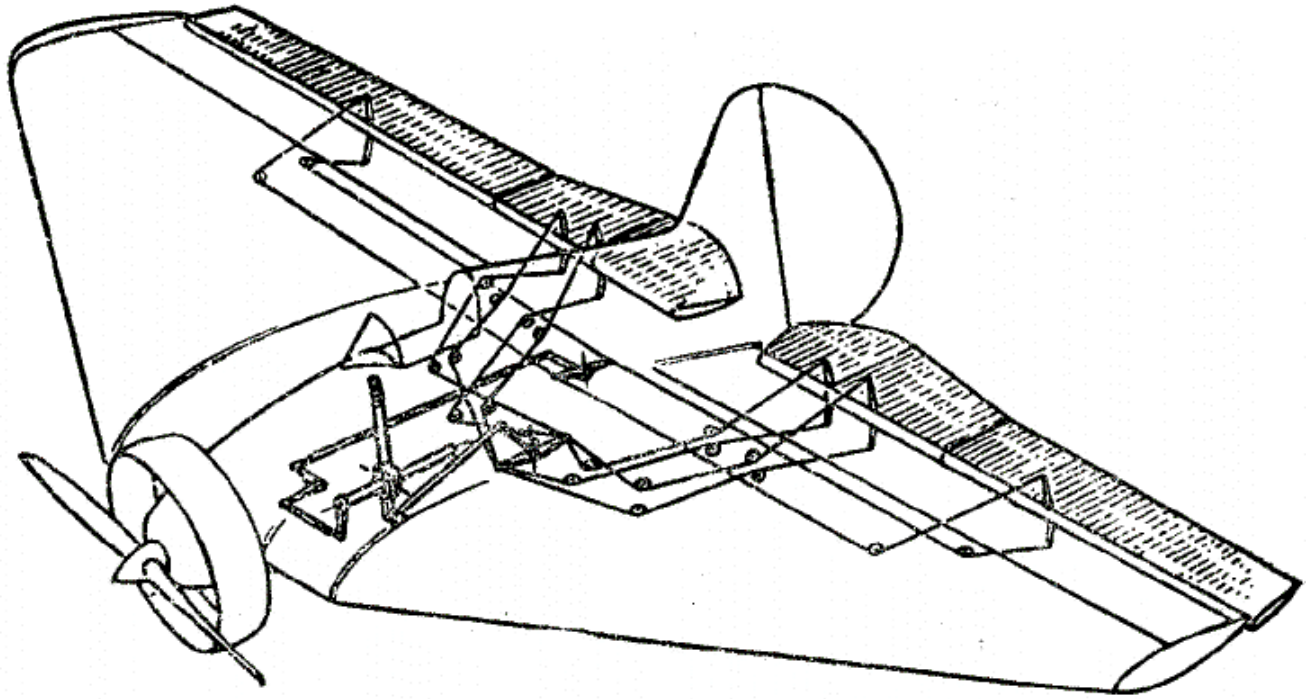
**No. 214** **APRIL 2004**

# T.W.I.T.T. NEWSLETTER

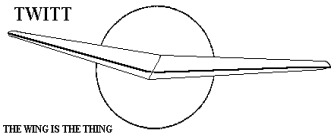


For more on this Arup design see the material on page 9 inside and visit this website (although it is entirely in Russian) http://www.mkmagazin.almanacwhf.ru/avia/bok_5_mk77.htm

**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., **0404** means this is your last issue unless renewed.

**Next TWITT meeting: Saturday, May 15, 2004, 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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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

As with all things, they come in good time. I am sorry that this issue is a little late, but I had been very busy with the final phases of planning for a professional association conference here in San Diego. It is now all over with and we were very pleased with the outcome both in attendance (record setting) and material delivered to those attending. Won't have to worry about that again for another year.

We were pleased to learn that one of TWITT's hanger mates, Wayne Donaldson, who owns the Stinson Reliant, was sworn in by the state of California to lead the Office of Historic Preservation. In this office he will uphold state and federal preservation laws and standards governing historic structures and sites, provide opinions on proposed changes to landmarks and help promote protection of cultural resources. Wayne's actions as a historical preservationist were evident in his efforts to save the Western Metal Supply Co. building in downtown San Diego that is nearly a century old. The building was actually incorporated into the newly built San Diego Padres' baseball park for old and young alike to marvel in this historic landmark from San Diego's early years.

One of the co-renters of the hanger we share with people who actually have airplanes and fly them quite regularly is Doug Fronius. He is the Director of Unmanned Systems for Northrop Grumman working out of their Rancho Bernardo, CA facility. Over the years, Doug has been involved in the Global Hawk, Fire Scout, and BQM-74E programs, and has occasionally talked about the programs at TWITT and SHA gatherings.

