No. 250 APRIL 2007

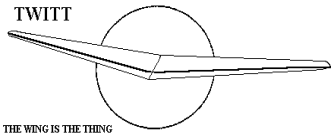
T.W.I.T.T. NEWSLETTER

NASA Boeing X-36 - NASA and McDonnell-Douglas Phantom Works developed the technology essential for a tailless aircraft beginning in 1989. To prove the technology worked Phantom Works built two unmanned X-36 aircraft. The first flight of the X-36 took place in May 1997. One of the two X-36 aircraft completed 31 successful research flights the last in Dec 1997. In 1998, the X-36 made two more flights to prove that software could make the necessary adjustments to fly a damaged tailless aircraft. Photo/Text Source: http://www.diseno-art.com/encyclopedia/archive/concept_aircraft.html

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., **0704** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, May 19, 2007, 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.

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Wt/#Issues	FRG	AUSTRALIA	AFRICA
1oz/1	1.75	1.75	1.00
12oz/12	11.00	12.00	8.00
24oz/24	20.00	22.00	15.00
36oz/36	30.00	32.00	22.00
48oz/48	40.00	42.00	30.00
60oz/60	50.00	53.00	37.00

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

Although I know that I have reached the time in my life when the people I knew as a child or early adulthood would pass away, I haven't been prepared for the series of losses we have had in the past several months.

Not only have we lost Bob Fronius and June Wiberg, but we lost Joe Fronius (a TWITT member for many years) about a week after Bob. Joe had been sick for some time so it wasn't unexpected, but to come so close to Bob's caught everyone off guard. Joe had been playing around with flying wing models for years and had actually started to build his own aircraft before his health began to fail. We have featured his efforts from time to time.

As you will see in the newsletter, we have also been informed that Stefan Brochocki passed away on March 26th. He too, had health issues in recent years, but was still an avid believer in flying wings. We understand that he really enjoyed getting each issue of the newsletter and staying abreast of what was going on in terms of flying wing development. I have included the obituary that was published, along with an Internet based guest register that you can use to leave a message for the family, if you desire. I placed an entry in the register on behalf of TWITT.

Having little to no material for the newsletter this month I decided to use a piece contributed to Sailplane Builder by Vittorio Pajno, which is one of the benefits of editing both publications. Although he is presenting it in terms of a conventional wing, I think there is probably some information in there that any builder can use for the initial design phase when planning the layout, construction material, etc. Besides it has lots of math in it that will drive some of you crazy. Unfortunately, Vittorio didn't supply the legends for the various components, but I bet many of you will figure it all out.

Andy

MAY 19, 2007 PROGRAM

As of the April issue I didn't have a confirmed program set for May at the hanger. I will continue to look for a speaker so we can have a regular meeting versus the memorial type. If anyone has any ideas they would like to put on the table I am always willing to make the contacts and see what we can come up with.

MARCH 17, 2007 MEETING RECAP

Since there wasn't a real meeting, this will just be a short recap of what occurred at Bob Fronius' memorial ceremony at the Allen Airways Flying Museum and a little more historical information on Bob.

As you can see from the picture there was a tremendous turnout for Bob's celebration. Doug Fronius remarked that his father would like it to be a celebration rather than a ceremony or a service, and that he would want everyone to have a good time remembering their experiences with Bob.

There was a tremendous cross section of ages and aviation interests represented at the celebration. Bob touched a lot of people's lives in his 92 years and there were some very interesting stories related as everyone visited after the formal part of the program. My dad and I were pleased to renew contact with Pete Girard who was a member of the local glider club for many years, but is better known as the test pilot for Ryan Aeronautical's Vertijet.

Doug and brother Floyd both reminisced about growing up with Bob as a father and noted that live was anything but dull. A number of people commented about the adventurous nature of Bob and that carried over to both sons, especially when it came to entering the world of hang gliding.

Bob's career included working in the experimental departments at the various aerospace companies in San Diego during and after the WW II, including Consolidated Vultee, Ryan and Rohr.

He founded the Ultralight Flyers Organization (UFO) that is now known as the San Diego Hang Gliding and Paragliding Association. So you can see many of the organizations he founded have outlived him, just like TWITT. He continued to hang glide until he was nearly 70.

