THE AUSTRALIAN HOMEBUILT SAILPLANE

Editor: James Garay

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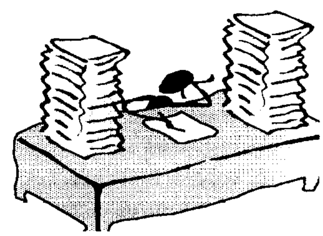
G'day folks, here we are again at the end of another year. It seems that it was only yesterday when I took over the duty of preparing this journal for your reading pleasure every 3 months and plenty of water has passed under the bridge. It has been hard for me and my team to please everybody because every one has their own different ways of doing things but we have overcome obstacles and we are striving to move forward.

3 Woodstock projects are currently under construction supported by our membership network, Malcolm Bennett is well ahead of schedule as is Brian Berwick, while Alan Bradley in South Australia is just starting, having bought plans from Dete Hasse. Also in NSW a young fellow Simon Bleuler is building a Carbon Dragon. I hope to have a full report of this eventuality in the next newsletter.

May I take this opportunity now that we are in the festive season of Christmas and New Year to wish everybody a Safe & Happy Holiday!

The Seasons greetings and Best Wishes for Health and Happiness in the New Year.

James Garay
Editor.



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Inside This Issue

MAIL BOX

Dear Ed,

Firstly congratulations on the completion and flying of your Woodstock sailplane. What a great bunch you have around you, and how sad they did not finish up at Locksley. We are short of "hands on" people and I am at a loss to know or to how that happened. God gave us a brain, but did not give us a book on how to use it... I must say!

What a pity you will not be at Stonefield. Maybe Mike Burns can help you to fit a belly release hook at the right point, as they also have auto towing and whinch.

The magazine is good stuff and I feel ashamed by not contributing, but soon as I settle at my new address I will do some on wood repairs and fibre glass structure or something along these lines.. Please renew my subscription. Thanks for everything to you and the AHS servants.
P.S. Paul Johnson told me that your Woody-Roo flies like a dream..! Regards Keith Nolan.

Dear Ed,

Hi..! James how are you keeping, I hope you are well...! you cheeky old bugger.

Tomorrow morning 5th I go into Mater Private Hospital to have my left shoulder re-constructed, been so sore and useless that I could not go flying, get in or out of a glider,

It is also has been limiting my work around the place including the gliders. Any way James I am confident that they will fix me up and every thing will be OK.Kindest regards. Al Gerber.

Ed's Note: Yes..Al ! I can not denied that I am an old bugger but not much cheekier than you. "Nurses of the hospital beware!"

TECHNICALITIES

FLIGHT TEST REPORT

Aircraft	WOODSTOCK VH-IKL
Location	TOCUMWAL A/D N.S.W.
Weather	15c Wind West Southwest 10–15 knots
Date	9th September 2001
Pilot	Peter Raphael
Experience	210 hours on type

Final inspections and weight and balance calculations were concluded on 8th September and sufficient ballast was added to place the C of G within the mid range for the test flight
The glider was towed to a height of 4000 feet at a requested speed of 50 knots. This was collaborated by the indicated airspeed within the glider.
Liftoff was typical of the type occurring early in the ground roll particularly with the head wind present.
The Aerotow was conducted in high tow as this permits the glider to remain clear of the tug wake until release.

After release straight and level flight was conducted and about 5 m/m of up aileron was noted on the starboard wing.
Airspeed was reduced gradually until buffet became apparent at around 33 knots, increasing down to 30 knots when the aircraft departed into a nose down attitude with little tendency to drop a wing, while maintenance of level flight was possible by both use of either rudder or ailerons. Holding the stick right back produced a phugoid cycle of increasing amplitude as the aircraft recovered and stalled again. Recovery was swift once the back pressure was released. Applying the airbrakes while executing the stall resulted in a slight increase in the stalling speed of about 2 – 3 knots. Reducing speed in the turn in order to induce an incipient spin resulted in early warning of the impending stall and no tendency for the glider to roll in either direction.

With the stick pressure relaxed the glider slowly diverged into a dive and this was allowed to progress until the aircraft reached 75 knots. As the VNE had not been stipulated at this time this was the maximum speed attained during the test flight. Additional trim control will be required to permit the aircraft to remain trimmed at placard speeds.
Roll rate and pitch control are typical of the type, being quite responsive and coordinated in all axis even at low speeds.

