the Monitor

March The MRCS Officers 2017

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Ken Myers

Next Meeting: Date: Wednesday, March 1
Time: 7 pm video, 7:30 Meeting, EAA Building

What's In This Issue:

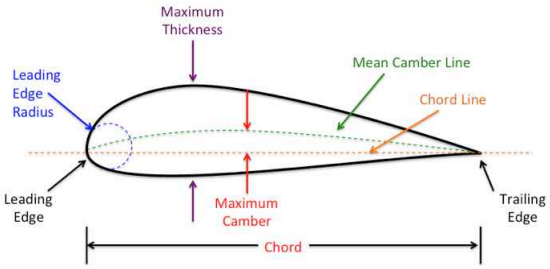
The February Meeting

A video of Flite Test's 2016 FliteFest was shown.

Airfoil Design: Reverse Engineering Data for Laser Cutting

A presentation by **Arthur Deane**
February 2017 Meeting

Airfoil Nomenclature
NACA 4 Digit Airfoils
Commonly Used on Our Models



1st Digit Maximum camber
2nd Digit Location max camber
3rd & 4th Digits Max thickness
These are expressed as a percentage of the chord

Example: NACA 2421
21% thick airfoil with 2% camber at 40% of chord

NACA 4 Digit Airfoils have some advantages and disadvantages.

They offer good stall characteristics. There is small center of pressure movement across the airfoil through the speed range. Surface roughness has little effect on them.

Unfortunately they have a low lift coefficient. They have realatively high drag and a high pitching moment.

These types of airfoils are used in general aviation aircraft, supersonic jets, helicopter blades and as fairings.

NACA 5+ digit airfoils have some peculiar stall conditions and are not recommended.

Types of Airfoils

Semi-symmetrical airfoils Are typically used on sport planes. They have less

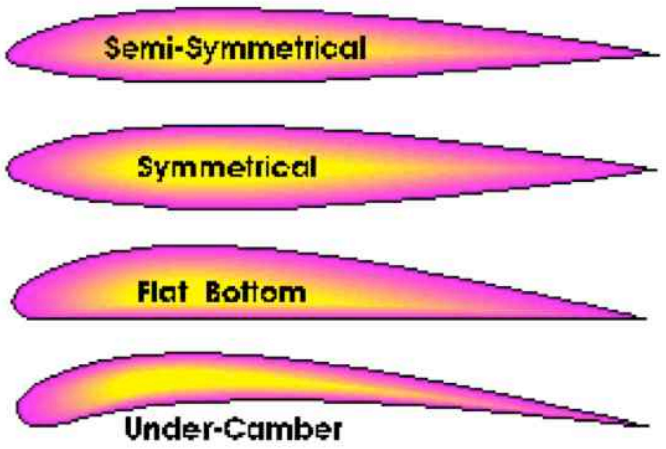
Helicopter Frequencies
21,27,29,39, 41
Sailplane Frequencies
11, 12

curve on bottom and have less drag than symmetriccal airfoils. Inverted flight is good. Some typical examples are the NACA 2408 and 2415.

Symmetrical airfoils provide hands off inverted flight. They resists stalls. Some aerobatic planes use the NACA 0012.

Flat bottomed airfoils are used for low speed aircraft and have high drag. They are quite speed sensitive. They will climb with an increase in speed.

Under-cambered airfoils provide high lift. They are typically used on sailplanes, free flight models and old timers.



The N66-012 airfoil is popular for plyon racers. The E168 /169 Symmetrical airfoil is thicker rearwards. Eppler designs use this airfoil. The E2114 is popular on gliders and UAVs. It is a thicker section airfoil. The S6061 and SD7003 are popular glider sections.

An Airfoil Program

A French airfoil program, in English, can be found at TRACFOIL.COM. It cost 10 Euros for the licensee, which is about $10.30.

It has a large selection of airfoils. About 2057 airfoils at last count. It incorporates all of the required construction cut outs and provides templates for foam cutting. It develops intermediate rib chords to match wing planform. Constant or variable rib spacing is available. The program calculates oblique rib shapes. It also calculates the dihedral and end rib shape.

