper left corner of the back of the enclosed photos and drawings that may help you relate them to my description. You can modify and/or omit this in any way you need for the newsletter. You might consider serializing it and including some history of the ARUPs, Vought Chance's Flying Flapjack, and Milt Hatfield's "Little birds".

Page 1 shows several photos of my early designs. The model in the two top photos are slicked up versions of the original ARUPs. A bunch of test runs on my 'poor man's wind tunnel' showed serious roll and pitch problems. More modifications and tests

Top Photo No. 1.

resulted in a tail and replacement of the ARUP ailerons, after 6 different sizes and shapes didn't work, with Vought Chance's "Flying Flapjack" (FF) naval Fighter's winglet elevons. I also copied and modified the FF's wing shape. The photo in the right bottom corner of this page shows the strips of embroider thread I taped to the model to see the motions of the airstream around the model. The photo next to it shows the Test RIG attached to the front of my Van. This rig and system is probably the smartest most effective, efficient and cheapest approach available to us amateur airplane designers.



Top Photo No. 2.

Text between the landing gear states, “entry over wing or trap door on passenger side”. The other image is John’s 6’ neighbor compared to the full sized aircraft.

The middle photos above show an early version of the "cockpit in wing" configuration. By this time I had tested 6 models, 3 as free flying RC models. I then made "Construction" models out of 1/8" wooden dowels. I held the dowels together with Hot Glue that was easy to apply and remove and slightly flexible which helped to test rigidness of structures. The photos show the full size mockup of the "cockpit in wing" configuration. I soon abandoned foam and fiberglass construction as too difficult to measure the

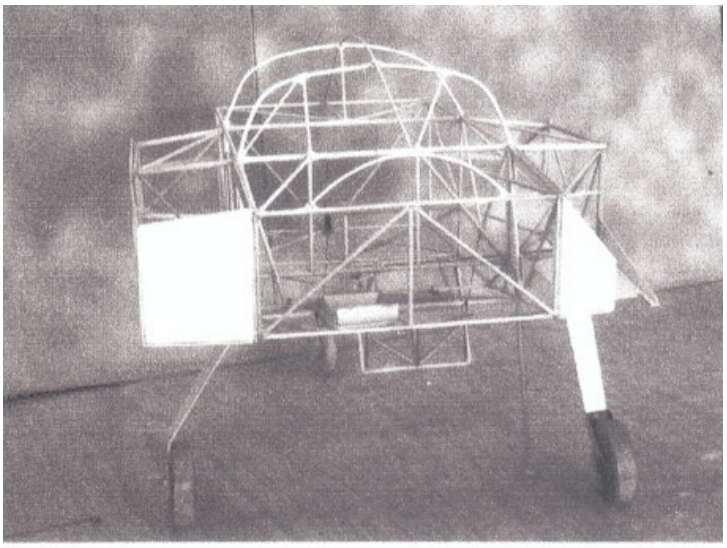
strength of a part short of destroying it. Steel tubing is easy to test and creates lots of openings to position cables, rods, etc. I discovered the warped pancake shape of the wing severely limited my view of the ground. At my advanced age and type of flying, I want to see as much Terra Firma as possible. I couldn't figure out a satisfactory way to get in or out of the cockpit.

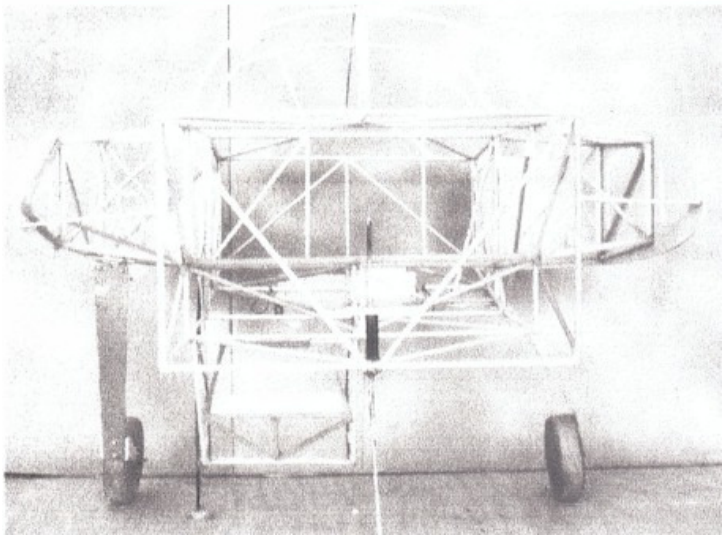
The photo below is an early test rig. Later we added a lead shot loaded canister on the tube between the swivel point so we could test the model at different weights. I was primarily testing the speeds and angles of attack that the flight controls started to function. We operated as a team of three. One of us drove the van and controlled speeds. One of us "flew" the model. And one of us filmed the motions of the model, controls and threads. We used about 1-3 miles of rural roads for our tests runs, rain or shine, winter or summer. We discussed each run and entered the remarks in a logbook. On a good day we could have 20 plus runs on film in an afternoon to take back to watch on TV. And we didn't break the Model !!!!!!

Poor Man's Wing Tunnel Test Rig

Tuft Testing

The photos below shows some solutions that looked OK on the stick models but didn't work when I tried to stuff my skinny body through them. Also they forced me to raise the ship too high off the ground. My final solution was to climb up over the leading edge of the wing with engine OFF !!!!!





More on this next month.

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

Books by Bruce Carmichael:
Personal Aircraft Drag Reduction: $30 pp + $17 postage outside USA: Low drag R&D history, laminar aircraft design, 300 mph on 100 hp.
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Bruce Carmichael brucehcarmichael@aol.com
34795 Camino Capistrano
Capistrano Beach, CA 92624 (949) 496-5191

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

FLYING WING SALES

BLUEPRINTS – Available for the Mitchell Wing Model U-2 Superwing Experimental motor glider and the B-10 Ultralight motor glider. These two aircraft were designed by Don Mitchell and are considered by many to be the finest flying wing airplanes available. The complete drawings, which include instructions, constructions photos and a flight manual cost $250 US delivery, $280 foreign delivery, postage paid.

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