SILENT ELECTRIC FLYERS SAN DIEGO

*Dedicated to the promotion of* ***electric propulsion*** *in all types of aeromodeling*

# PEAK CHARGE

*April, 2004*
*Volume XVI, issue 4*



## SEFSD Calendar

| Pylon Racing | F5B Contest | Next Meeting | Electroglide |
|---|---|---|---|
| 2nd Saturday | 3rd Sunday | Aerospace Museum | Saturday |
| 11:00 AM | 9:00 AM | Balboa Park | following meeting |
| May 8 | Mazy 16 | 4th Tuesday | 9:00 AM, May 29 |
| | | 7:00 PM, May 25 | |

## Board of Directors

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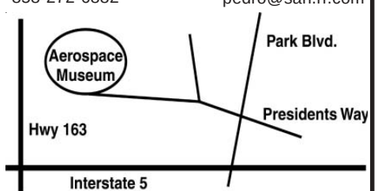
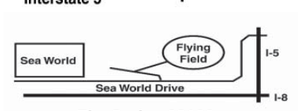



**Zip Code 92109**

**Flying Field GPS Coordinates**
Latitude 32.7625480 Longitude 1721415

web site: http://sefsd.org/

## *Mission Statement*

The objective of the Silent Electric Flyers of San Diego is to promote and further the technology of electric powered R/C aeromodeling; encourage competition in Electric Soaring, Pylon Racing, FAI-F5B/D, Scale, Old Timer, and Pattern Electric categories by hosting major Industry-sponsored events and sanctioning "Fun-Fly" types of contests; provide forums for the exchange of technical information, instruction and experience; and participate in demonstrations of electric propulsion in area-wide model aviation events.

AMA Charter Club 3078







| Pilot | | Round 1 (time/cuts) | Round 2 (time/cuts) | Round 3 (time/cuts) | Round 4 (time/cuts) |
|---|---|---|---|---|---|
| David Fee | | 87.8/1 | DNS | DNS | DNS |
| Travis Flynn | | DNS | 74.7/0 | 71.1/0 | NA/0 |
| Steve Neu | | 78/0 | DNS | DNS | DNS |
| Troy Peterson | | DNF/0 | 70.0/2 | DNF/2 | DNF/1 |

## The March 27 Electroglide

*Don Wemple*

| Pilot | Model | Toss 1 | Toss 2 | Toss 3 | Total |
|---|---|---|---|---|---|
| Dave Kemper | Pulsar 2000 M | 50 | 71 | 54 | 175 |
| Don Wemple | Pulsar | 83 | 0 | 63 | 146 |
| Bob Stinson | Ascent | 23 | 41 | 73 | 137 |
| Russ Parks | Last Down II | 31 | 36 | 26 | 93 |
| Bob Anson | Ascent | 36 | 30 | 16 | 72 |
| Roger Peterson | Quarro | 25 | 20 | 19 | 64 |
| Fred Daugherty | Elexaco | 15 | 24 | 0 | 39 |

Seven pilots for this Electroglide! And even then, some of the regulars were missing! I think that it shows that this event is alive and well here in San Diego!

I missed the general meeting for March, but a phone call from Wayne Walker informed me that there was quite an interest shown in having an "open" Electroglide added to our Club's activities. Many of us who have been flying the event have been in favor of such a move, but we never seemed to get any takers when we mentioned it. But thanks, Wayne, it now looks as though an "open" will be a regular thing.

What we did for this month was to "sandwich" the open flyers (there were only two for this first time) between the tosses for the speed 400 lads. No problems seemed to arise and so this looks as though it will be standard procedure in coming months.

I well know that the word "competition" repels lots of our members, and so I think that getting 10 competitors out on the field is GREAT. But for those of you who have held back for fear of the word, please be assured that our kind of competition is REAL SOFT! You have nothing to gain except to become a better pilot as a result of joining us. And you can do it with the ship you have, or look for something new — either speed 400, or open. We await your joining in the fun.
For more information you can contact either me or Wayne Walker.

The next Electroglide Weekend is Saturday, May 1. The first toss for the speed 400ers will be at 9:30; the first toss for the open class will be at 9:45.