The circuit was flown at 50 knots, with due consideration for the wind speed, and the airbrakes applied during the final approach. While not comparable to conventional 2 seaters the single surface airbrakes provided an effective increase in the sink rate. This is able to be supplemented by the exceptional side slipping ability of the aircraft in order to provide high sink rates when necessary.

The aircraft exhibited no undesirable characteristics during the flight and in all aspects performed in accordance with my expectations and experience on the type. ***Peter Raphael.***

STRENGTH OF MATERIALS

INTRODUCTION

The term " strength " is an all embracing one, and we require to be more specific if wishing to know the properties of a material. The desired properties such as Tensile strength, Compressive strength, Impact strength can be quoted fairly precisely.

MATERIAL SPECIFICATIONS

Requirements

The various properties of existing materials by test, or desirable properties are alloyed into new materials by test, or desirable properties are alloyed into new materials, and these properties are then written up as a specification. The existence of a specification enables a designer to design a structure knowing that it will meet a minimum strength requirement if "specification" materials are used in its construction.

A specification has both upper and lower limits on the various properties, so ensuring quality control of the material. The latest British Specifications for aircraft timbers, however, do not quote all strength properties and other references are needed to obtain design figures.

DETERMINATION

The value of the various properties for a specific material are decided upon by the appropriate Standards Authority. In this country it is the Standards association of Australia. Similar organisations exist in overseas countries.

A large number of tests are carries out on samples provided by various sources and from these an average value is obtained and declared the standard. During production samples are taken from each batch and tested for conformity with the specification, and either accepted or rejected.

STRENGTH PROPERTIES

Tensile strength

This term refers to the maximum load per unit area (i.e, stress) that a material will withstand before failure occurs. It is obtained by loading a specimen until it fails, and dividing the load at failure by the cross sectional area of the failure

Applied to metals and many others material this is a straight forward process, but in the case of timber it is difficult to obtain a consistent answer.

For design work the Modulus of Rupture is taken and used for tensile strength. This modulus is the calculated stress in the tension fibres of a beam at the failing load of the beam.

Compressive strength

This is taken as the stress at which collapse of the material occurs under compressive load.

In the case of timber the compressive strength varies considerable depending upon the grain direction. In general the compressive strength along the grain is 2 to 4 times that across the grain. It is important to note when considering the bearing load for bolts, which is dependent upon the compressive strength, that the allowable load is not directly proportional to the bolt diameter. I.e. Doubling the bolt diameter does not double the load carrying capability.

Shear Strength

The shearing strength is determined by loading a piece of the material so as to produce a shearing stress in the material until failure occurs.

Stiffness

Stiffness is a term which is commonly used to indicate the rigidity of the material in the elastic range. Stiffness is measured by the modulus of elasticity (E) of the material. A big value of E indicates the material has a small deformation for a given stress.

Brittleness or Impact Strength.

This is a measure of the ability of the material to absorb shock loading. Brittle material are low in impact strength which is measured by the amount of energy required to break a specimen at a given stress. The most common of impact testing machines is the Izod tester, in which a weight dropped through a known arc breaks the specimen and rises an amount depending upon the energy absorbed during the breaking process.

Hardness

Hardness is the property of a material to resist scratching, cutting or penetration. The principle involved in hardness test is to sink a hardened steel ball or diamond under a definite load into the material being tested, and to measure the amount of penetration or the size of the impression.

Experiment has shown that the hardness bears a direct relationship to the tensile strength of materials, and use is made of this fact when inspecting production batches of materials.

Elongation or Ductility

This is the ability of a material to deform i.e stretch, elongate or compress, before rupturing.
The amount of elongation is given as a percentage of length. The value is ascertained during specification testing.

Fatigue Strength

The repeated application of a fluctuating tensile stress well below its tensile strength will cause the material to fail after a period of time. The number of applications of stress to cause failure is dependent upon the magnitude of the peak stress. The fatigue strength is given as the minimum stress that will cause failure to occur only after a very large number of applications, about ten million.

Natural timber has a high fatigue strength, expressed as a percentage of the ultimate tensile strength, an aluminium alloys very low fatigue strength.

FACTORS AFFECTING STRENGTH

Stress Concentration

The presence of a hole or a sudden change in cross sectional area will cause a concentration of stress at the amount that the material can elongate between the yield point (or proportional limit) and the ultimate strength, there will be and "internal adjustment" of the stresses. The lack of the ability to redistribute the stress will result in the failure of a member when the nominal stress in it is well below the ultimate strength.