I hope everyone is working hard on their latest project, whether it be a full size or model aircraft. Take a few minutes and drop us a line on your progress, and include a couple of pictures while you're at it.

Andy

**MAY 15, 2004**

**PROGRAM**

We are still exploring several possibilities for programs for May, so stay tuned to the website if you are on-line or look for the announcement in next month's newsletter.

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## MARCH 20, 2004 MEETING RECAP

Andy got the meeting started by welcoming the small, but hard-core group to the hanger and thanking our speaker for stepping in at the last moment. He then rolled right into the program featuring Ray Cote and the Ryson Cloudster motor glider.

The basis for the presentation was Ray's flight from El Mirage, California to Oshkosh, WI in the Cloudster using only 28 gallons of fuel for the 1,800-mile trip. This involved about 13 hours of power flight and 20 hours of soaring flight over 5-days and 4-nights. Bob Fronius sealed and signed the tank filler caps as part of the certification for the flight. Ray kept heading in about a northeasterly direction never varying more that about a hundred miles either side of his planned route and then only to fly in good lift to reduce power time.

**ABOVE:** This is the Cloudster in its folded, hangered configuration. It has been in storage for a while after the start of an annual that hasn't been finished. It has an engine cowling and wheel pants, which make it look much sleeker when installed.

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Each day would begin with a powered climb to an altitude sufficient enough to catch the available thermals and then soar as much as possible. When the lift was weak or he was over inhospitable territory he did have the engine on at a low power setting to provide some degree of safety. At the end of each day he would find a small airport where he could glide in and camp out for the night. In the morning, after it looked like the lift was forming, he would push the glider out to the end of the runway, start the engine and immediately takeoff to conserve fuel.


**ABOVE:** Ray Cote (left) during his presentation with Gavin Slater and Bob Chase listening to how he was able to make this cross-country trip.

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The first night he stopped at Cedar City, Utah, the second day he managed to get to Craig, Colorado, and the third evening was in Oshkosh, Nebraska. AT this point he encountered a severe cold front that made the going very hard and dangerous. Mr. Ryan told Ray to try and complete the trip by the deadline, but if he couldn't because of the weather, then that would be okay. Not long after that conversation, the weather broke and Ray headed out for Oshkosh, WI, arriving with just 4-gallons of gas in the Cloudster's tanks. He had managed to soar the last 100 miles or so into Oshkosh and landed as a glider, including rolling up to the podium where Mr. Ryan was standing.

He averaged about 55 mph for the trip, which was the best L/D of the motorglider. He obviously made the most efficient use of both the powered and soaring capabilities of the glider during the trip. Powered flight was usually at about 1,500 rpm at high pitch while burning about 1.5 gallons an hour at those settings. His highest altitude along the way was 16,000', south of Las Vegas, Nevada, which gave him the necessary

altitude to venture into Fire Valley and reach Cedar City.

Ray used all types of lift during the trip. Obviously, he used thermals in Nevada to get to altitude, but he also used a lot of ridge lift in the mountainous areas along his route of flight. When leaving Craig he got stuck in a valley for nearly 45-minutes trying to work his way out of the down, but once free he climbed to 10,000' and pressed on at best L/D. He emphasized that he never did any high-speed cruising, but always used 55 mph to get the most efficient performance not speed.



These are a couple of shots I found on the Internet of the Cloudster, but I can't tell the name of the airport. This gives you a good idea of the aircraft in the fully configured condition, including the wheel pants on both the mains and tailwheel.
http://www.fotoimages.com/aircraft/JAP.htm

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With the tanks still sealed and using just the last 4-gallons, Ray went out on the CAFÉ efficiency contest held at Oshkosh, however, the rainy conditions impacted the L/D too much and he wasn't able to win the event. If the cross-country trip was any indication of the Cloudster's efficiency, he probably could have taken the prize if the weather had cooperated.

Ray went through a series of slides giving us a good idea of the kind of country he had to cross while making his way to Oshkosh. A lot of it was wilderness without much in the way of civilization around in the event of an engine failure and no lift. But he also got to see some really beautiful parts of Arizona and New Mexico that most people don't have the opportunity to witness.

Once the festivities were over at Oshkosh, Ray took the Cloudster to Elmira, New York for more displays and somewhat of a promotional tour for the motorglider. Mr. Ryan had made a proposal to Schweizer Aircraft to build the Cloudster, but the deal fell through and Schweizer went on to build their own version of a motorglider that never caught on. His trip continued along the east coast glider ports showing the performance capabilities of the aircraft, since the plans were to put the Cloudster into production, something that did not come to fruition.