Tracfoil Procedure

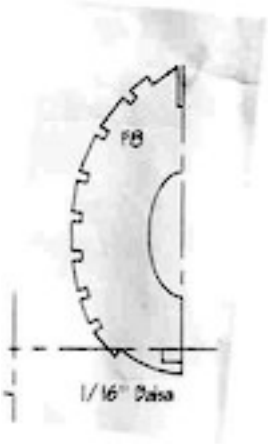
Design

Select airfoils shape
Select sheeting thickness May be unsheeted
Select LE width
Select TE width
Select spars Multiple, cutouts top or bottom or both
Select holes Multiple round or square
Foam patterns
Incorporates washout

Handling

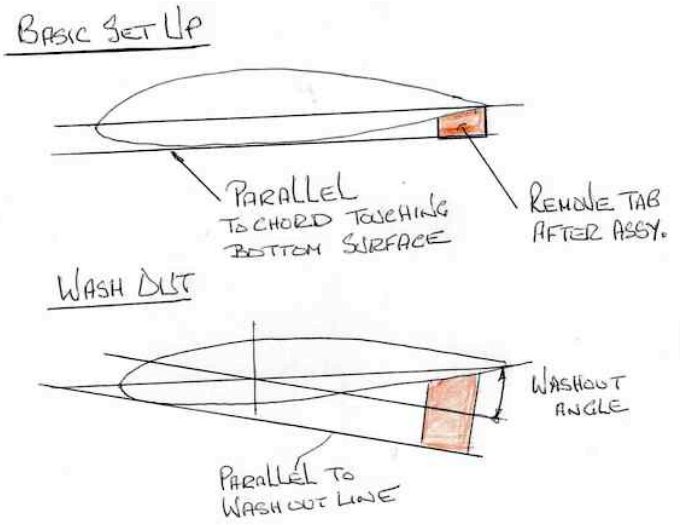
Save each rib shape in Tracfoil .TRA
Export ribs in .DXF or .DWG (AutoCAD Format)
Open .DXF files in a CAD program
Incorporate into your design
Develop a cutting file in .DXF (Nesting the parts)

Other Parts



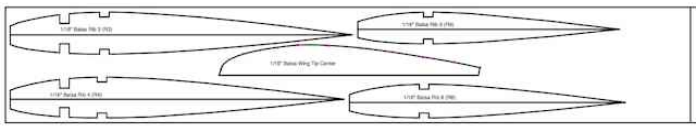
Parts scanned from Plans are .JPG, which is a graphics format. For laser cutting, the file must be converted to a vector format.
Some programs will convert to vecotor format are:
Corel Draw
Some CAD programs can accept graphics and convert to vector format
DesignCAD will handle
Scan TWAIN scanner
Command Auto Trace Bitmap

The program also has a feature that will create building tabs.



Nesting for Laser Cutting

Any wing sheeting thickness needs to be removed, as well as anything that is not part of the airfoil, to be cut. This can be done in a CAD program and then saved to a .dxf file for the cutter.



Tailless Designs

Arthur's 2nd Presentation

All airplanes have vertical tail surfaces. Birds don't have vertical tails and therefore cannot fly!!!

The Four Ways Birds Differ from Aircraft

Birds turn and maneuver without a vertical tail.
Birds have slender tips (feathers) that carry little load.
Birds gracefully fly formation with overlapped wingtips.
Birds have narrow wingtips without tip stall.

Some Definitions

Adverse Yaw

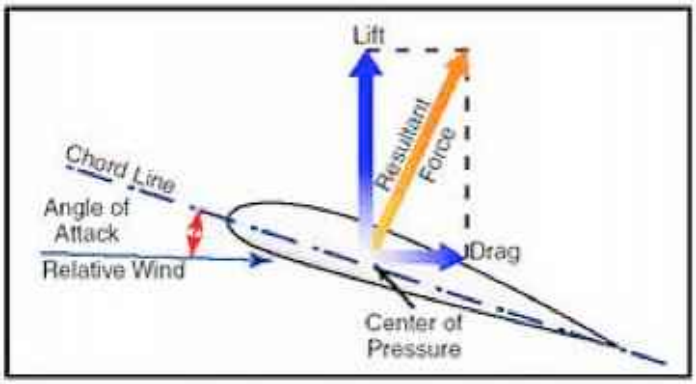
A plane yaws in the opposite direction to a roll command. The increased drag on the rising wing introduces an opposite yawing moment. This can sometimes be catastrophic.