# SEFSD Book and Video List

## Book Title

Electric Motor Handbook
Entering Electrics
Foam Wings
The Quiet Revolution
R/C Airplane Finishing & Detailing
R/C Airplane Building Techniques
R/C Airplane Workshop Secrets
Some back issues of S&E Modeler

## Video Title

1994 KRC Electric Fly
1996 KRC Electric Fly
1997 KRC Electric Fly
1996 London Bridge Seaplanes
1996 NATS Highlights
2000 San Diego Midwinter Electrics
Advanced Kit Conversions
Airborne R/C Video (Fred Harris)
Airplane ( Joe Wurts )
Airforce Top Gun
A Celebration of Eagles
Basic Construction for Beginners
Building with Foam
Byron Originals show season 1985
Desert Storm/ Tornado
Double Eagle
Electric Jet Factory
Electric Flight ( Building & Flying )
Electric Flight & Schneider Cup
Electrifying the FANTASY (Vol. III)
F-16 Falcon
Float Flying – John Sullivan
Gas to Electric Conversions
Learn How to Build a Power Airplane
Let's Get Serious About Electric Flight
Mini-Max Power Gliders
Monokote I
Monokote A
Neat 2001+
Power for Performance Electric Flight
Schneider Sport Electric
T-Birds
U.S. Air Core Basic Building Tips
Vacuum Bagging tips
Warbirds over Schenectady
Wring it Out ( Vol. 1 )
Wring it Out ( Vol. 2 )

## DVD Titles:

Pro Aero Tow
Secrets of Thermals
Endless Lift III
Just Want to Fly
Airshow 2 (2001 MWE

**Listed Videos are available from Uranna Greene**
**Phone: (858) 453-4249 or e-mail:**
**ugreene@san.rr.com**

# March 3rd F5D Pylon Results

**by David Fee**

This month we had no S400 pylon races, rather we focused on F5D so the team members could practice. Travis came down from LA and Troy came from Orange County. We set up the FAI course and flew one at a time, just so we could measure times with a minimum of manpower. The pylon 1 judge used a hand-held FRS radio and pressed the "call" button when the model reached the pylon. The pilot's helper had a matching FRS radio, holding it such that the pilot could hear the audio signal telling him it was time to complete the turn. The particular radios which were used had a negligible time delay for the audio signal on the receiving end, so this method worked well. The only trouble was the occasional conversation coming from Sea World, in which the participants were discussing where to find the free beer.

Ok, so the main goal of the day was to test the power systems and just get some stick time. Steve and I did not fly all the rounds, as we are less motivated than the team members. Steve lent his model to Travis to try, and I broke a prop on landing (yes, I brought more than one). Troy was working hard to complete 10 laps with his 9-cell CP1700 setup, but his motor was just a hair too hot… and he ran out of gas after 8-9 laps. This setup is incredibly fast, but if you can't complete 10 laps, it means nothing. Travis had a battery problem which prevented him from flying round 1, but got it working for the rest. Travis is using the 10-cell 1950 FAUP setup which is very fast, but the cells don't take the abuse well. Steve and I are using 7 GP3000 cells. These have more energy available, despite the lower cell count. Pilot skill is everything, as demonstrated by my time versus Travis flying Steve's model. Travis flew the course 17 seconds faster than I did, with an equivalent power system.

There will be a lot of testing going on in the next few months to find the best setup for the upcoming World Champs in York, England this summer. The high currents required by the 7-cell battery are taking a toll on the controllers, but that is a resolvable issue. New high-current controllers are being developed for the 18-cell F5B gliders, which may be helpful in the pylon racers. Watch this space for updates on the progress of these great racing pilots. Go USA!





# The President's Message

*by David Pitcairn*

As spring gets into full swing there are a number of important events that need to occur in order to prepare us for 2005 and the future longevity of the SEFSD.

First on the Agenda is the MWE. 2004 was a very successful event, due to the hard work of many members. The few glitches we had can be avoided in the future if the planning is started now. The big questions are, do we hold the event next year, when and who will organize it? All those with opinions or input should plan on attending the MWE kickoff meeting Wednesday, May 12th, 7pm, at my house. Email me for directions at dtpitcairn@aol.com.

The second big need is for a PR person to step forward (preferred but not necessary to have a background in Public Relations). This is a newly created position that is vital to the future of the club. This person would become the public front for the club when dealing with the City, Park, and Media representatives. Included in the job would be smoothing the way for the MWE with the city and leading the effort to include the SEFSD in the Mission Bay Parks Master Plan. The latter task is especially important because there is a parking lot planned for the site of our flying field and one day they may not renew our permit. If you care about the future of your favorite flying field, now is the time to step forward. As an aside, I heard another field north up the 15 has been lost, and more will surely disappear, so if we lose this field there may not be anywhere to fly.

Chuck Grim, Don Madison, and David Pitcairn met with the City Manager and Head of the Park Rangers to discuss the MWE and the field. The meeting went well and there seems to be an opportunity to include the club in the Master Plan for the park (see above). The only gripe the Park Rangers had was that a few people are using the field as a bathroom. This is totally unacceptable and does nothing for the City's or Park's image for visitors and residents alike. The fine is $250, which is quite steep, so I would not like any of you to have to pay it. I understand the bathrooms are a bit far to walk to, and it is a pain to open and close the gate, but we must do it. One solution that has been suggested is that people take a friend to help with the gate (carpool) when driving to the bathroom. The alternative is that if this continues to be a problem then the city will require us to have a portapottie (eyesore) at the field. It will be one more thing to take care of and will cause a significant increase in the cost of club membership.