One of the slides showed the Cloudster towing a Schweizer 1-26. Bob Fronius had rigged a tow hook to it and Ray said it made a very good tow plane for 1-26s and 2-33s.

Once Ray finished with the presentation on his trip with the Cloudster, he showed a video of the 2000 Reno Air Races, where he won the Formula One Gold Cup event in his aircraft, Alley Cat. This was the last year that he won, since the 2001 races were cancelled and for 2002/2003 the plane was flown by a another pilot.


This is a model of the Cloudster available from the following website. It looks like it is very true to scale.
http://www.modelhangar.cz/index.php?in=bazar&kat=1&posun=2

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Bob Chase gave us a copy of the announcement indicating he has been named the US Ultralight Association's Region 11 Representative, which covers California, Hawaii, Nevada and Guam.

Bob has had a life-long interest in tailless and flying wing type aircraft. He built his first tailless model aircraft when he was seven.

He is currently a member of the Sport Flyers of Southern California (USUA Club #017) and the Ultralight Squadron of America in Perris, CA. He has been a long-time member of TWITT and once served as our Vice President.

Congratulations to Bob on his new position.

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## LETTERS TO THE EDITOR

March 14, 2004

Dear Andy:

Just got my March Newsletter and was very happy to see the photos of the BKB on the first page. Finally! Now people can see what she looks like, unfortunately I was only able to get one flight in her, although I spent thousands of hours building her. She was designed by my friend Stefan Brochocki. We both worked at Canadair in Montreal in the fifties. We both belonged to the Montreal Gliding Club, which was sponsored by Canadair. Stefan was a pilot in the Polish Air Force in England during the war and flew Wellington Bombers, and after two tours of active Bombing raids, became a pilot ferrying B-24s from Montreal to Karachi (India) towards the end of the war. (To build up the eastern air force of the RAF) Stefan had learned to soar in Poland before the war and his instructor was a guy called Witold Kasperzyk who apparently was a very good pilot. Well he, Kasper, as he called himself, turned up as an employee at Canadair and worked as an inspector, on the floor. They called themselves Liaison Engineers. I was working at that time on a small Jet trainer, designing flight controls. It became what is now known as the SNOW BIRD, the aerobatic display plane of the Canadian Air force.

One day out at the gliding club, on a weekend Stephan approached me with a plan to design and build a tailless glider, he said he had been dreaming about for years. He then showed me some sketches and I could see that he had given this some deep thought so I agreed to work with him on a project to build a prototype plane, with a possible future of producing it. It looked exactly like the photo. And I liked it right away. Now came the question where to build it. He lived in an apartment, with his wife and two children, and I lived in a rented room. So he said he knew somebody who might help us. The next week he introduced me to a man named Kasper, who also worked at Canadair. Apparently he had an apartment with an empty basement he was willing to rent us. I didn't like the man and said so. So he talked me into agreeing to try it and I gave in, not knowing that he had agreed with Kasper to also help with the work and become a partner.

So we started buying materials, tools, etc. As we started to work on the plane, I made drawings and so did Stefan and Kasper occasionally came and looked and gave advice how to do things. They always talked Polish so I couldn't understand what they were talking about. Finally he, Kasper, said he would help, also. But his motto was: This is no PHARMACY! Consequently I had to redo most of his shoddy work and I told Stefan about it but he wouldn't believe it. By that time we had spent a lot of time and money on our project, and it would have been a pity to waste it so we carried on.

Finally after two years of hard work and many hours of discussions etc., the plane was ready to test fly (Kasper had left by then, saying he would go to Boeing because he had some connection there. But the agreement we had made that the three original builders would each have the same rights and use of the plane for one year after the first flight, still stood. Stefan was the one to do the first flight and on the big day he seemed a little nervous to me, but he said he was okay so we arranged a car tow to about20 feet but something went wrong. He started some violent PIO's released and landed violently hitting the ground. The canopy, a beautiful blown Plexiglas affair fell off and broke. Stefan climbed out and walked to his car and drove away. We pushed the plane hack into the hanger. I gave it a thorough inspection and found nothing wrong. There started a lot of discussions but nobody could figure out what had happened.

The next Monday morning, Stefan came to me and we started going over the whole debacle. He was very sorry about how he had behaved but said that he thought that the test flying should be done by a qualified test pilot, which he wasn't. He would try and find one, which he did. He knew a test pilot who was test flying the F-86 Canadair was building at that time and was also a keen glider pilot. His name was David Marsden. He had already talked to him and he agreed to do it, but it would have to wait for a few weeks.