Proverse Yaw

With proverse yaw, a plane yaws in the direction of the roll command. This provides good stability, but pilots do not like excessive amounts.

Induced Drag

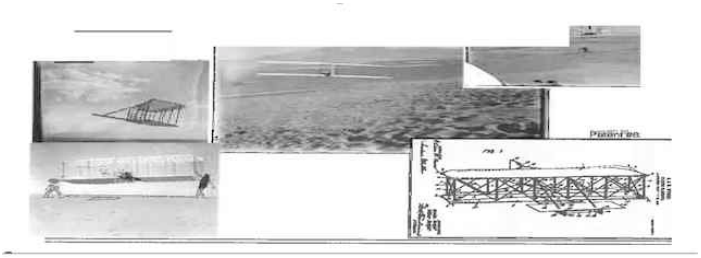
An airfoil generates lift normal to the chord line. When resolved perpendicular and parallel to the line of flight there is a rearward component. That component is drag.



The Wright Brothers

Their initial experiments from 1899 to1905 used gliders and kites, which had no vertical tail and exhibited adverse yaw.

Their 1905 patent application included a rear mounted vertical tail.

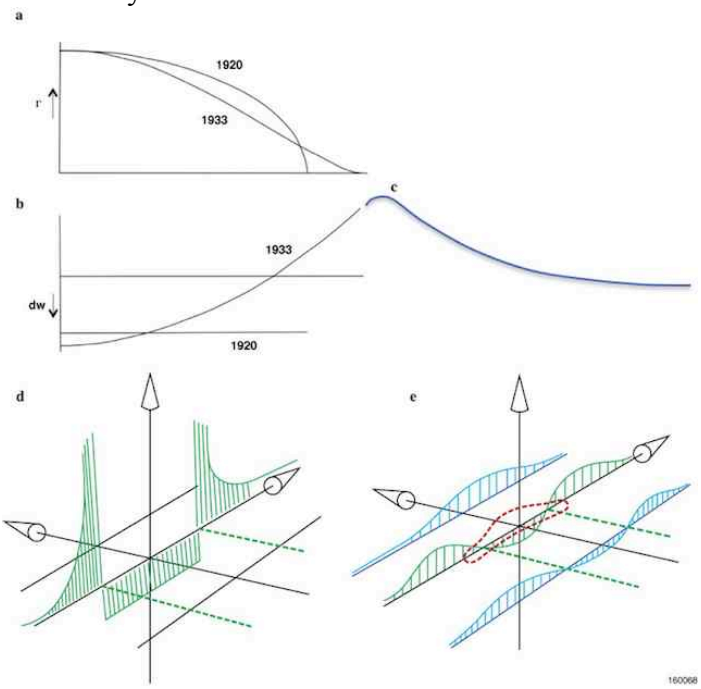


Virtually every airplane built since has had a vertical stabilizer.

Some Aerodynamic Research

In 1920, the German physicist, Prandtl, developed elliptical spanwide lift distribution. The constant downwash was most efficient. The elliptical shape is a sine function.

In 1933 Prandtl modified his theory. He noted that if the span is increased by 22%, and a bell shaped lift distribution is used, then the induced drag will be reduced by 11%.



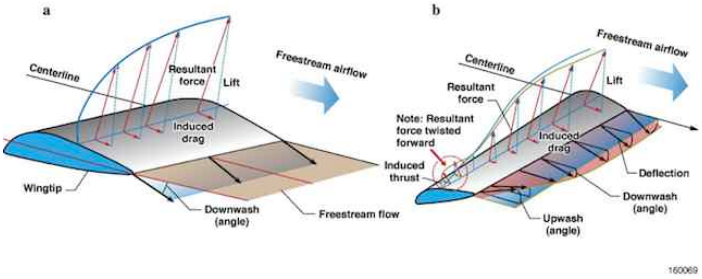
The diagram compares his 1920 theory to the 1933 update.