Bob was a founding member of the San Diego Chapter 14 of the EAA in 1956 that is still a very active chapter.

He was a fixture at Gillespie for 60 years and entertained countless visitors at his hanger that was also a designated museum. For those of you who haven't been fortunate enough to visit the hanger, it is a treasure house of aviation history including sailplanes, hang gliders, experimental aircraft and much, much more.

The celebration was a fitting way to say goodbye to a dear friend and colleague. We were all pleased that so many people attended and had such wonderful memories of their encounters with Bob over the years.

Bob's ashes were laid to rest in a mausoleum alcove at Fort Rosecrans Cemetery overlooking San Diego bay and the downtown area. He is not too far from where Charles and Anne Lindberg made many soaring flights using the off shore winds coming over Point Loma. Bob was instrumental in having historic plagues placed at a location where some of the launches occurred. We are sure he is enjoying the view and being close to this historic site. Rest in Peace.

LETTERS TO THE EDITOR

February 16, 2007

(ed. – This was received from Helga Gross upon hearing about June Wiberg's death and I forgot to include it in last month's newsletter. She also made a nice contribution to TWITT on behalf of herself and Bernie who had been a member for many years.)

June was very nice and thoughtful to us. I miss her and will never forget her.
Take care – Bless you!

Helga Gross
Ramona, CA

The card included this thought:

Memories never lose the magic to rekindle the closeness that lives on in the sacred places of the heart.

March 8, 2007

Membership:

I have just purchased a membership to TWITT and hope to get my login information shortly. I'm looking forward to becoming part of your community.

Thanks,

Greg Brady
<greg.brady@crosstrainer.ca>

(ed. – I sent Greg a welcome note and gave him the ID and password so he could immediately begin enjoying reading through 5-years of newsletter we have on the web site. He joined through payment by PayPal, which has been working really well.
So as a reminder, if your membership is coming up for renewal, don't forget you can now pay electronically using either funds from your own PayPal account or by your personal credit card. This works well for everyone, since you don't have to track the check, which can take a month or more to clear and TWITT received immediate credit for the funds.)

March 10, 2007

Tailless aircraft

Would the French Flying flea design be classed as a tailless aircraft

Leigh
<hl-jm.cave@ntlworld.com>
United Kingdom

(ed. – I passed along the following: To answer your question I think the Flea would be more like a canard configuration that a flying wing or tailless aircraft. In this case you have two wings working in tandem to produce the lift and control the flight, whereas a tailless aircraft would have no rear wing/tail or a forward canard.
I also told her I would pass long anyone's answer that was significantly different from this. So if you have an opinion, please send it in.)

March 27, 2007

WIG Article

Hoping this mail reaches you.
Very interesting article re the WIG, I'm trying to get my head around the concept of a flat airfoil. How were you suggesting the control pitch? Do you have any more details?

Thanks & best regards

David G Bennett.
<dbennett@sify.com>

(ed. – This message was also addressed to Chuck Bixel whose Wing In Groundeffect material is on the web site. I haven't seen a reply from Chuck, but I find it interesting that there continues to be interest in this concept although we don't see much commercial activity.)

March 29, 2007

R/C Eagles, Hawks, Vultures, etc.

Dear Bob (Hoey):

I came across your web page in a Google search for [vulture radio control]. Very interesting!

I am looking for an electric powered (propeller, not just a high start sailplane) R/C plane with a silhouette aloft of a large bird (vulture, eagle, hawk, condor). Ideally, I would like a RTF, but I haven't been able to find anything, even a kit. Are you aware of anything?

Thanks for your help,

Ross Kelly
<kellytr@bc.edu>
Vanderslice Professor of Chemistry
Department of Chemistry
Boston College
Chestnut Hill, MA 02467

PS. I happen to be a member of the Charles River Radio Control club referred to in your letters section.

(ed. – I haven't seen a reply from Bob to this inquiry, but I know in the past he has indicated there are no plans available from his group for any of the R/C birds they have developed over the years. There was also another message from Italy asking the same question just a couple of days later.

One of the R/C magazines did publish a set of plans for the vulture (I believe), but it was a scratch built model and not an RTF (ready to fly). It is sort of a shame that the model companies haven't taken this area up what with all the attention to endangered species and general interest in bird flight.)