The Board of Directors will now meet regularly on the first Wednesday of every month at 7 pm, so if you would like to attend, send me an email.

I am pleased to report that Captain George Faulkner (Professor Emeritus of Aerospace Engineering at SDSU) will be our guest speaker at the next club meeting! He will be sharing some insights about the "forces" involved with flying, such as lift and drag, and the importance of and reason for the Center of Gravity (C.G.) location. Feel free to bring any aerodynamic or other questions that you would like answered.

## *Wanted!*

### Public Relations Chairperson

This is your chance to ensure the future of the SEFSD, further the MWE, and help promote the club to the City and General Public!

Interested parties should contact David Pitcairn at
**dtpitcairn@aol.com** or **619-865-5929**

# Minutes from the March Meeting

*by David Fee*

**Introduction-**
David Pitcairn called the January meeting to order on 3/23/04 at 7:07 PM. There were three visitors in attendance this evening. Bob Cook, Frank Smith and David Hobby introduced themselves and were greeted accordingly. Bob has only recently discovered our hobby, Frank is back following a 4-year hiatus, and David Hobby flew all the way from Australia to visit us (well, not exactly). David is an accomplished FAI (F5B) competitor and is here on business, but made sure to pay his SEFSD friends a visit.

**Old Business-**
The SEFSD video library has been stable for some time. Any questions or concerns, including requests for new items, should be addressed to Urana Green.

Chuck Grim reported that occasional field maintenance has been performed as usual.

**New Business-**

David Pitcairn mentioned that there had been reports from the park rangers stating that there was a problem with club members using the bushes adjacent to the runway as a restroom. It should go without saying that this is a violation of city ordinance, as well as decency. The city requests that we use the restrooms located at the boat ramp, and we have been notified that failure to comply could result in a requirement that we provide a full-time port-a-potty at the field. Needless to say, this would be expensive and the club would like to avoid the liability. Members expressed concern for those with limited mobility. Although the restrooms are but a short walk away, it is often easier to drive. However, opening and closing the gate becomes an issue. It was advised that a good method for handling this is to go with a friend. The driver can remain in the car while the passenger gets out to open and close the gate. The issue will be addressed in detail at the next board meeting.

*A notice was made that those members and guests who need to use the elevator access to the club meeting room at the Aerospace Museum should call ahead during business hours to ensure that an employee will be present to assist them.*

David Pitcairn and several members of the board are working with the city to get the SEFSD flying field included in the Parks Department's Master Plan. This has been ongoing for some time, but is receiving special attention at the current time. David asked the membership if anyone was interested in acting as a liaison with the city.

There will be a special guest speaker at the April meeting. Dr. George Faulkner of the San Diego State University Department of Aerospace Engineering and Engineering Mechanics will present a lecture on the physics of flight, following which he will accept questions on aerodynamics and flight in general. You do not want to miss this opportunity!

**Club Competitions and Events-**

The S400 Electroglide will be held Saturday, 3/27/04, at 9:30AM. If weather precludes, the event will be rescheduled for the following weekend. The Electroglide event is always held on the Saturday following the SEFSD monthly meeting. For further information, please contact Don Wemple.

Wayne Walker suggested an "open class" Electroglide, to be flown with more powerful motors. Any model would be allowed, and motor runs would be determined by power level. Wayne offered to sponsor and organize this event, to be held concurrently with the S400 Electroglide.

The 2004 World Championships of Electric Flight will be held in York England this August. Three of the six team members are members of SEFSD and team practices will





# Aviation Truisms

*The following is a list of aviation truths compiled by a Continental airline pilot.*

**from *Space City Crash*Space City R/C**
**Mike Crotts, editor**
**Houston, TX**

1) Every takeoff is optional. Every landing is mandatory.

2) If you push the stick forward, the houses get bigger. If you pull the stick back, they get smaller. That is, unless you keep pulling the stick back; then, the houses get bigger again.

3) Flying isn't dangerous. Crashing is what's dangerous.

4) It's better to be down here wishing you were up there than up there wishing you were down here.

5) The only time you have too much fuel is when you're on fire.

6) The propeller is just a big fan in front of the airplane used to keep the pilot cool. When it stops, you can actually watch the pilot sweating.

7) When in doubt, hold onto your altitude. No one has ever collided with the sky.

8) A "good" landing is one from which you can walk away. A "great" landing is one after which you can use the airplane again.

9) Learn from the mistakes of others. You won't live long enough to make all of them yourself.

10) You know you've landed with the wheels up if it takes full power to taxi to the ramp.

11) The probability of survival is inversely proportional to the angle of arrival. Large angle of arrival=small probability of survival and vice versa.

12) Never let an aircraft take you somewhere your brain didn't get to five minutes earlier.