There is zero load and vortex at tip. There is a small vortex at 70% of the span where a downdraft changes to an updraft.

The bell curve is based on K1(K2sine^3 - K3cos2). This results in a wing with and elliptical twist along its length.

Sine^3 controls the proverse yaw. He found that Sine^4 is too much.

A comparison of elliptical and bell shaped lift distributions can be seen in the diagram.



The upwash angle at the tip of the bell distribution results in a negative drag force, that is forward thrust.

With wing roll, the thrust increased on one side and decreased on the other. This provides a moment opposing adverse yaw. The bell shaped lift distribution provides proverse yaw.

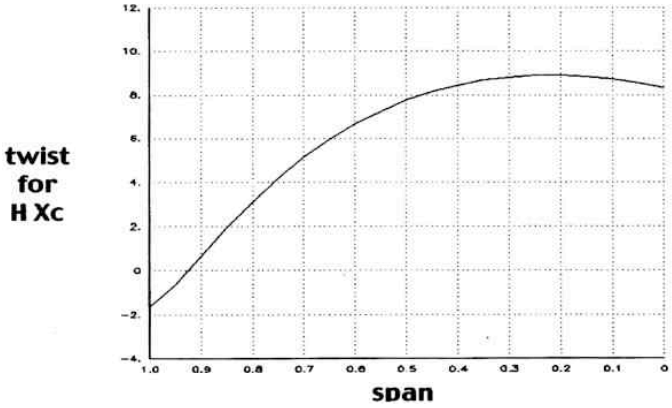


Table 3. Wing twist distribution

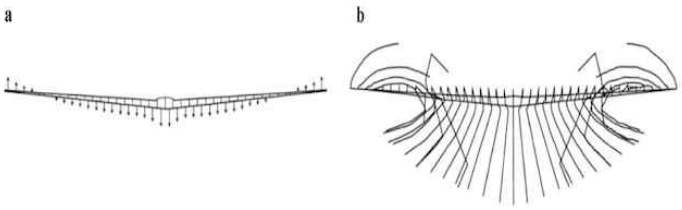
	Wing twist		
0	8.3274	11	7.2592
1	8.5524	12	6.6634
2	8.7259	13	5.9579
3	8.8441	14	5.1362
4	8.9030	15	4.1927
5	8.8984	16	3.1253
6	8.8257	17	1.9394
7	8.6801	18	0.6589
8	8.4565	19	-0.6417
9	8.1492	20	-1.6726
10	7.7522		

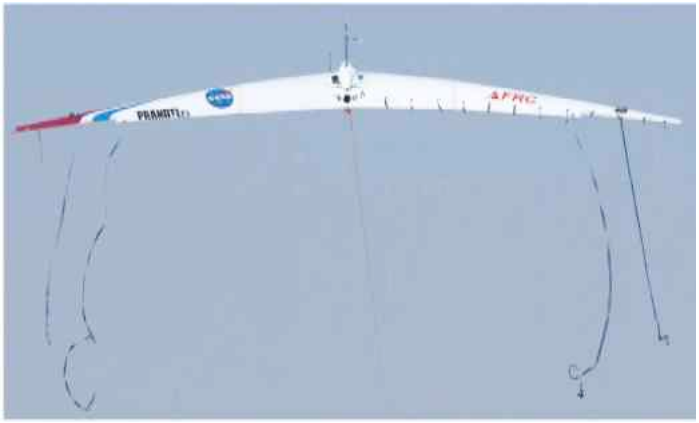
There is a wing twist for the bell shaped lift distribution. This provides a continuous span wide elliptical lift distribution.

There is approximately 10.5 degrees of twist variation.