March 29, 2007

Enclosed find an ad for the second printing of my Collected Sailplane Articles and Soaring Misadventures, $30 post paid.

Also enclosed is an ad for the first printing of my Collected Aircraft Performance Improvement Articles and Lectures, $30 post paid.

Could you please place these ads in the TWITT classifieds.

Bruce Carmichael

(ed. – I have added them to the Reference Material section where you can also find information on ordering copies.)

(ed. – This is the message we received announcing the passing of Stefan Brochocki on March 26th. It also included this obituary that I think you will find interesting about Stefan who was one of the "B"s in BKB-1.

As noted in my column, I have posted a guest registration on behalf of TWITT, but please feel free to add our own if you knew him or just want to pass along your personal condolences to the family.)

March 28, 2007

It is with deep sorrow and regret that I must tell you that my father, Stefan, passed away this past Monday. He had fought a long battle against cancer and heart disease.

His condition deteriorated rapidly in the last two weeks. I was blessed to be able to spend much of that time with him while he was hospitalized. We were able to talk of many things before the medication clouded his mind. My mother, my brother, and I miss him terribly. He will not be forgotten.

I have attached Stefan's obituary.

Stefanie Brochocki

Forever In Our Hearts

Oh I have skipped the surly bonds of earth
And danced the skies on laughter-silvered wings;
Sunward I've climbed, and joined the tumbling mirth
Of sun-split clouds…and done a hundred things
You have not dreamed of…wheeled and soared and swung
High in the sunlit silence. Hov'ring there,
I've chased the shouting wind along, and flung
My eager craft through footless halls of air.
Up, up the long, delirious, burning blue
I've topped the windswept heights with easy grace
Where never lark nor even eagle flew.
And while with silent lifting mind I've trod
The high untrespassed sanctity of space
Put out my hand and touched the face of God.

John Gillespie Magee Jr.

STEFAN KAZIMIERZ BROCHOCKI: Peacefully at St. Eustache Hospital, March 26, 2007; at the age of 89, after a lengthy illness. Son of the late Wladyslaw Brochocki and Helena Baranowska. Beloved husband of Elizabeth Poole, and dear, loving father of Stefanie (Napanee, ON) and Jan (Lachute, QC), cherished grandfather of Konrad Brochocki. Predeceased by brother Stefan (Isle of Wight). Sadly missed and lovingly remembered by family and friends in Canada, Poland, England, USA, and New Zealand.

Stefan was raised in Krasne, Poland, and served as a bomber pilot in the Polish Air Force during WWII. For his service he was decorated with the Virtuti Militari and the Cross of Valour. He completed a second tour of duty with the Ferry Command flying out of Dorval, QC.

After the war he was an aeronautical engineer for Canadair Ltd. until retirement. His contributions to the world of aviation were many. He was part of the teams that produced Canadair's CL-41 Snowbird, CL-44, CL-84 VTOL, CL-215 Waterbomber, and Challenger aircraft.

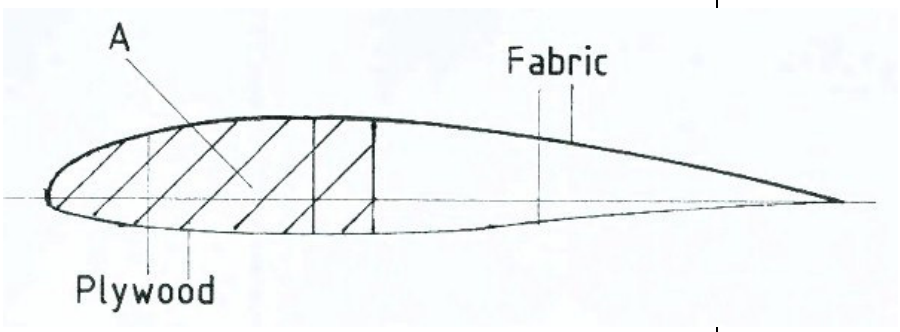
He was a member of the Gatineau Gliding Club and The Wing is the Thing, as well as an instructor with the Montreal Soaring Council. He designed and built the extraordinary tailless sailplane, the BKB and led a group of volunteers that restored the German MU-13 glider.