Now I was asked by my boss if I would like to go to Boeing for a year to work there on a common project. They had an agreement with them to borrow

engineers, from us. It was just before the winter would start and I thought that would be nice to get away from the 30 degree whether we normally had. So I agreed to go. Besides, they promised me a nice raise! So now what to do about the BKB?

I decided to give my part of the deal, lock stock and barrel to my friend Dave Webb who was then the Soaring champion of Canada Flying a Skylark. So off I went to Seattle to work for Boeing, for a year. But they put me to work on the B727 instead of the Bomark Missile, as planned. I didn't mind for I am a peaceful fellow. I enjoyed living in Seattle and the year went quickly. I finished the landing gear control system design as promised and it turned out to work well. They never had a failure in 4,000 planes.

Now I returned to Montreal and left Canadair for a job to work for McGill University on a site in Barbados in the Caribbean where they have a research establishment called Brace Institute where they do research in wind and solar energy. They had a nice machine shop and needed a supervisor for it. So, that's what I did for the next 5 years. I tested various windmills, designed a wind rotor to pump water cheaply for underdeveloped, third world countries, rebuilt a huge French built Andreau Windmill, 40 feet high with a 20 foot diameter propeller which was not very efficient. Wrote reports about my experiments etc., etc.

Before I had left for Seattle to work at Boeing, Dave Marsden had flown the BKB and made several changes to the elevon system, putting stronger springs for balance and also to the wing tip rudders to increase the rudders quickness. I got the opportunity to make a flight in the late afternoon on the weekend. I took a tow up to 3,000 feet and was lucky to catch a weak evening thermal and managed to stay over the field for 45 minutes soaring in slow circles. It was beautiful and I made a good landing just before dark.

After working for five years in Barbados, I got what I think is called island fever, and accepted an offer from Boeing to go back and work on the 747 which they were just starting to design. I did the rudder system, which took about two years and then transferred to the SST design team. This was cancelled after wasting millions of dollars and never-ending arguments with politicians who know nothing about planes and Boeing had to lay off 60,000 people.

During this time I spent in Seattle I had gone one weekend to the gliding club where Kasper was flying the BKB, which he claimed was his design. He had repainted it from black and white to red & white (the Polish national colors). After asking some people where Kasper kept his plane I was told it was over in the broken down cow shed next to the runway. I went there and found my old BKB a heap of broken plywood the wings all smashed lying in a pile next to it all rotting away. I couldn't believe it at first and returned to the person who had told me where to find it. I asked what happened and he told me that the pilot had been killed in it several months ago and it was being kept there for the FAA to inspect. Then I found out after talking to some other people at the flying field that Kasper had permitted some guy who had never flown a sailplane before to fly in it after giving him instructions by gesticulating with his hands. He took off and dove straight down after release, and was killed. He had no license and had never flown a plane before. Kasper told him it was easy! Not only that but I was also told that Kasper had obtained a patent from the US patent office for designing the plane.

I certainly think it would be possible to recreate the plane with today's modern materials and methods if somebody was interested to do so. I am sure Stefan would give him all the necessary support. I believe that the original drawings still exist unless Kasper stole those too. According to what Dave Webb told me he said he thought that the performance was better than his own Skylark, which is a great compliment. I am sure that Stefan and Stefanie who has done so much hard work too would be proud to see it fly again, and so would I.

Best wishes,

Alfred Bodek
26012 Eshelman Av.
Lomita CA 90717

No Computer, No Web, No TV, No worry

*(ed. – Thank you for the great story on the development of the BKB. There has been some interest in the sailplane over the years, but until a set of plans becomes available not much can be done. I do agree that it needs to be done in modern materials to reduce the overall weight and perhaps incorporate some of the more modern airfoils that have become available in subsequent years. Hopefully, Stefanie will have some good news about all of this in the future.*

*I love the simplicity of your ending commentary. Sometimes I think technology has taken over too much of our lives.)*

March 30, 2004

TWITT:

Enclosed is my check to renew my membership for another year. Enjoy the newsletter very much. Keep up the great job you are doing.

Enclosed is a newspaper clipping from last Friday's Sacramento Bee. I tried to trace the company down. This may be of interest to both groups, SHA and TWITT.