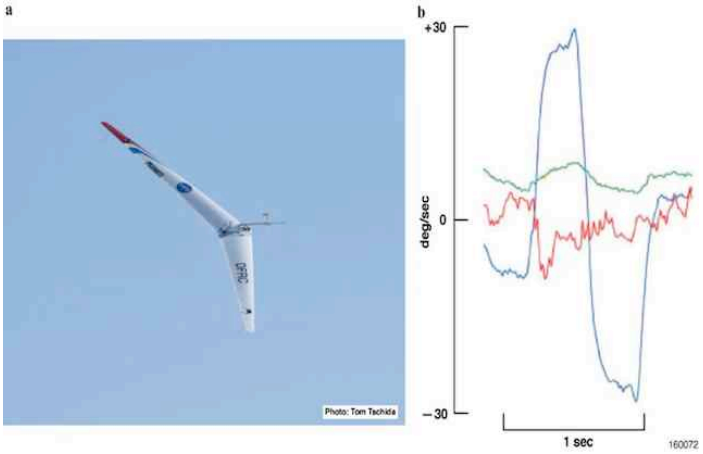
The maximum positive twist occurs at 20% of span from the root.

The zero twist point, which is the point of change from down to updraft, occurs at 90% span from the root.





Flight Test 1 demonstrated small vortex's separating at 70% span.



Key

Red pitch ~ (California desert)

Blue roll

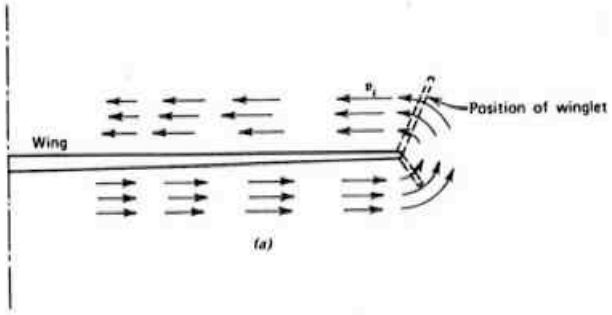
Green yaw

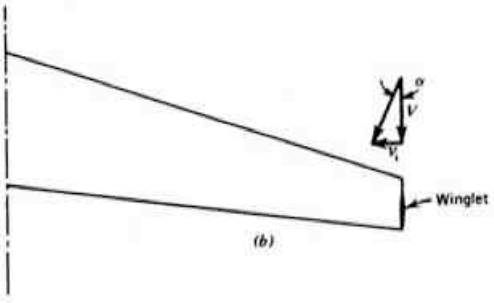
Flight Test 2 showed that a 30 degree roll results in 2.5/3.0 degrees of proverse yaw.

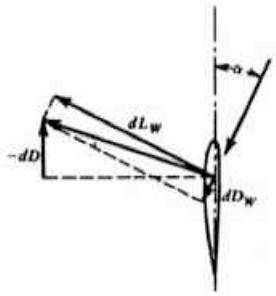
Richard Whitcomb's Winglets

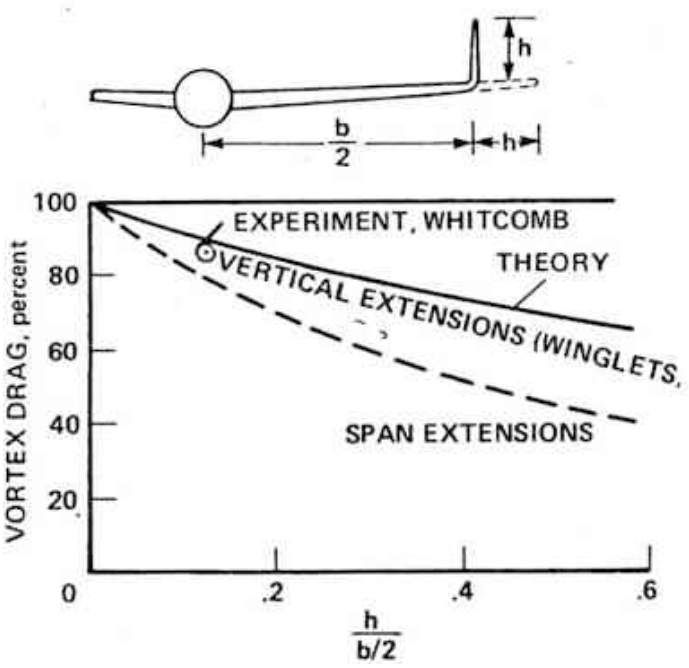
Whitcomb's Winglets

Whitcomb's concept of winglets, from the 1970s, uses vortex flow to develop forward induced thrust at wingtips. Induced drag decreases at about half the span "extension". There is reduced wing root bending stress.