A further and more serious effect of stress concentration is to increase the likelihood of a fatigue crack appearing in these local areas of high stress, leading to collapse of the member.

The matter of stress concentrations should be carefully considered when using such materials as improved wood and aluminium alloys.

Connection of Dissimilar Materials

When materials of differing stiffness, such as normal wood, improved wood or metals are fastened together for a considerable distance and are under a high stress, consideration should be given to the fact that the fastening cause the total deformation of all materials to be the same,
A typical example is a long metal strap bolted to a wood spar flange for the purpose of taking the load out of the wood at a wing joint. In order that the load be uniformly distributed among the bolts, the ratio of the stress to the modulus of elasticity should be the same for both materials at every point.

This may be approximated in practical structures by tapering the straps and the wood in such a manner that the average stress in each (over the length of the fastening) divided by its modulus of elasticity gives the same ratio.

When splicing high-density materials to wood, or in dropping off bearing plates, the slope of the scarf should be less steep than the slope allowed for normal wood.

Welding

There are two sources of weakness when two pieces of material are welded together. Firstly in the material adjacent to the weld by reduction in tensile strength resulting from heating. This can partially corrected by heat treatment. Secondly in the weld itself resulting from incorrect welding practice. For glider construction it is essential that all welding be carried out by a qualified aircraft welder.

The supplies of Chrome Molybdenum steel in this country are a mixture of American and Australian, both made to the same Specification S.A.E.4130. However Australian steel manufactured prior to 1946 is virtually non weldable, and should not be used for welded fittings.

Steel manufactured after this date is designated X 4130 and is weldable.

Shrinkage in timber

When the moisture content in a piece of wood is lowered its dimensions decreases. Checking or splitting of wood members frequently occurs when shrinkage take place in members that are restrained against dimensional change.

Restraint is sometimes given by metal fittings and quite often by plywood reinforcements, since plywood shrinkage is roughly only 1/20 of cross grain shrinkage in plain wood.

Temperature

The strength of most materials decreases as the temperature rises. The temperatures encountered in gliding do not affect any metallic material. However, temperature must be considered when dealing with timber structures and fibreglass reinforced plastic.

Extensive investigations conducted on an international basis revealed that temperatures exceeding 80 C and with corresponding moisture contents of 20% where possible in wooden aircraft operating in Northern Australia. Test conducted in a typical wooden structure indicated an overall reduction in strength of about 45%

The reduction of timber strength with increase in temperature is available from standard handbooks. The drop in strength and stiffness of fibreglass reinforced plastic is dependent upon the properties of the resin and German airworthiness authorities require static strength test to be conducted at 54 C. If this temperature is reached in practice the glider must no be launched.

Moisture content

All timber strength are quoted for a standard moisture content of 15%. The strength decreases for moisture contents greater than this value and there is a corresponding increase in strength for lower values.

To be continued.

WHAT'S NEW?

THE END OF A JOURNEY

By James Garay

Yes...! at last my Woodstock which I christened "Woody-Roo" following an Australian dream time story, is in the air. The Erudite Peter Raphael did the flight test, and took me several weeks waiting for the good weather to fly it..

Finally it happened and I flew it at Bacchus Marsh airfield where my club, The Beafourt Gliding Club, has the headquarters.

At the beginning I was a little bit nervous, but it suddenly disappears after the ground rolling and soon I realized that I was airborne, all my senses were centralized in the towing which was performed by my friend Peter Huges who was the tug pilot setting the tug on 55 knots it was such a pleasant satisfaction for that particular moment in which my mind was recording back memories after ten year of dreaming flying my own glider

All my dreams are now true and I found myself in front of the controls of my " Woody-Roo" talking like it was as a little boy," ***at last you are with me... little beauty"...I whispered***...! and at two thousand feet I released I saw the tug turning to the left as I did turn to the right in a gentle turn. ***I was taking my Woody-Roo in a turn with my hands*** ....and taking all appropriate care and my memory recalled some past scene a long time ago when I was teaching my son to walk. He is now in his early forties.

Time goes by and many dreams where in my mind when Woody-Roo was under construction ... I was dreaming flying among the eagles taking me high and higher until reality came back telling me not to dream.