Love of sailing inspired him to design and create a unique trimaran, the Lotus; and the first Canadian sailboard, the Ski-mer. His passions included gardening, skiing, and sail boarding.

The family will receive condolences on Sat. March 31 at Salon Funeraire Guay. Donations in Stefan's memory can be sent to the World Wildlife Federation and the Canadian Cancer Society.

On-line guest book:

http://www.legacy.com/can-montreal/Obituaries.asp?Page=Notice&PersonID=86988514



Preliminary Wing Design

By. Vittorio Pajno

As promised I have sent the first article dealing with air loads acting on the glider structure and the related calculations allowing an amateur to design - in an old but simple way - the structures.

Modern rules are complicated and not easy to be understood by the amateur. The scope of the articles are to introduce the amateur reader - in the spirit of ESA – to this very delicate matter.

My book " Sailplane Design" and with the support of students of an University can solve - in a second phase - the problems connected to the design safety and to the respect of the actual rules governing glider design. I wrote them to make this matter more popular – glider design – but I warn the reader that these calculations can be considered only preliminary and good enough to find out the preliminary weights and the structural basic dimensions.

The program is to split this matter into four articles: the first one will deal with the wing, the second with the fuselage, the third with the tail surfaces and, the fourth with fittings and controls.

Introduction

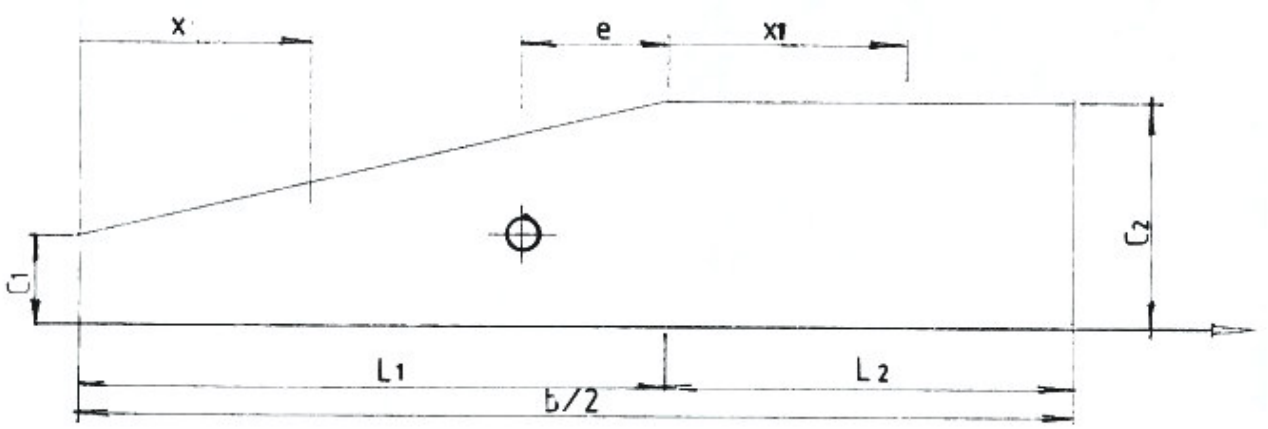
It has probably been a long time that you have dreamed about a simple glider you may build with traditional materials as wood and a few parts in steel or aluminium, but some problems of various nature stopped you from starting your project. To help the people that want to design this simple glider I am writing four articles to introduce the readers in this matter.

The base is the old Italian and German (RAI and BVS) rules from which many successful gliders have been designed before the second world war and even after.

In the USA the FAA rules (issued in 1940 and revised about 40 years ago) are available and I suggest to use also them. What is needed to start your design is an HP calculator with a lot of memory but also capable of calculating derivatives and integrals, a drawing board (possibly with a parallel rule) having dimensions 1.00 m x 1.80 m and a computer - of course.

Pencils and drafting paper (tracing paper to start) and the eventual help of a good student of a University where he/she is going to be graduated in Aircraft Engineering could be sought.

This is only if you are not skilled with mathematics. I tried to make what follows pragmatic and easy for everybody but only the reader can judge if I have reached this scope.



The Wing Loads

You have written the specification of your glider and from the book "The World's Sailplanes" we get some data useful to start the calculations. We have also the data related to the airfoils we want to use and they are traced on paper in scale 1:1.