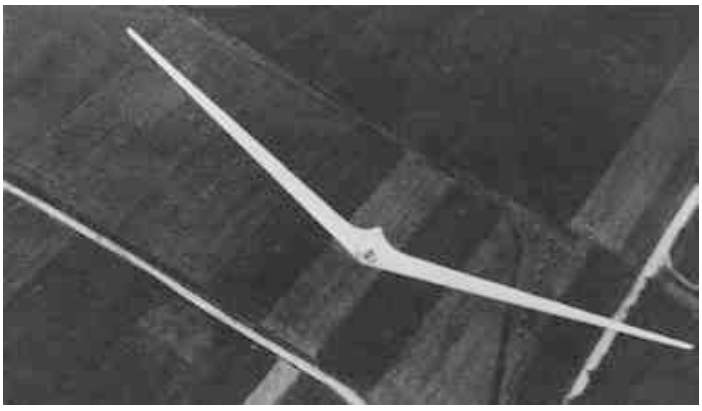






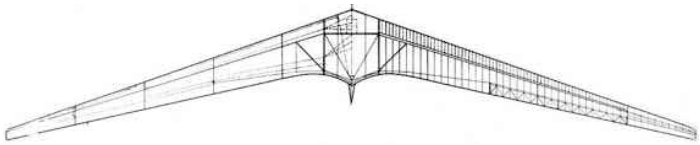


The Horten Brothers Experiments
1935 to 1955



The Horten Brothers developed tailless designs from around 1930, and continued until about 1955.

While a student of Prantdl, they developed the technology principally through model and piloted gliders. They must be recognized for their pioneering work.



Control of Yaw

There are 3 choices for the control of yaw:

1. Incorporate vertical surfaces, as in traditional airplane design

2. Control yaw with drag devices via computers

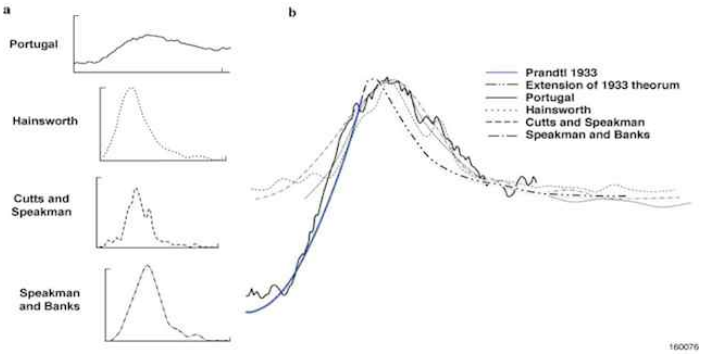
3. Use the bell shaped lift distribution to provide proverse yaw

Using the bell shaped lift curve, designers can now eliminate vertical tail structures. This esults in weight and drag savings of up to potential 30%. Of course there are operational limitations such as the longer wing span for in ground handling and control with one engine out and during crosswind landings.

The Next Step in Development

Current test wings have demonstrated control and flight capability. The test wing is now being instrumented to determine airflow and local pressures to prove the aerodynamics. Drag reduction is still in question.