During the building process I had the opportunity to know several people related to the gliding movement, some with different opinions when I said that I was building a glider, some off them said.. Jim!...it is better to buy a second hand one....or You...! will never finish it up. And a couple of them did say... Jimmy..! go for it have fun and you will find at the end a very rewarding moment as I did when I had my first fly in my Woody-Roo.

Many time in this journal's pages I had mentioned that many people have been helping me during the final stage of completion and one more time I want to express my sincere thanks and gratitude to Malcolm Bennett ,Peter Raphael (The Erudite) and Mike Burns for their unconditional friendship , support and encouragement.

I found that the Woody Roo is a dream to fly it has no vicious behavior and it is very responsive to the controls which are very light (very similar to the Cirrus).

I am a member of Beaufort Gliding Club and so it my Woody-Roo based at Bacchus Marsh Airfield 40 Km west of Melbourne. Victoria Australia.

HINTS & TIPS

LET US FIBREGLASS

by Pedro Rafael (El Erudito)

Fiberglass, or more correctly fibreglass and resin composite, is a popular method of producing seemingly complex structures such as fairings vents, tail dollies etc. as a one off or in quantities. This article will I hope, give you a general overview of the fundamentals of "Fibreglassing".
A visit to a specialist supplier of the mentioned products should inspire and enlighten you to the world of exotic moulding and casting materials now available.

Materials:

CHOPPED STRAND MAT

Probably the most widely used variety of glass fibre but it really only suitable where weight and strength are not a consideration. This is usual used for the ground handling gear such as tail dollies and wing walkers. Chopped strand mat of average weight is supplied in one metre widths and needs about one litre of resin to saturate every square metre.

PIGMENTS

These are generally available in two forms and are useful in providing a durable final finish to the completed article.
Dry Powder, which must be thoroughly mixed with a little resin at a time to ensure it is absolutely lump free. This paste can then be dispersed in your bulk resin
Paste, in which the above process has been carried out mechanically. It's a little dearer this way but perhaps, more convenient.

SURFACING TISSUE

This is a glass tissue about .2 mm thick, produced to hide the 'viewing' of the glass reinforcing fibres. It can be used as a cushioning layer between gel coats and main- glass layers- It will help to hide the glass weave pattern.

WOVEN CLOTH

From the very light silk like fabric through to some heavy basket weave styles, these provide the best strength to weight ratios. Most popular is the 5-6 oz style, and multiple layers can be used to achieve the required strength. Also available in a variety of tape widths.

GEL COATS

These are flexible, very resilient colored resins specially designed as the first application to a female mould. Having a gel like consistency allows them to hang in the mould at a reasonable thickness. They have higher resistance to abrasion and impact, and produce tough surfaces. Failing use of these, a layer of surface tissue in the mould with some pigmented resin will also achieve a satisfactory result.

POLYESTER LAMINATING RESINS

The most popular due to ready availability and reasonable cost, these are suitable for laminating or sheathing purposes. They adhere well to timber (provided it is dry, free of oil or paint) and are resistant to sea and fresh water, Gelation time varies with the ambient temperature.

EPOXY RESINS

These have greater bonding strength compared with polyester and less shrinkage and better weathering. However, they are more costly, slower curing and have problems with handling such as causing dermatitis, etc, or allergic reactions In application over the following materials epoxies are highly recommended. Aluminium, steel, teak, oak, western red cedar as well as other non-porous surfaces. It is common to use epoxy to act as a seal first and then follow with polyester to save money. Before a polyester is used over an epoxy the latter must be fully cured. When using epoxy resins wear protective clothing, eye protection, avoid enclosed spaces. If you get any on your skin, wash immediately with soap and water or de-natured alcohol. Epoxies tend to even out better than polyesters and come up with a better surface without as much sanding between coats. They may also be used in conjunction with the readily available polystyrene foams as a disposable plug.

RESIN FILLERS

A number of different fillers are available to bulk up resin for a variety of purposes. Lightweight filling is accomplished by using microballoons or phenolic balloons. Harder fillers are created by the use of talc, cotton flock, thixotropic powder and other combinations depending on the particular application.