H. Fred Blanton
Vacaville, CA

*(ed. – Thanks for the renewal. We are always pleased when our members keep coming back, since it means we must be doing something right.*

*What Fred is talking about is a portable fuel cell power system that exceeds the capabilities of a comparable conventional battery pack. The application covered in the article was for TV cameras, but I think Fred is looking at it as a potential power source for an electric powered motorglider. Below is a press release piece from their website:*

*http://www.jadoopower.com/index.html*

*"March 11, 2004 Jadoo Power Systems Delivers Fuel Cell Product to Local TV Station Jadoo Power Systems, a leading provider of portable fuel cell power systems, announced today that it had delivered its professional video camera power system, the NABII, to KOVR, the CBS affiliate in Sacramento, CA."*

*A TV cameraman has been testing the system and indicated he has gotten 4 hours 45 minutes out of one unit, whereas the comparable battery would have only lasted 20-40 minutes.*

*The website has the following specifications:*

| | |
|---|---|
| *Peak Power* | *60 watts* |
| *Voltage* | *Compatible with 12-14.4 volt systems* |
| *Runtime* | *145 Whrs* |

*Since I am not an electrical engineer I don't know how these numbers compare with battery or solar cell output in terms of powering an electric motor to provide the necessary thrust for a launch. If someone has an idea on whether or not it would work, we would like to hear from you. The units are little pricey at $4,000, which they say is about the same as the regular batteries they replace.)*

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February 28, 2004

TWITT:

I am enclosing US dollars for my 2004 subscription renewal.

I wish I could attend your meetings, but the distance is too much; it is a pity I did not know about TWITT in 1968, when I was working in the Silicon Valley and living in Palo Alto.

Keep up the good work.

Sincerely,

Ferdinando Galè
BAVENO, ITALY

*(ed. – Thanks for the renewal. It would have been difficult to learn of TWITT when you were in California, since it wasn't conceived and formed until 1986, but we appreciate the thought.)*

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March 15, 2004

TWITT:

**Y**es! I vote to go "pure electronic" with the newsletter. If this is the future, then let it be.

Eugene F. Turner
San Jacinto, CA

*(ed. – This was in response to some earlier discussions about switching to an electronic format for the newsletter for those members that would prefer such a service. Our survey results suggested that this was not a preferred method by those who responded, most wanting the commercially printed version since it was a better alternative to sending a file to their personal printer.*

*Recently, R/C Soaring Digest took a survey of its subscribers and based on the results have decided to go to a pure electronic publication of their newsletter. They generally have a more computer oriented base than TWITT, so for them it will probably work very well.*

*I don't plan on pursuing the electronic option for TWITT at the present time. If I get a different response from our membership over time, then I will revisit the issue and see if a mix of mailing and electronic would be a viable option to satisfy everyone. If you have a specific opinion, I would beglad to hear it.)*

*(ed. - These are some of the threads that have been running around on the Nurflugel mailing list in the past several weeks. I have not included the addresses, names, etc., of the originators and repliers since that takes a lot of work and probably no one really cares. I also did not do a lot of work cleaning up spelling errors or short cuts to the English language, so don't blame any of it on me.)*

**Subject: Northrop N9M**

I am kicking around ideas for an N9M model again, does anyone know the wing thickness used on the original? It wouldn't look right with a skinny section.

As I understand it, the pusher props also acted as vertical surfaces, which is why there were no fins on the N9M. So what happens if the props stop turning in flight?

The craft would start to develop a side oscillatory motion, which would be possible (but very difficult) to control for an expert pilot. Yeah, dutch-rolling - that's what I figured! Sounds like the props had better keep turning all the time then.

I have built three flying N9M models over the last year. They have wingspans of 8, 6.5 and 4 feet. I am currently building a flying N9M model with a 154" wingspan.

I have flown all of my model N9M's without power and what I find is that they fly well with and without the props turning. I do not experience any control difficulties. I have a twin-engine electric version (78" wingspan) that I take up several hundred feet and turn the engines off and catch a thermal or two.

The engines do add some stabilization when they are turning and it is slightly noticeable when I am flying the model, but the model is not destabilized and or even mildly uncontrollable when the engines are off. I have even flown my twin-engine models on one engine and they are still flyable.

That electric one sounds about the size I was thinking of (I don't fly slimers any more). What power setup do you have in it?

I am using two inexpensive Speed 400's, two controllers and one, 2400 mAh eight cell battery pack mounted in the nose. I get about 15 minutes of flight time with throttle management. The plane weighs 3 pounds 1 oz and flies on about 1/2 throttle.

You can view pictures of this plane at

http://photos.yahoo.com/northropn9m

Select the album titled "Electric Wing."

A few years back when the N9M was restored the first test flight had engine problems requiring shutting down. It became a very good glider and landed without mishap. The whole thing was on the evening news broadcast in Southern California. Film ... er ... videotape may still be available from some of the local affiliates.

Stability of the N9M never appeared to be a problem. Power, rather, the lack there of was. (Okay, shoot me if I'm mistaken here). Changes in the development program, when later models where changed from prop to jet power had some loss of control so rudders were added (looked like bad placement to me) to recover some of that loss. Of course, the whole program had required so many changes the aircraft was no longer properly balanced so who really knows what the problems where. Have seen at least two versions of why the flying wings crashed killing Glen Edwards and crew. Who is to say what the truth is.