For this example I will refer to the glider Scheibe Spatz B (pg. 97 on the above mentioned book).

The load acting on your wing is given by:

$$L = n \cdot (W - W_W)$$

As per CS 22 we know that at the speed V_A the load factor is:

$$n = 5.30$$

The max all up weight is 230 kg and the wing weight is 70 kg so the load on the wing is

$$L = 5.30 \cdot (230 - 68) = 858.60 \text{ kg}$$

The wing area and the wing loading are:

$$\frac{L}{S} = \frac{858.60}{10.90} = 78.77 \textbf{ kg / m}^2$$

The wing planform is composed by a rectangle and a trapezium and the loads at the tip and where the planform is rectangular are respectively:

$$L_{TIP} = C_1 = C \cdot \frac{L}{S} = 0.50 \cdot 78.77 = 39.385 \text{ kg / m}$$

$$L_R = C_2 = 0.99 \cdot 78.77 = 77.982 \text{ kg / m}$$

To calculate shear and bending moment in each section we will use the following formula:
In the trapezoidal area the load equation is:

$$L^* = \frac{C_2 - C_1}{b_{TRAP}} \cdot x + C_1 = \frac{38.597}{3.10} \cdot x + 39.385$$

Integrating one time this equation we have the shear in the first part of the wing

$$S_{TRAP} = 12.4508 \cdot \frac{x^2}{2} + 39.385 \cdot x$$

being the trapezoidal part span $b_{TRAP} = 3.10$ m

If we want to know the shear force acting on the wing at 3.10 m from the tip, i.e. where the wing planform become rectangular, we introduce this value and we have:

$$S_{3.10} = 6.225 \cdot 3.10^2 + 39.385 \cdot 3.10 = 181.92 \text{ kg}$$

Integrating one more time the Shear equation we have the bending moment equation:

$$M = 12.4508 \cdot \frac{x^3}{3} + 39.385 \cdot \frac{x^2}{2} = 4.1502 \cdot x^3 + 19.6926 \cdot x^2$$

So the bending moment is at 3.10 m from the tip:

$$M = 123.641 + 1892464 = 312.8874 \text{ kg m}$$

We can make a table with the sections considered and put in this the related shear forces and bending moments and we will add also the static data required to design the spar section.
For the rectangular part we have to consider that:

$$S_{RECT} = S_{3.10} + C_2 \cdot x_1 = 181.92 + 77.982 \cdot x_1$$

and

$$M_{RECT} = S_{3.10}(e + x_1) + C_2 \cdot \frac{x_1^2}{2}$$

at the wing centre we will have that being

$$e = \frac{M}{S_{3.10}} = \frac{312.8874}{181.92} = 1.7199 \text{ m}$$

$$S_{CL} = 181.92 + 77.982 \cdot 3 = 415.8688 \text{ kg}$$

$$M = 181.92 \cdot (1.7199 + 3) + 77.982 \cdot \frac{3^2}{2} = 1209.567 \text{ kg m}$$

The Wing Torsion

The simplest way to calculate the wing torsion - only in first approximation and having in mind that this matter is more complex than as presented - is shown below. We want find out about the wing skin thickness evaluating therefore the weight of this glider part and, for this purpose we need to read the value of C_{mo} on the wing section polar. From the CS 22 rules we have to calculate and decide which is the chosen value for the speed V_D.

Supposing that the above values are:

$$C_{mo} = -0.080 \qquad \text{and} \qquad V_D = 180 \text{ km / h = 50 m / s}$$

$$M_T = \frac{1}{2}\rho \cdot C_{mo} S \cdot mac \cdot V_D^2 = -0.0625 \cdot 0.08 \cdot 10.9 \cdot 0.83 \cdot 50^2 = -113.0875 \text{ kg m}$$

On half wing we will have:

$$M_{Half-Wing} = 56.54375 \text{ kg m}$$

Structural Checks

If the wing, e.g. has an 18 % thick airfoil, we can consider that the max height to be considered for the spar is:

$$H_{SPAR} = C \cdot Thk - Thk_{SKIN} = 990 \cdot 18 - 2 \cdot 1.50 = 175.20 \text{ mm}$$

The spar width will be, if the spar section was rectangular.