MIXING RESIN AND CATALYST

Resin can be obtained in both waxed and wax-free with waxed resin being the most common. When cured the wax surfaces and presents a smooth tack free surface. unwaxed resin is useful where there is the possibility of further cloth and resin being applied after the first layers have cured. Failing this, mechanical means may need to be used to remove the waxy surface and prevent delamination.
Cans of resin and bottles of catalyst usually have mixing instructions attached. A simple way of measuring is to allow 1 percent of catalyst by volume to 100 parts of resin in hot weather, rising to 3 percent for cold weather. There is great latitude in these proportions. You can double or treble these proportions in adverse conditions.
Conversely watch that you do not put too much catalyst in it resulting in overheating in the mixing vessel, and even fire. The exothermic reaction can be minimised by using shallow containers and getting the resin distributed as quickly as possible. Once you notice that the resin is becoming thick and jelly-like it is best to discontinue its use and mix a fresh batch. Catalyst, Methyl Ethyl Ketone Peroxide, is toxic. keep away from eyes, skin and kids.

THE MOULD

While some articles can be made as a direct lay-up over a foam core sometimes it is necessary or advantageous to use a mould to produce multiple items. A reasonably rigid surface mould may be made of wood or metal coated with mesh and-or plaster or even the original article itself A "Male" mould is used where the inside of the finished article is the important surface which is seen. A "Female" mould is usually made for such things as wheel fairings, fuel and water tanks, shower bases, car fenders,. etc. For a one off item, total loss moulding using polyurethane foam can be used and shaped as required. After the lay-up is completed the foam can be gouged away and the inner surface recoated to a smooth finish

In the case of a reusable mould, the mould must be well sealed to make the surface impervious to the resin. Use several coats of shellac rubbed down between coats, then several coats of release agent. Release agents are available as a water soluble PVC coating, simple to use and effective barrier, or wax polishes giving perhaps a higher level of finish on the produced item , but with a risk of leaving unprotected areas.

THE LAYUP

A generous coat of resin or gel-coat should first be applied to the waxed mould.
As soon as possible after gelation of this layer has occurred, a heavy coat of the laminating mix is brushed on and the mat/cloth applied .
Apply more resin to the top surface of the mat/cloth, stippling with a brush or with rollers to ensure complete saturation and removal of trapped air bubbles. White patches and visible fibres are evidence that the wet-out is not complete.

Further layers of mat or resin may be applied in the same way until the desired strength and rigidity is obtained, but remember resin alone is brittle, the strength is in the cloth and an excess of resin is detrimental. When hard the moulding may be removed, but care must be taken to see that it is not strained until it is perfectly hard. This applies particularly to articles made on male moulds, as the slightest shrinkage causes contraction onto the mould. Curing of the resin can be assisted by use of heat, such as sunlight, hot air or infra-red lamps.
One layer of mat will usually give an approximate thickness when moulded, of 2.5 mm. To give additional strength or thickness, woven cloth can also be incorporated. Tissue can he applied to the outside for a smoother finish.
In estimating quantities, a rough guide is one square metre of mat needs about a litre of resin to saturate it, and one square metre of cloth needs 1/2 litre. All types of fibreglass can be sanded later with a heavy duty sander to smooth out roughness and a coat of resin applied to give a gloss.
Pigments can be incorporated to attain permanent colors.

CARE OF THE HANDS

Gloves are by far the best option when working with resins, however unset resin can be removed from the bands with Acetone followed by soap and warm water. In warm weather it is advisable to use Barrier Cream on the hands to minimise the risk of dermatitis. Some people are also allergic to any kind of cream so it would be a good idea to consult your doctor if you are subject to skin complaints

TROUBLE CORNER

What do you do if your resin does not set? Did the remains left in the mixing vessel set? If it has, it indicates the rest of it on your job will set too, but because the dissipation of heat in the vessel is less, it has set quicker. Try and apply artificial heat locally or by shutting doors, etc and getting the temperature up to at least 20 deg.C. This should push it over the hill and set it. A radiator held about 45 cm. away and moved slowly over the surface will increase the temperature sufficiently to do the trick. Some people have mixed up a hatch of resin with extra catalyst and painted that over the surface successfully, but should the first coat still he in a "runny" state, this is almost impossible. Heat is certainly the best way. Check that your catalyst is not stale. It's shelf life is quite short, time being about a couple of months in a cool place, a few weeks in a hot place. Tape and cloth should be stored in a dry place. If they absorb slight moisture the weave may appear white when saturated with resin.

STORING RESINS

Resin will last for a year or two, when kept in a cool place out of direct light. The catalyst has a much shorter life of only about two months. Keep it also in a cool place and well stoppered. If you are in doubt try a test batch before getting on with a big job. If it doesn't set, say in three hours, or at least show signs of it, buy some fresh catalyst. It's relatively cheap for the quantity you need. If sediment has gone to the bottom of the resin simply stir it well. Remember to keep all these things out of reach of children!