From my own experiments: I took a powered Zagi (similar planform), removed the tip rudders and flew it in a all wing configuration using the motor for launch only. It flew okay (at least I thought so) as long as the control inputs were not excessive, which could cause very bad adverse yaw and loss of control (not a great model pilot). I have seen guys with the glider version (with tip rudders) do amazing stuff, but they are about half the wing loading.

That is exactly what I was thinking of. I like the little Sp400 jobs.

Hey, I know a Klingberg Wing when I see one! Mine is still in the box, waiting for me to get off my backside and build it. From what I've seen, Rol Klingberg took his design directly from the N9M anyway.

Your wing ribs seem thinner than those in the KW kit, what section did you use?

Thanks, I've found the sections now.

NACA 65,3.018 at the tip, 019 at the root, and 024 around the cockpit.

I've never tried building a model with sections that thick - it would certainly make a strong spar!

The airfoil is an Eppler 334.

Yep they were NACA 6 series airfoils. Don't use them on a model the pressure distribution guarantees that you'll have high drag and a bad stall.

I've never built a wing more than 14% thick, and that was starting to get draggy. I'd prefer a section that looks at least similar to the full size, a modern thin airfoil would change the appearance of the plane completely.

I could always use NACA 0018, or copy the section from the Klingberg Wing...

Size is undecided yet, easiest to build is about 70" span because that makes the LE a convenient 36" length. If I can get hold of some 48" balsa without too much hassle then I could go up to 90" span, although Sp600 motors would be more practical then.

Steve, all the versions blend together during the 16-hour workdays here on my farm. Will have to pull my reference books out of storage and check again, but am certain either the N9M or the version just prior was so underpowered it barely cleared Santa Monica mountains during its early flights.

None the less, the one up at Chino makes the air show circuits. Its a beaut to watch fly. I have pictures somewhere.....:~

It was the one before, the N-1M, which was pretty much a flying test bed.

From "The flying wings of Jack Northrop" by Garry R Pape: "The N-1M flew most of its life with 117 h.p. Franklin engines and three-bladed propellers. Though considered quite underpowered, this configuration was an improvement over the original 65 h.p. Lycoming engines and two-bladed propeller combination."

Yep, that's the N9M. I'd really like to see that one day, I have photos but it's not the same as actually being there. Maybe one day.

Of all the Northrop nurflugels, I'm especially fond of the N-1M as without the extensive changes and mods, none of the pretty and exotic follow-ons would have been nearly as successful. It flew with varied sweep, dihedral, tip kickup and kick downs, washouts, airfoils and yaw control variations. I was present at the NASM restoration, and even the right and left wing structure varied quite a bit under the skin, full reason unknown, but probably due to repairs and mods.

Not well known, but Hawley Bowlus and Don Mitchell built a swept planform pre-war flying wing glider that used some parts from existing Bowlus designs, and exchanged notes and ideas with the Northrop folks. Lots of Don's flying wing ultralight designs were influenced (instigated?) by these experiments.

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**Subject: Russian BOK-5 and Arup info found!**

Thanks to Ronald L Shoemaker <jppp@juno.com> I got the following URL.

http://www.mkmagazin.almanacwhf.ru/avia/bok_5_mk77.htm

It shows some drawings of the BOK-5 flying wing and a Arup. GOOD DRAWINGS! Pity, the text is in Russian. Any Russians here on the list?

<babelfish.altavista.com> is able to translate the page into English. The translation may be less than perfect but is for sure much better than my Russian! :-)

Another page about the BOK-5.

http://www.mkmagazin.almanacwhf.ru/avia/bok_5.htm

Wouldn't those tip rudders, being so far ahead, be ineffectual if not down right destabilizing?

It doesn't look like it will fly. At least not with me in it. It looks like it would be highly unstable

Guys, if you are talking about the K-12. Yep, it does not fly. That was proved during the test-"flights". The designer was send to Siberia or somewhere else to prevent other designs of him being used. Well, that is the story I heard.

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**Subject: H IV images**

http://www.segelflug.de/gallery/Horten-IV?&page=1

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**Subject: UIUC Data Base**

Does anyone know what happened to the UIUC Airfoil Coordinates Data Base site. Someone on another forum remarked that he had been unable to access it for weeks, and I can't get it to come up using my "Favorites" links.

A hacker attacked it, so it went down for a while. It came up under a slightly different URL: http://www.aae.uiuc.edu/m-selig/ads.html My Incomplete Guide to Airfoil Usage also moved, to:

http://www.aae.uiuc.edu/m-selig/ads/aircraft.html

Try: http://www.aae.uiuc.edu/m-selig/ads/coord_database.html

Mike Selig keeps it up for us. Good resource.