13) Stay out of clouds. The silver lining that everyone's talking about might be another airplane going the opposite direction.

from *Space City Crash*Space City R/C
Mike Crotts, editor
Houston, TX

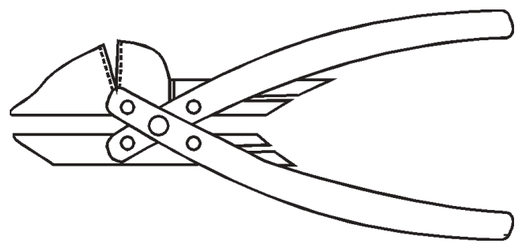
**Modeling Quote of the Month**

You know you're a real modeler when you arrange your shirts in the closet in two groups—the ones with CyA glue spots, and those without.

from *Space City Crash*Space City R/CMike Crotts, editor Houston, TX

# Helpful Hints

At the flying field you never seem to have the right size wrench to tighten one of the myriad of little nuts that we have all over our planes and engines. And a pair of pliers is one thing you MUST have—but if you use them on a nut, you stand a good chance of messing it up, because the pliers always have an angle between the jaws.Try getting some fishing pliers as shown. These little gems have jaws that stay parallel, which won't tear up a nut. Plus, because of their geometry, they have a very powerful wire cutter! Your "fishing" pliers may end up as the most useful tool in your field box!



from STRCC News, Clay Ramskill, former editor
Arlington

# Improving poorly controlled, dangerous takeoffs

By JIM DEVINE

How often have you seen an airplane that is taking off to the east roll off toward the pilot stations? Usually, the pilot gives the engine more gas and, using the ailerons, yanks the airplane back to the right. Occasionally, the airplane continues to the left, clears the safety barriers, and heads for the people in the pits and the cars just beyond.

If you have poorly controlled, potentially dangerous takeoffs, try practicing control of your aircraft on the runway. First, check your wheels and make sure they have a little toe-in. Also, the wheels should not continue to spin when given a flick. To create friction and avoid free-wheeling, slip a 3/16-inch long piece of fuel line on the axle and push the retainer collar in tight. With proper adjustment, the wheels will turn only if you push them with your finger. This braking action allows for a high idle speed without the airplane moving, which reduces the chance of the engine dying when the idle is too low. This also helps stop an airplane that might otherwise roll off the end of a runway during landing.

Pick a day when the wind is light and the runway isn't being used. Practice taxiing back and forth the length of the runway, using the rudder for control. Stay within a few feet of the yellow center line. When you have mastered taxiing at a slow speed, click the throttle up another notch or two and keep practicing. With enough practice and a slow, smooth application of power, you can approach takeoff speed while moving down the center of the runway. You also can practice aborting the flight by shutting off the fuel when you are about to lose directional control of the airplane.

With this improved directional control and practice at aborting a poorly controlled airplane, your takeoffs will be much safer, and a pleasure to watch.

from *TRAC News*
Tampa Radio-Control Aircraft Club
Jim Smith, editor
Tampa, FL

## Comments on life

**from the newsletter of the Mississinewa Skyhawks Inc.**
**Dave Hecker, editor Somerset, IN**

A day without sunshine is like ... night.
On the other hand, you have different fingers.
I just got lost in thought. It was unfamiliar territory.
42.7% of all statistics are made up on the spot.
I feel like I'm diagonally parked in a parallel universe.
Honk if you love peace and quiet.
Remember, half the people you know are below average.
He who laughs last thinks slowest.
Depression is merely anger without enthusiasm.
The early bird may get the worm, but the second mouse gets the cheese.
I drive way too fast to worry about cholesterol.
Support bacteria. They're the only culture some people have.
Monday is an awful way to spend 1/7 of your life.





be held at the field each weekend in the afternoons. Visitors are welcome, and helpers are always needed. Please come out and watch these powerful planes on the cutting edge of electric technology.

**Newsletter-**
Beginning this month, the newsletters went out using the full 9-digit zip codes in an effort to save as much as two days in the delivery time.

**Membership-**
Our membership chairman, Pandi Bala, was not present to report on membership renewals. As of April 1st, those who have not renewed their SEFSD membership are not authorized to use the flying field and will not receive further newsletters. If you have any questions, Pandi can be reached at pandi@san.rr.com. Membership dues are $35 per year and include a subscription to ***Peak Charge*** and full use of the club flying field seven days a week.

**Club Programs-**
No specific discussion was held on club officer positions or elections.

**Safety, Safety, Safety…**
There was no safety announcement at the meeting. Please remember to review and be familiar with the Field Rules which are posted at the field, and may be found in your January 2004 ***Peak Charge***. Be courteous and safe at all times.

**The Training Program-**
There was no specific announcement regarding the training program. General training is available most weekends from 8:00-10:00AM. Aerobatics training is available Wednesdays at 10:00AM. New volunteers to help with training are always appreciated.