Comparison of Bird and Airplane Flight Characteristics



Aircraft

Large heavy load carrying wing tips

Aircraft in formation fly wing tip to wing tip

Aircraft with narrow sharp wing tips are prone to stall

Aircraft require a vertical tail or other drag

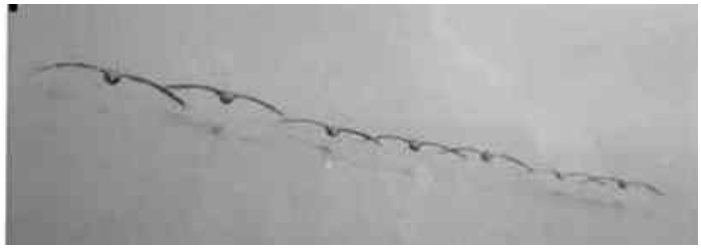
Birds

Long soft flexible wing tips, with narrow chord and limited load carrying

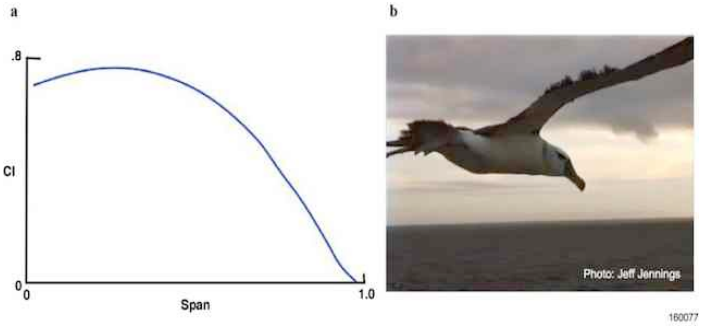
In formations. birds use upwash from leading bird with wings overlapping

Narrow chord, sharp tipped wing tip does not tip stall (No tip load)

Birds demonstrate precise control and stability, inducing control without a vertical tail surface



Bird Flight



A hovering, wandering Albatross

Wing stall (fluttering feathers) is developing at approximately 20% span as predicted with the bell shaped lift curve.

As the wandering albatross continues to drift around Antarctica there is only one conclusion possible! Birds are using the bell shaped lift distribution for stability and control.

Birds have been using this technology for billions of years.

After a 120 years of flight, engineers, and physicists, are only now beginning to understand the benefits.

References and Acknowlegements

1. The best reference and starting point on the bell shaped spanload is NACA/TP—2016-219072, Al Bowers "On Wings of the Minimum Induced Drag; Spanload implications for Aircraft and Birds".

2. Ludwig Prandtl must be recognized for his initial mathematical theory, which advanced aeronautical engineers and physicists ability to predict aircraft performance.

3. The contribution of the Horten Brothers is immense. While students of Prandtl, they did not follow his work, rather they commenced testing and developing flying wings based on their own ideas.

In the 1930s they built and flew a large number of models. Launched them from hills and watched performance. The high point of their work was the development, in 1944, of a outstanding twin jet bomber/fighter for the Luftwaffle. Their work continued in Argentina until 1955.

4. The other developer who needs recognition is Al Bowers, Chief Scientist at NASA Edwards. For 20 years he pondered why wings could not be developed with inherent stability. Over the years he became a fanatic believer in the Horten Brothers work. Publicizing and presenting the theory.

In the last 10 years he has brought all the previous work into focus with his work demonstrating that airplanes do not require vertical tails. He has also demonstrated the validity of the original theory using modern design analysis, and the testing of models with instrumentation able to clearly demonstrate wing performance.

5. Our own Keith Shaw, from Ann Arbor, must be recognized for his publicizing the Horten Brothers, through historical presentations and flying beautifical RC models of the Horten designs.

The Business Meeting

Lynn Morgan, club secretary, noted that we have 22 membership renewals at this time. The dues are DUE NOW. The March meeting is the last day to pay the regular $100 dues. After that there is a $25 additional fee. WHY!!! We need to know what our budget is for the year so that we can plan accordingly. Please get your dues, a copy of your current AMA membership card and a $100 check to Lynn as soon as possible.

Lynn Morgan
15790 Penn
Livonia, MI 48150

Dave Stacer, club treasurer, noted that there has not been much activity in the treasuery lately, except for the payment of reoccuring bills.

Ken Myers, vice-president, noted that the dates for the 33rd Annual Mid-Am Electric Flies are July 8 and 9. He stated that the reason that Flite Fest 2016 was shown was to spark interest in a new events and award this year.

New Events for this year's Mid-Am Are for NCM (Not Conventional Materials) aircraft.

Traditionally, model aircraft airframes have been mostly constructed from balsa wood, plywood, spruce, and fiberglass. For the purposes of this meet, NCM airframes are mostly constructed from not conventional materials i.e.; sheet foam, foam board, cardboard, block foam, foam insulation material, etc.