Well, it's still on line. I guess there were changes. It comes up at...

http://www.aae.uiuc.edu/m-selig/ads/coord_database.html

I was trying at:

http://amber.aae.uiuc.edu/~m-selig/ads/coord_database.html

which must be obsolete. Sorry.

The site URLs are subject to change, but the link given below is a portal, which will always take you directly to the current location(s).

http://www.uiuc.edu/ph/www/m-selig

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**Subject: Horten H X glider**

Glad to see you again. How is your Horten H Xb doing? Were you able to get or make the missing plans? Did you start construction? This glider still has a lot of my interest. You mention how bad flight behavior of the Urubu when the wings are dirty. Do the H X's have the same problem? I hope not.

Currently thinking about designing a glider for next years Red Bulls Flugtag in Antwerp. I consider a flying wing. Pelican dimensions or H X dimensions. Not sure yet. Also not sure if I will find the time because I am already building a wooden Flying Flea glider. Well, we will see where this idea gets. Anyway ... I want to know more about the flying of the H X's. And I might try it this way. But I can assure you that I first will use the glider as a windjammer. This means that I place the glider in the wind and use the controls to keep the wings level. Maybe even try to stand to hold the glider up a bit. But ... again ... I will see if I can do this while still working on the wooden glider. By the way, the Flugtag model will be made out of cheap materials because those flights end in ... water. So, probably a single flight before destruction. Might consider a few hops on a nearby hang glider learning hill of 20 m high.

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**Subject: Slightly off subject**

I am building a carbon epoxy sandwich single piece wing, and was wondering if anyone could help me with weight. Whenever I see other designs of the same size of the same construction, they are always extremely light. My designs always seem to be heavy. I am using polystyrene and thinking of drilling holes in it to reduce weight as the carbon will bridge the gaps like it would with honeycomb. I am using 3 layers of 3 x 3 k carbon and West System epoxy. Aluminum honeycomb is to hard to form, and plastic honeycomb is heavier than the foam.

When it comes to the finish I want the carbon to show through so I leave the clear epoxy finish. After long experimentation to achieve a glossy uniform finish (I lay down a layer of epoxy and let it gel in the mold before I lay up any carbon) but I get air bubbles in between the perfect outer finish, and the carbon weave.

Any ideas?

What are your construction techniques? Vacuum bagging? From below, you use a female mold, but it doesn't seem that you use vacuum bagging. Use vacuum bagging.

Whenever we have gaps, either in foam or honeycomb, there will be some sagging across the gap. A golf ball texture is ok for the Inner-Most-Layer (IML), but it is horrible for the Outer-Most-Layer (OML). [love this jargon ;-) I think we get paid by the acronym] Are you using a female mold or mold less construction techniques?

Why 3 layers? What's your lay-up schedule and how does that match your structural numbers? What is your spar doing? The skin is for shear and torsion. The spar with spar cap is for flight loads. How have you got them designed?

Why not use the aramid honeycomb, like ECA 1/8" cell size - 1.8 lbs per cubic foot from Euro-Composites? They are on the web.

Better not be in the sun then. On a 100°F sunny day, the black carbon finish will reach 200°F, which is above the Tg of the West Systems epoxy.

So you want to build light, well, here goes: Release the mold correctly. Spray in an acrylic urethane clear paint with UV block, just like any good car clear coat. If you don't, the UV will degrade the epoxy resin's strength. Powder anyone? Let the acrylic urethane paint dry to a tack. When it's ready, wet out and squeegee the

pre-cut carbon on the 3 mil poly plastic sheeting (Associated Bag 4ft x 100ft ~$10) on your flat table. Carry the carbon and plastic carrier to the mold. Position carefully, don't move it too much. Remove the plastic carrier sheeting. When your are finished with your OML, put on the peel ply, bleeder/breather, and vacuum bag it. When this has cured fully, like about a week, debag carefully including the peal ply but leaving the skin in the mold ;-). A fully cured hard outer skin will minimize the golf ball dimples. Sand the OML and clean with reagent grade isopropyl alcohol. Take an epoxy damp lint-free rag and moisten the OML fabric in the mold. Make up a peanut butter of epoxy and micro-balloons to act as a syntactic foam to bond the cured skin to the honeycomb. Spread the epoxy & micro thinly across the OML fabric in the mold. Wet out the IML carbon fabric on the flat table with the plastic carrier, but don't squeegee yet. Place the honeycomb on the wet fabric and press fully into the wet fabric to pre-moisten the cell edges. Maybe even a little wiggling too, but not too vigorously as to deform the carbon fabric weave. Flip the core and moisten the other side. Place the core in the mold. Squeegee the carbon fabric that's still on the plastic sheeting. Place the fabric with the plastic carrier in the mold. Remove the plastic carrier. Finish your lay-up schedule. Put on your peel ply, bleeder/breather, and vacuum bag. Let it cure. More or less, there you have it.