**Club Raffle-**
**There were kits, motors, batteries, chargers, servos and other accessories offered in the raffle.**

**How To-**
This month, there was no "how to" demonstration at the meeting.

**Show & Tell-**
Frank Smith brought a scratch-built "Duster" which he scaled down to 4-foot span from a Model Aviation plan. The model is powered by a Jeti Phasor 15/3 motor powered by a 7-cell 1700mAh pack. He made the fiberglass cowl by laying the fiberglass and resin over a male mold he made from modeling clay. Simple, and works great!


Frank Gagliardi brought a magnificent deHaviland Mosquito model with a 66" wingspan. The model, which he built for Steve Neu, is from a Czech kit purchased by Steve in Germany several years ago. The kit features a fiberglass fuselage and obeche-veneered foam wings. Interesting features are scale nose cannons, scale spinners and custom-built dual-strut pneumatic retracting main gear. Frank painted the Mosquito with latex house paint, which he had color-matched in Valspar brand paint at his local

Dixieline lumber. He sealed the paint job with ZAR water-based clear polyurethane. Stunning!

David Fee showed his latest fiberglass SkaT fuselage. This is not a new design, but the fuselage features the paint-in-mold technique. Finished weight, including canopy, is 29 grams.

**Entertainment-**
There was no specific entertainment program this evening.

The meeting was adjourned at approximately 8:30PM.

# Guest Speaker!

## D. G. Faulkner, Jr. Captain, USN (Ret.)

### Professor Emeritus of Aerospace Engineering, SDSU
### When: SEFSD CLUB Meeting April 27th
### Where: San Diego Aerospace Museum, Balboa Park

Topic: Forces on an airplane and the importance and reasons for the placement of the Center of Gravity. Other aerodynamic questions welcome.

Captain George Faulkner started out with Model airplanes as a child and went on to graduate as a Navy Officer from Duke University with a BS degree. His early Navy career included flying Bearcats and a tour of duty in Korea flying the F4U Corsair off aircraft carriers.

After studying Aeronautical Engineering at the Navy Postgraduate School and Princeton, Captain Faulkner returned to squadron duty as a Maintenance Officer on the Navy's oldest operational jet fighter. Next, as an Aeronautical Engineering Duty Officer, Captain Faulkner devoted his time to R&D and operational support. After starting and serving as the first chair of the Aeronautics Committee of the Engineering Department, he served as Chief of Naval Operations at Naval Air Systems Command (NAVAIR).

Upon retirement from the Navy in 1978, Captian Faulkner returned to San Diego and taught in the Aerospace Engineering Department at SDSU for 14 years. The high points included teaching the capstone course in airplane design, and serving as faculty advisor for the AIAA Student Branch, which included the First Place winning Design, Build, Fly competition team!

## Editor's Note:

From time to time I am asked if I carry carry MEMBER CLASSIFIED advertisements in PEAK CHARGE. The answer: with pleasure, but don't try to sell the farm.





ratio greater than 20:1 will need to be at least 12% thick. If at all possible, thicken wings to add strength.

2. If the aerofoil cannot be thickened, the best way to add strength is to decrease the aspect ratio. Either reduce the span or increase the chord.

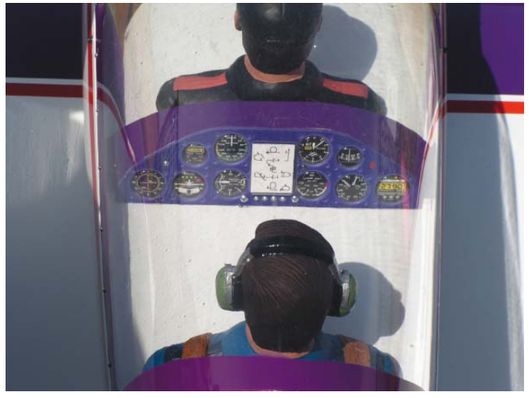
3. If the aerofoil and the aspect ratio are set, then the best way to add strength for minimum weight is to increase the thickness of the skins. This is particularly effective if the original skins were thin compared to the total thickness of the wing.

4. If the skins are already thick, then the only thing left to do is to replace the skins with a material having a higher modulus of elasticity.

One popular method of increasing wing strength is to incorporate a vertical web of ply or glass into the structure. Normally, this web is placed where the traditional shear web is positioned in the wing. There is a mistaken idea that this web resists the non-existent vertical crushing force. Using this web does increase the strength of a wing, but not by resisting crushing. The original function of the foam was to resist transverse shear; the vertical web will now resist this force. The foam is now more or less redundant, and large sections of it could be cut away.

With a shear web incorporated in the structure, the wing is now a beam with both flanges and web constructed from a material with the same or similar modulus of elasticity. This means that our formula for flexural rigidity is now invalid, as the web will be carrying some of the bending load. The problem is that the moment of inertia formula shows us that the web will only ever be able to carry up to 13% of the bending load. This increase in strength could easily be obtained in a number of better ways other than using a web. Even choosing skin material with a 13% higher modulus of elasticity (better wood selection) will give the desired strength increase, without the building complications and additional weight of incorporating a web. Of course, adding a few percent to the thickness of the wing will give a much higher increase in strength for virtually no increase in weight.