SANDING

This is best done with "wet and dry" abrasive paper of about 80 grit you can use it wet or dry, but when used with water the paper washes out better and does not clog so readily.
Finer finishes can he obtained with finer grades of paper. Flexible discs in an angle grinder are useful it removing and reshaping cured glass composite while the cutoff wheels will provide for trimming excess.. "Brasso" or auto polishing compounds can be used for final finishing of gelcoats

I would highly recommend that you read and comply with the relevant Material Safety Data Sheets for the types of products you intend to use as there can be long term effects from the handling and absorption of these materials. Particularly with epoxies, there have been instances where the users have become too unwell to enjoy the outputs of their labours.

To be continued in Next Issue.

FIBRE REINFORCED PLASTIC CONSTRUCTION.

Editor's note.
This is An excerpt from Inspectors handbook . M.O.S.P. G.F.A.

Acknowledgement:
Compiling this document has required substantial research, drawing on many technical publications, maker's manuals, the accumulated experience of the GFA Inspector network, the Australian Department of Aviation and the German L.B.A.

The following text only touches the subject of composites lightly readers are advised to add to their knowledge by reference to many publications available on this particular topic.

Up to the mid 1960's the world aviation community had developed is skills in timber and metal airframe structures to a very high level, coming to grips with manufacturing techniques, aging and fatigue, ensuring adequate, predictable management of these materials.
At the end of the 1950's the German Government funded and fostered substantial development and research into the new medium of "Glass Fibre Reinforced Plastics". That research led to the founding of the current, German monopolised, sailplane manufacturing industry.

This step forwards into composite construction technique supplemented the research then continuing into laminar flow aerodynamics, the two combining to conceive the first generation of high performance F.R.P. sailplanes which includes the Phoebus, Diamant, Libelle, etc.
That development and research is continuing today, resulting in the use of Carbon Fibres, Kevlar fibres and new, more efficient fibres with advanced laminar control techniques providing sailplanes such as Nimbus 3, ASW 22/25, etc.

It took the Aviation industry some 30 years after the Wright Bros, to start to replace wood with metal and some 30 years more to provide a possible replacement for metal.

During those 60 years these materials became very manageable and are still in wide use today. This would suggest that composite structure are still in their infancy and will require significant monitoring and research if we are to keep them at an adequate level of structural safety.

WHAT IS COMPOSITE?

Reinforced concrete (steel bars encased in a cement mixture) is a COMPOSITE MATERIAL. The STRENGTH of the steel bars combines with the STIFFNESS of the concrete, resulting in a material CREATED ON THE JOB which will satisfy the structure's design requirements.

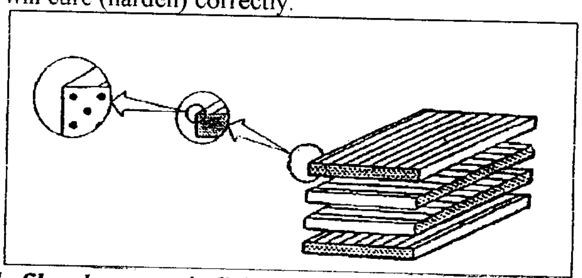
In our sailplanes we need the STRENGTH of:

1 Glass fibres
2 Carbon fibres
3 Kevlar fibres

Those fibres are very strong, but very small in diameter, therefore to be able to use them efficiently they must be ENCASED in a RESIN or MATRIX which will both provide STIFFNESS and PROTECT the fibres from the environment.

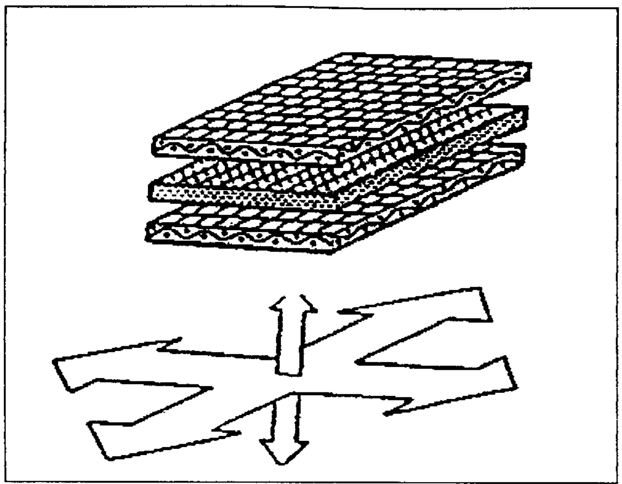
We are only concerned with 2 types of resins in sailplane construction:
1 Epoxy resin
2 Polyester resin

We combine our fibres and resin (in liquid form) by placing a succession of layers or "plies" on top of each other, saturating each layer with resin which has been properly prepared such that will cure (harden) correctly.