$$B = 6 \cdot \frac{M_{MAX}}{\sigma \cdot H_{SPAR}^2} = 6 \cdot \frac{1209.567 \cdot 100}{380 \cdot 17.5^2} = 6.22199 \text{ cm = 69.122 mm}$$

Such a spar will be simple but heavy. Considering a box spar with rectangular caps having:

$$B = 70 \text{ mm}$$

We will evaluate the cap thickness with the:

$$T_{CAP}^3 = H^3 - \frac{6 \cdot M_{MAX} \cdot H_{SPAR}}{\sigma \cdot B} = 17.5^3 - \frac{6 \cdot 120956.7 \cdot 17.5}{380 \cdot 7} = 584.768 \text{ cm}^3$$

$$T_{CAP} = 8.36 \text{ cm}$$

It is evident that the width B must be increased. Further calculations are needed.
Let' find out the webs thickness with the:

$$T_{WEB} = 1.50 \cdot \frac{S_{MAX}}{\tau \cdot H_{SPAR}} = 1.50 \cdot \frac{415.8688}{120 \cdot 17.52} = 0.296 \text{ cm = 2.967 mm}$$

We will use two webs 1.50 mm thick using birch plywood with fibers oriented at 45 °.

For the wing torsion calculations we have to consider the following formula:

$$t_{SKIN} = \frac{M_T}{2 \cdot A \cdot \tau} = \frac{56.54375 \cdot 100}{2 \cdot 600 \cdot 120} = 0.039266 \text{ cm}$$

A skin 0.392 mm thick would be **theoretically** sufficient to hold the aerodynamic torsion but we have also to check the deformation of the wing.

For the sake of simplicity we have to use the following formula to find out the wing rotation:

$$d\varphi = \frac{M_T \cdot P}{4A^2 \cdot t_{SKIN} \cdot G} dx$$

We have to prepare a table to calculate the angle of torsion and this will be of the following type:

Station	M_T **kg cm**	A **cm**^{2}	P **cm**	t_{SKIN} **cm**	$d\varphi$ **rad**	dy **cm**	$d\varphi \cdot dy$ **rad cm**
0.000	0.000					0.000	
0.600						60.00	
1.200						60.00	
1.800						60.00	
…….						…….	
…….						…….	
6.100	5654.375						
					$\sum d\varphi$		$\sum d\varphi \cdot dy$

The variation of the wing torsion along the span will be calculated it considering that the torsion is proportional to the wing area, e.g.

$$M_{TX} = \frac{M_{MAX} \cdot S_X}{S/2}$$

At Station 3.100 from the tip (i.e. where the rectangular part start) we will have:

$$M_{TX} = \frac{5654.375 \cdot (0.99 + 0.5) \cdot 3.1/2}{10.9/2} = 2396.106 \quad \text{kg cm}$$

An example related to the root Station of the:

$$d\varphi = \frac{5654.375 \cdot 100}{4 \cdot 566^2 \cdot 0.20 \cdot 40000} = 0.000055027 \ \text{rad}$$

in which the perimeter of the caisson P is considered 100 cm long and the wing skin thickness is evaluated in 0.20 cm or 2 mm.

N.B. this value has been used just to introduce a number in the formula; the exact thickness must be calculated and chosen by the designer.

The total rotation will be found calculating the value of the total of the sum shown in the last column and this must be multiplied by 57.30 to get the wing rotation in degrees.

Conclusion

The above has been prepared with the scope to encourage creative people loving aviation and gliders helping them to develop ideas in practical results. It is evident that this is just a first step and much more must be said in order to design a wing in the best way. Nevertheless these calculations are helpful in order to find the approximate weight of the wing parts and to estimate the C.G. position.

Without these estimates we cannot calculate the glider stability and also the influence of other factors connected to the wing weight.

The above is only a simple trace to start, remembering that glider design that must be done according to the existing rules.

Mitchell U-2 Threads:

Rudders

Posted by: "Tim" tmpilot84@yahoo.com

It is slow on this site so thought I would thro out an A10 question. I am working on a A10 that has never been flown. What is the setting on the rudders? It seems like I read awhile back that there is suppose to be a toe-in on them. Is there a easy way to set them? It looks like the fiberglass on the wing tips is what holds them at a set toe-in.