References
Statics & Strength of Materials Irving J. Levinson
Structural Mechanics Fourth Edition Durka, Morgan, Williams
Applied Strength of Materials Jenson, Chenoweth
The Glassfibre Handbook R H Warring Argus Book



**Aresti Symbols on Dash of Frank's 330L**

**Frank Wallace 1/3 scale 330L**

force experienced by the foam. The foam is performing the task that shear webbing does in a traditional built-up wing. The name says it all - the foam is resisting transverse shear ie. span wise shear.

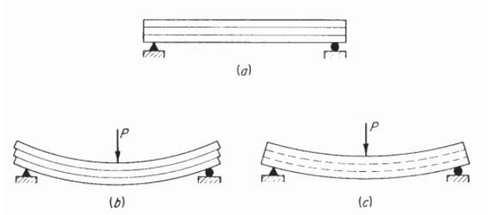
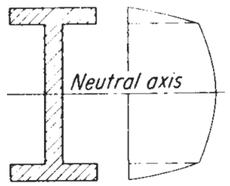



Figure 2(a) shows a beam composed of a number of thin layers placed on top of each other with no adhesion. A force P is applied. In figure 2(b) we can see that as the force bends the beam the laminations slide relative to one another. If as in figure 2(c) the beam is solid, this slipping tendency will be prevented by the internal forces acting parallel to the axis of the beam. The intensity of these forces (the shearing stress) acts on every horizontal plane, since every such plane is a potential sliding surface.

The distribution of the shear force in a beam is not evenly distributed from top to bottom.




In fact, from figure 3 it can be seen that the majority of the shear force is resisted by the web. For a typical I beam the flanges resist only about 8% of the total shear, leaving the web to resist the remaining 92%. The shear force experienced in the web is inversely proportional to the width of the beam (chord of the wing) and the thickness of the beam. As the foam extends from the leading edge to the trailing edge of the wing it is as wide as possible. Therefore, the only way to reduce the shear force in the web is to increase the thickness. In general, unless very thin wings with a high aspect ratio are being constructed, the foam web is more than capable of withstanding the shear stress.

Torsional Rigidity

A torsional force applied to a beam will severely reduce that beam's ability to resist bending moments. Particularly if the torsional force is strong enough to twist the beam. Aerodynamic forces can subject a wing to torsional forces, especially if the wing has washout built into it.

These aerodynamic forces increase with air speed. Therefore, we can subject a wing to the worst case scenario by pushing down until a lot of speed has built up (twisting the wing) and then suddenly pulling in up elevator (bending the wing) to slow down - a certain non-theoretical method of determining if your wings are strong enough. Torsional loads on a wing set up shear forces in the skins. In other words, the span wise fibres in the skin are forced to slip relative to one another. Wood has fibres that go from end to end with the grain of the wing. These fibres do not have much holding them together to resist this slipping force. Wings skinned with wood only will not be able to withstand large torsional forces. Fibre glass cloth that has the same number and size of fibres in both directions, when used as a skinning material, will be able to resist large torsional forces. Fibre glass used in conjunction with wood will make the wood much stronger in torsion. Glass used by itself will be overly strong in torsion compared to it's ability to resist bending moments. If glass is to be used on its own, the glass cloth that has more fibres running span wise than chord wise would be desirable.

Conclusions

This article has presented some of the formulas to do a stress analysis on a composite wing; however, I have simplified the process somewhat. It is also difficult to get engineering data, like the modulus of elasticity, for materials such as balsa wood. We would need all of this information to do calculations on each particular model. Even without spending the time to do these calculations, it is possible to derive a number of conclusions regarding strong, light wing construction by applying the above theory.

1. As the thickness of a wing gives the most strength regardless of materials used, thin wings (say less than 10% thick) are going to be difficult to make strong if the aspect ratio exceeds approximately 15:1. Wings with an aspect





# Tips and Techniques

## Fiberglass Application Made Easier

When applying fiberglass reinforcing to the center of your wing, try this trick to keep the fiberglass smooth. First spray the area around the center of the wing joiners (top and bottom) with 3M #77 Spray Adhesive. Now you can position and press down the fiberglass, taking time to get all of the wrinkles out. The spray adhesive holds it in place until the final gluing, preventing buckling and fraying.