Each fibre becomes individually encased in resin allowing the natural, strength, stiffness and toughness of the fibre to be utilised fully

The designer can then selectively "sculpture" material by varying the number and types of "plies" in proportion to the intensity and direction of the applied loads that the finished structure must be capable of supporting.



The finished material which results from this laminating process can then be termed:

1 Carbon Reinforced Plastic. (RFP) or (CFRP)
2 Glass Reinforced Plastic (GRP) or (GFRP)
3 Kevlar Reinforced Plastic (SRP) or (SFRP) (S=Synthetic)
4 Fibre Reinforced Plastic (FRP) (general term)

At this point we must recognize the DISTINCT difference between these materials and other material used in aviation.

Steel, Aluminium alloys, Plywood or Timber, are all bought or obtained in a FULLY FINISHED FORM, made to known specifications, guaranteed to meet stated minimum strengths.

Composites are MADE IN PLACE (layed up) during the moulding or manufacturing process. This results in structural materials which have features that must be respected.

1 Each batch "layed up" can be slightly different in weight, density, strength and stiffness.

2 Each batch can be affected by differences in temperature and humidity during their curing period.

3 Reproducing exactly the same material characteristics during repair work is virtually impossible.

WHAT ARE RESINS?
Synthetic resins are plastics. We are concerned with the imbedding in them of reinforcing, fibrous materials then curing them from a liquid to a solid.
The solid resin is then termed the MATRIX for the fibres.

Polyester and epoxy resins in liquid for contain "Monomers" (substances consisting of simple molecules) which convert to "Polymers" (substances consisting of complex "cross linked" molecules) when the resin is "cured".

The solid material that result from the curing process is termed a THERMOSET plastic, tough and durable, which cannot be heated and reformed as say Perspex can, i.e. it is "infusible".

Other plastic that can be heated, reformed and cooled repeatedly are called THERMOPLASTICS.

The chemical reaction that "cures" or "polymerises" Solidifies) our resin is accomplished by the correct combination of : Heat, Pressure, Chemical curing agents; all applied in the specified proportions.

Where the resin is cured at room temperature and is observed to give off heat as it solidifies, that heat liberation is termed EXOTHERM.

Let us look at the resins we use to bond the fibres together. As stated above we use two types of resin.

1 Polyester resin
2 Epoxy resin

What is the difference?

POLYESTER
This resin is cured by adding to it a chemical called a CATALYST which causes the resin molecules to lengthen and solidify. The time taken to cure depend on the amount of catalyst added, a small amount gives a long time, a large amount giving a short time. The faster the cure, the more heat generated.

Polyester is tolerant to variation of CATALYST TO RESIN ratio, ensuring that cure will eventually take place, but the cured product has limitations.

1 During curing it will shrink noticeably
2 The cured resin is low strength
3 Poor adhesive qualities

NOTE!
Polyester is only found in NON STRUCTURAL areas of older wooden sailplanes and must not be used to repair EPOXY resin structures.

EPOXY RESIN
Epoxy resin consist of two parts.

1 Epoxy resin
2 Hardener

These two parts must be mixed very accurately, because the individual molecules in one part need to find individual molecules in the other part, allowing them to CROSS-LINK, the final cured strength depending on a very high proportion of all molecules having cross linked. Incorrect mixing ratios will result in incomplete cures and low strength.

Applying heat during the curing process will speed up the cross linking process and observation of low humidity will ensure that moisture is not taken up by the curing resin, lowering its strength.

Epoxy has the highest strength, stiffness and toughness of all resins in use and is the only resin system used in modern sailplane production. (One French type being the sole exception)

RESIN COMPATIBILITY

One resin's ability to bond with another is a very serious part of the repair work we undertake on our sailplanes.