Posted by: "Joe Cook" JoeCook1@thegrid.net

Yes, the A-10 rudders are set with toe-in to provide additional yaw stability. From Para. 1A-3 - Flight Controls of the A-10 Owner's Flight Manual: "The rudders are rigged at 16 degrees toe-in relative to the wing line which equals 4 degrees relative to the line of flight (12 degrees sweepback). Full rudder is rigged to 80 degrees deployment." You can stretch a snap line from tip to tip at the axes of the rudders and use that as a datum to measure the 4 degrees toe-in against.

If you don't have the manual, you might also need the stabilator settings. Same para: "Stabilator movements relative to the wing chord range from 6 degrees negative (stick full forward) to 25 degrees positive (stick full aft), thus insuring positive pitch stability."

I bought the Manual from Larry Smith at Ameriplanes in '99. Don't know if he still sells them, but well worth the purchase price for any A-10 owner It's 42 pages plus 18 pages of Figures and info in the Appendix.

Nurflugel Threads:

Hang Glider Flutter

Posted by: ssspoon@aol.com

A few days ago Bob wrote;

> "I am stating the obvious, but flutter creates drag and destroys lift ... there is NO energy gain from the oscillation.
>
> At the same time, I was initially curious, and upon reflection horrified when an ultralight Rogallo type bird claimed that their distinctive TE flutter 1) added stability (!!) and 2) was a safety benefit, cropping up when the craft was in danger of exceeding max safe speed!
>
> IMHO, like claiming if your craft disintegrates around you, the "automatic ejection" is a safety benefit!"

Bob shame on you with all your experience failing to look at the glass as half full.

I being an old time hang glider pilot think I know where he was coming from.

The early hang gliders were not very rigid compared to what we have today.

The unsupported trailing edge cloth would sometimes flap with greater ferocity as speed increased.

I can't make claims to additional stability but the flapping trailing edge increased drag to the extent that a lower terminal velocity was achieved had there been no flapping, and thereby increased safety, in that a crash might have been experienced at say only 45 miles per hour rather than 55, and resulted in only total paralysis rather than expiration.

Posted by: msmprod@optushome.com.au

I tend to agree, Larry. When flying in Scotland, in the early '70s, trailing edge laughing was common. On the first hang glider I designed and built for myself (due to my light weight at the time: 17 stones!) I used women corset's busks, joined together, to stiffen the trailing edge. It worked quite well. I still have the photos, if of any interest. The sails area was 320 sq/ft and the glider weighed 75 lb.

Posted by: Denoferth@aol.com

I was looking through my soaring videos and came across 1984 VCR with one "horrific" shot of a glass sailplane in flutter mode. It's "Boundaries" by Grenz Schicht. "Sailplanes in the service of science. English version, 30 minutes. This film shows the testing of new production and experimental sailplanes. Stunning recordings of flutter on wings and tail surfaces, and rare footage of historic sailplanes, including the Horten flying wing. Computer graphics shows complex calculations simplified and easy to understand. A must for glider schools and clubs." It was distributed by Scott Airpark, 12582 Lutheran Rd., Locettsville, VA 22180-9406.

It shows two methods of establishing polars and explains the process, has interviews with German notables, is nearly all flying or preparing to fly, and does have a few shots of the Horten and the All Wing.

AVAILABLE PLANS & REFERENCE MATERIAL

Coming Soon: Tailless Aircraft Bibliography Edition 1-g

Edition 1-f, which is sold out, contained over 5600 annotated tailless aircraft and related listings: reports, papers, books, articles, patents, etc. of 1867 - present, listed chronologically and supported by introductory material, 3 Appendices, and other helpful information. Historical overview. Information on sources, location and acquisition of material. Alphabetical listing of 370 creators of tailless and related aircraft, including dates and configurations. More. Only a limited number printed. Not cross referenced: 342 pages. It was spiral bound in plain black vinyl. By far the largest ever of its kind - a unique source of hardcore information.

But don't despair, Edition 1-g is in the works and will be bigger and better than ever. It will also include a very extensive listing of the relevant U.S. patents, which may be the most comprehensive one ever put together. A publication date has not been set yet, so check back here once in a while.

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

Cost: $5.00 postage paid
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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
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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.

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