PS Why do so many people run their carbon all the way out to the wing tip? The loads are *zero*! Oh, that's right, tip weights. ;-)

In the long run, it'll cost you more to go without vacuum. A vacuum bagging set up can be made for less than $100 if you know what your are doing with a refrigerator pump. Otherwise retail, see The Composites Store at www.cstsales.com for a ready to go $300 system. I built mine using a surplus vacuum pump used for air conditioning, a motor from Harbor Freight, and an old air compressor tank. Total cost was less than $100. My model wing vacuum pump is made from a small air compressor that could be used as a vacuum pump, a used helium gas tank for balloons, and a few fittings including the shut-off regulator, which I got from Aerospace Composites Products. Check out their web site too. If you use less resin, you'll eventually save that price. There are other sources too. Listeners, let's hear your suggestions, please. If you go without vacuum, you'll pay the "price" with the heavy structure. Sorry, no way around that.

I'm sorry. I'm not following here. You have a female plaster mold for a wing from leading edge to trailing edge? Core or no core, you can vacuum bag.

Wait, let's go back a little. Wings carry massive lifting loads and minimal torsional loads by comparison. Spars carry the flight loads and skins carry the torsional loads. Can you please post a drawing to the Nurflugel files section? Yes, there are spreadsheets.

This called co-curing of the OML, core, and IML. (I'm assuming that your phrase "the other side" is the IML of fabric. It appears that you are using the "other mold half" as a closed mold technique. Is this correct? Pictures would be nice in the files or photos section.

Oh, my!! Euro-composites sells a 4 ft. x 8 ft. sheet of 0.190 inch thick 1/8" dia.cell size aramid honeycomb that has 1.8 lbs./cu.ft. density for around $75 dollars. They have a $500 min. order (7 sheets) but you can get smaller quantities from places like CST but the price is around $110 per half sheet.

In a non-structural part, Tg isn't all that important. Structural it is. So, before we raise the resin temp, let's know what the Tg actually is. PTM&W Aeropoxy has a Tg of 194°F. I personally wouldn't want to trust it, so I'd paint it white. If you *must* have the carbon show, use the higher cure temp epoxy, but you *never* need an autoclave. You just need a simple oven to reach the appropriate cure temp for the appropriate time.

You don't want the fabric to wrinkle or sag while you position it in the tool. Wetting out the fabric in the tool is usually less successful in lowering the resin left in the fabric.

Cure and hard are two different things. That 24 hr cure is not rock hard. Anything less than rock hard will show a honeycomb print-through.

Make one skin at a time. At this point I'm only talking about the outer fabric.

I'm guessing that you are referring to squeezing the lay-up between 2 mold surfaces, like in a closed mold technique. Vacuum is the other side of the mold. Big parts can be made with vacuum bags, while closed mold techniques for boats are *very* expensive. Vacuum is so easy for small parts too.

We must have a wet bond. Wet the skin still in the mold with the wet resin rag and wet the honeycomb with the wet IML fabric still on the table. Jim Marske has pointed out to me that even using just resin and foam and *not* using the micro-balloons makes for a strong structure and weights are almost the same! He says, "We did the micro slurry bit on the prototype Genesis wing and found out the skin partially separated from the foam core when we pulled it out of the mold. So we did an experiment making 2 panels. One using micro and the other using just resin. The first [micro] skin stripped off the foam with no trouble at all. The 2nd skin [resin] could not be stripped off.

Weight difference was very little." Jim also says, "Then we had problems with dimples in the top skin caused by elbows resting on the completed wing. We did some impact testing dropping an 30mm steel ball on a panel from 500 mm [with] the panel laid solid on a concrete floor. Several panels with different density foam cores were used. Our 3 pcf (6mm) foam failed. Also 4 lb failed. 5 lb was acceptable. Interestingly, the weights of the 3 lb and 5 lb panel were the same. There were fewer holes in the 5 lb for the resin to fill." Listen to him folks!

Working with honeycomb results in a stronger lighter structure, but oh my, the extra work! Listen to Jim! Use the 5 lb. density foam and go for the co-cure vacuum bag technique. Please pre-moisten the foam with resin. We can all kiss the micro goodbye. How thick is the foam? It depends upon the torsional forces across the wing.

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**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.

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**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.

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