Foam Flurry for NCM aircraft: This is a true event. It is based upon the all up/last down event of early electric meets. Any NCM aircraft may be used (no ARF types). Power systems are limited to a maximum of 3S (no paralleling) LiPo batteries or 4S maximum, no paralleling, for A123 packs. All planes qualifying for this event will launch at the same time, and the last one to land will be declared the winner.

Most Unique NCM Aircraft Award: A new award will be given on Sunday to an aircraft in the NCM category that is judged as 'most unique' by the Mid-Am panel of judges.

Lynn Morgan noted that Larry Markey recommends the Radian, not the Radian Pro, for our upcoming 'competition' glider league. The league will have a points system. There is more info on the Midwest RC Society FaceBook page. There will also be information on our Web site.

Show and Tell

Denny Sumner shared his beautiful AcroStar biplane. He scratch built it from plans from a 1973 Radio Control Modeler (RCM) magazine.

He had the wing ribs and formers laser cut. It is excellently covered with Ultracote, except for the black trim, which is MonoKote.

His build thread, on RC Groups is at: https://www.rcgroups.com/forums/showthread.php?2749251-Electrocution-of-a-1973-RCM-Acro-Star-Bipe

Originally designed for a glow .60-size motor, his power system consists of a Cobra 4120/14 (710Kv) outrunner, Scorpion 70 Amp ESC and Castle Creations BEC. He plans to try both an APC 12x8E and 13x8E prop to see which works best.

With a 4S 5300mAh LiPo battery, it weighs 5 pounds 14 ounces.

The bipe has 820 square inches of wing area for a wing loading of 16.51 ounces per square foot and a wing cube factor of 6.92.

An excellent project Denny, and excellently executed!

Hobbico Returns to the Ultimate Soccer Arenas

From Joe Hass via email

On Monday, April 3, Hobbico will do its Pre Toledo Show visit at the Ultimate Soccer Arenas from 7 p.m. - 9 p.m. There is no admission and everyone is welcome. On April 4, during the indoor flying from 10 a.m. to 2 p.m., they will do demonstrations. There is no cost if you are not flying. Regular session costs apply to fly.

Upcoming PMAC & Skymasters Joint Swap Shop

On Saturday, March 4, the Pontiac Miniature Aircraft Club (PMAC) and the Skymasters are holding a combined Swap Shop. It is at a new location this year. It is at the St. George Church/ Cultural Center, 43816 Woodward Ave., Bloomfield Hills, MI, 48302. It opens to the public at 9 a.m. General admission is $5, with women, children and active military admission free. There will be coffee, donuts, lunch and refreshments available.

Tables ($20 mail floor or $25 wall) can be reserved at skymasters.org/register. The vendor setup is at 8:00 a.m.

To change your email address contact Ken Myers at kmyersefo@mac.com

The 2017 membership application is available at the club Web site, http://www.midwestrcsociety.org, for downloading with the link on the homepage.

Upcoming Events:

Tuesdays, Indoor Flying at the Ultimate Soccer Arenas in Pontiac, 10 a.m. to 1 p.m.

Wednesdays, Indoor flying in Brighton at the Legacy Center, 12:30 p.m. to 2:30 p.m.

March 1, Wednesday, MRCS meeting, video 7 p.m, meeting 7:30 p.m., Guest Speaker: **Ken Myers**, Topic: Selecting Power systems for sport and sport scale models.

March 4, Saturday, PMAC & Skymasters Joint Swap Shop (details in this issue)

April 3 & 4, Hobbico Pre-Toledo visit to the Ultimate Soccer Arenas (see this issue for details)

April 7, 8 & 9 The 63rd Toledo RC Expo, SeaGate Centre, 401 Jefferson Ave, Toledo, OH 43604

June 3, Saturday, Keith Shaw Birthday Electric Fly in (details to follow)

July 8 & 9, Sat. & Sun., 33rd Mid-America Electric Flies (details to follow)

Midwest RC Monitor
Editor: Ken Myers
1911 Bradshaw Ct.
Commerce Twp., MI 48390

The Next Meeting:
Date: Wednesday, March 1, 2017
Time: 7 p.m. Video, 7:30 p.m. Meeting
Place: EAA Building, Mettetal Airport