from Plane Talk
Troy Smith, editor
Three Rivers, MI

## Nail File Supreme

I went with my wife a few weeks ago to a beauty supply shop that sells to beauty shops and cosmetologists, but will also sell to the general public. While I was there I saw some fingernail file boards. Now we all use these, generally getting them at the discount store, and they are made of hard paper with grit on both sides. They have two characteristics: 1) they are handy as the dickens and 2) they only last a few minutes and the grit is gone. Well, the one I bought for 49 cents was for professionals, a lot bigger, and on a resilient foam base with that nice gray grit that lasts so long. The thing is marvelous! Get a few, and make the manufacturer wonder why so many people in Peoria have started to file their nails!

from the Summit Valley R/C Flyer's Newsletter
Tomy Meisel, editor
Peoria, IL

## Epoxy

Did you ever have your six-minute epoxy start setting up on you after one or two minutes? Epoxy manufacturers suggest that you mix your epoxy on a flat, wide open surface as opposed to a deep container. It seems that mixing epoxy in a deep container speeds up its chemical reaction time. If you still want to use a deep container, add a little alcohol (don't exceed 50%) to the epoxy to slow down setting time.

from Valley City R/C Club Newsletter
Carl Koehn, editor
Parma Heights, OH

## OH Dull X-Acto Blades

Tired of dull X-Acto blades? The only time I replace blades is when I drop one and break off the point. I covered my last plane using only one blade! Go to your local hardware store or knife emporium and purchase a Washita whet stone. Washita is an extremely fine grade of stone used for finish honing a knife blade to a razor edge. About ten strokes on each side should return your X-Acto blades to their original sharpness. Mine is about 1-1/2 x 4 inches, made by the Buck Knife people, and is the perfect size for sharpening #11 X-Acto blades. These stones cost about $10, but think how many blades you used covering your last plane with MonoKote®. It won't take many packs of blades to pay for your stone, and it will last for many years. I've had mine for at least 15 years and it's still going strong. Be sure to apply plenty of oil to the stone before sharpening your blades. I use 3-in-1 oil. It will keep the metal particles that are removed from the blade in suspension so you can wipe them away instead of having them clog the pores of the stone and render it useless. Wipe the stone with a paper towel after each use. Repeat this oil-sharpen-wipe procedure each time you use the stone and it will last forever. An instruction booklet is usually packed with each stone. Read it to find the best way to sharpen your blades.

from R/C Skyhawks Club Newsletter
Craig Miller, editor
Remsen, IA

## Take that Scratch Out!

A question was posed on rec.models.rc.air: "Hello Everyone, does anyone know how to take the scratches out of a butyrate canopy? I was thinking there might be some kind of wax that would work. Any ideas?" The answer: Check marine/boating supply stores for "Aurora" plastic windshield cleaner/protector (two bottles); #1 is a polishing compound, and #2 appears to be a silicone based wax/polish. Works well except on deep scratches; works wonders on old clouded canopies. Let me know if you try this!

from Transmitter
John Clark, editor
San Marcos, CA

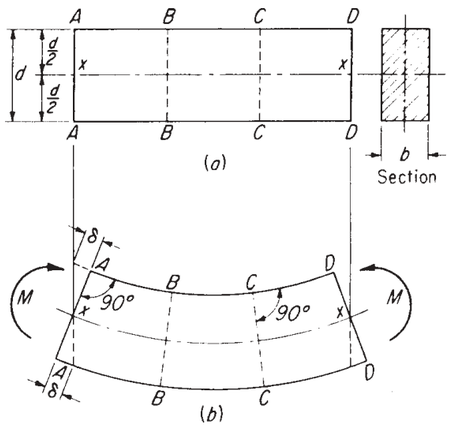
# Stress analysis of a composite foam wing

***Written By Peter Averill 1995***

What is the strongest and lightest way to increase the strength of a foam core wing?

An un-braced wing, for the purposes of stress analysis, can simply be considered as a cantilevered beam. This is fortunate, as there is a considerable body of knowledge regarding such beams. In fact, some of the earliest studies in mechanics of materials were concerned with the strength and deflection of beams. Galileo, in 1638, was one of the first to propose a theory of stress distribution caused by bending, which, in part, was the accepted approach for many years to follow. Errors in the thinking of the day were pointed out in 1773 by Coulomb, a French military engineer. His concepts of stress distribution are now accepted as theoretically correct.

In a beam acted upon by a bending moment, like a wing in level up-right flight, the span-wise fibres above the neutral plane are in compression and the fibres below the neutral plane are in tension. The position of the neutral plane is determined by the cross sectional shape of the beam. However, for a symmetrical beam it will be in the middle. By compression we mean that the fibres on the top of the beam are being acted on by a force that is trying shorten them. Conversely, the fibres in tension are experiencing a force that is trying to lengthen them.




In figure 1, the neutral plane is the centre line x-x. Part (b) shows the beam experiencing a bending moment. It can be seen that the top distance A-D has shortened by d length, while the bottom distance A-D has lengthened by d length.

The further the fibres are away from the neutral plane the greater the load they carry, diminishing to zero load at the neutral plane. These forces are fine, provided they do not exceed the elastic limits of the material that is being subjected to the force.

Modulus of Elasticity

The amount of change in length in a particular material for a given force is called the 'modulus of elasticity' or 'Young's modulus', named after Thomas Young (1773-1829). The letter E is used to denote the modulus of elasticity.

$$E = \frac{Stress}{Strain}$$

where: Stress=load(force)/cross sectional area
Strain=change in length/original length

As Strain is dimensionless, the dimensions for E are the same as for Stress, that is Newtons/mm$^2$. Therefore, the higher a material's modulus of elasticity, the greater its ability to withstand force without deforming. Some materials have a different value for E in compression than in tension.

Moment of Inertia

As the fibres in the centre of a beam are carrying no load and the outer fibres are carrying the majority of the load, it stands to reason that there can be less fibres in the centre of the beam without compromising strength. This phenomenon was discovered some time ago and brought about the common 'I' beam, sometimes called the universal beam. Engineering tables are available that give the correct dimensions of the flange and web to give the best strength to weight ratio. This ability for different cross sections to resist bending is called the 'Moment of inertia.' Moment of inertia is denoted by the letter 'I.' The moment of inertia can be found by breaking the cross section up into many small areas and then summing the small areas multiplied by the distance they are from the neutral plane





squared. Mathematically, this summation is done by integration, giving the following formula:

$$I = \int y^2 dA$$

where: dA= the elemental area of cross section at distance y from the neutral plane

The important point is that the stress in the fibres is proportional to the square of the distance they are from the neutral plane. Therefore, a fibre twice the distance from the neutral plane carries four times the load. It is interesting to note that in a metal 'I' beam, the web resists only 13% of a bending moment to which it is subjected, while the two flanges will resist about 87%.

Composite wings

In a foam core wing the web of the beam is the foam and the flanges are the upper and lower skins. As the skins converge on the neutral plane (at the leading and trailing edge) they carry less and less load. So the flanges of the beam are effectively the skins at the thickest point of the wing. Depending on the aerofoil used, this could be the skin from the 10% (from the LE) position to the 50% (from the LE) position of the chord.

The idea of composite construction is to use different materials bonded together to create a structure. Each material is chosen to carry particular loads within the overall structure. By using the lightest material to carry a specific load, the overall weight of the structure can be minimised. In the case of foam core wings the foam is not meant to be carrying any of the bending loads. In fact, the modulus of elasticity of the foam is so much lower than that of the skin material that a formula for the rigidity of a wing can ignore the contribution to rigidity made by the foam. A formula for the rigidity of a composite wing allowing for the modulus of elasticity of the skin and the moment of inertia of the structure is as follows:

$$R = \frac{E * b * (T^3 - c^3)}{12}$$

where: R= flexural rigidity
E= modulus of elasticity of the skin material
T= the total thickness of the beam (wing)
c= the core thickness
b= the width of the beam (approximately 40% of the wing chord)

It can be seen that the relationship of rigidity to modulus of elasticity and beam width are linear, ie., doubling either E or b will double the rigidity of the wing. By substituting figures into the formula it can also be found that initially doubling the thickness of the skins will almost double the rigidity. However, further increasing the thickness of the skins has less and less effect on the rigidity, as the thickness of the skins becomes a larger percentage of the overall thickness of the wing. If the skin thickness is increased too much, the wing becomes a solid beam made of the skin material. As we have seen from the moment of inertia formula, most of the material in the centre of such a beam is contributing very little to the strength of the beam. The greatest increase in rigidity can be had from increasing the overall thickness of the wing. In fact, rigidity increases at the square of the thickness. In other words, doubling the thickness will increase the rigidity four times.

The conclusions from these observations are obvious. If we wish to increase the rigidity of a wing without changing the aerofoil or cord, we have to either replace the skin with another material with a higher E, or increase the thickness of the skins. The latter option will only have a great effect if the skins were thin in comparison to the thickness of the wing. If we can increase the aerofoil thickness and/or the cord of the wing, we can easily increase the rigidity of the wing. As we have seen, a minor increase in thickness will have the largest increase in rigidity.

What is the foam for?

As the modulus of elasticity of the foam is so low, it contributes a negligible amount to the rigidity of the wing. Indeed, the previous formula ignores the foam. So what does it do? The skins can only carry the bending loads if they maintain their relative position to each other. By gluing the skins to the foam they are held in the correct position. Obviously, as the structure is subjected to bending loads, some stress must be experienced by the foam. One of the most popular ideas people seem to have is that there is a force compressing the foam from the top to the bottom of the beam. Evidence for the existence of this force comes from inspecting failed wings. This is misleading, as it is difficult to determine the cause and the effect. Usually, the top skin has failed in compression and the structure has collapsed in on itself, thereby crushing the foam. The important point here is that the foam crushed because the skin failed, as opposed to the foam crushing, allowing the skin to fail. In fact, there is no top to bottom compression