Let us look at some relationships:

1 Polyester onto Epoxy---------It will not stick
2 Polyester onto polyester------Poor adhesion
3 Epoxy onto Polyester---------Good bond
4 Epoxy onto epoxy-------------The best possible bond

BUT,

There are many types of Epoxy resins marketed, each type having its own particular formulation, many for specific applications. This means that all times we must use an Epoxy resin which is either:

1 Identical to the Epoxy used by the manufacturer
2 An Epoxy resin verified by the manufacturer, or some other recognised authority as being fully compatible with the original resin.

It is not enough to show compatibility by equivalent chemical formula. We must also consider how the alternative resin will cure. Will it be softer, harder, less stiff, more stiff in the long term? Will it wet the new fibres as well as the original? What we must have in the finish is the COMBINATION of glass and resin compatible to the structure it has become part of.

To be continued.

SHOP TALK

A LITTLE BIT OF AUSTRALIAN GLIDING HISTORY. By Allan Ash.

Launching by wire. Part 2-Winch Driving

The design of launching winches has improved a lot since the early days of bolting a drum of wire onto a jacked-up wheel of an old jalopy. Some winches today are professionally designed and built, while even those built by club members have usually been designed by people with a lot of mechanical knowledge.

The result is that the winch launching today is a lot safer and more reliable than it was 50 years ago.

The basic design however remains the same. A powerful engine drives one or two drums through a gearbox and the launching wire is reeled onto the drum(s) through guide rollers and are fitted with a brake and some form of emergency cutting device.

The winch driver is usually housed in a cabin which provides shelter from the sun, rain and cold wind as well as from the wild lashing of a broken launch wire. It was not always so.

Driving the winch is relatively simple, being similar to driving a car. While some winches have an automatic clutch, the majority have a hand-operated clutch, which is easier to move smoothly than the usual foot operated clutch.

The process of launching is straightforward and can be learned quickly if proper instruction and supervision is provided.

A winch needs a daily inspection, just as an aircraft does. Moving parts must be kept greased or oiled and free from obstruction. The battery should be in good condition and sufficiently charged. The fuel tank should hold enough for a day's operation or should be checked after a specified number of launches. The oil level in the engine should also be checked.

Ideally, the launching wire should be fully laid out and carefully checked for wear and potential breaks. This takes time, but less than the time to untangle and repair a broken wire, not to mention the possibility of a broken aircraft.

In a well-run club, the inspection of the winch and wire can be done while the aircraft are being removed from the hangar, rigged and DI'd (Daily inspection).

The operation of the winch needs to be firm and smooth to provide a smooth, safe launch for the sailplane. Sudden or jerky movement of the throttle should be avoided.

Before the first launch of the day, the winch engine should be thoroughly warmed up. At the " take up slack" signal, the driver should engage the appropriate gear (depending on the weight of the aircraft, the wind strength and the power of the engine) and start winding the wire very slowly.

When the "all out" signal is received the throttle should be opened and the clutch smoothly operated.

In the early stage of the launch, the winch driver should be alert for any sudden "stop" signal from the launching site. It is essential that the sailplane be given plenty of power for take off. There is nothing worse for a pilot than a soggy, uncertain take off.

As soon as the sailplane is safely into the air, the throttle setting should quickly be adjusted to the appropriate setting to provide a smooth climb at the sailplane's best climbing speed.

This will vary, depending on the design of the aircraft. If the speed is too fast or too slow the pilot should signal appropriately and the winch driver should alter the throttle setting. Once again, it is important that this be done smoothly. Remember also that the wind speed usually increases with altitude and except in calm conditions, the winch speed can be gradually reduced as the aircraft gets higher.

When the sailplane is climbing at its correct speed, the launching cable should have a slight downward bow. If the cable is too straight, it usually means the launching speed is to high. If the wire bows to much, the speed is too low. Getting the correct bow in the cable is a matter of practice and is likely to vary somewhat with different aircraft, usually depending on their weight.

When the sailplane reaches the top of the launch, and is no longer climbing, the pilot will release, hopefully after lowering the nose of the aircraft a little first. If the cable is release under tension it is likely to spring downwards suddenly, sometimes causing the wire to wrap itself around parts of the winch.

If the winch driver considers that the pilot is hanging on too long, and is likely to carry the wire too close to the winch, the throttle should be closed rapidly and fully so that the pilot is clearly aware that the power has been cut off.

As the cable falls, it is retarded somewhat by the drogue parachute that should be fitted some eight metres from the tow rings at the sailplane end.

When the winch driver sees the drogue open, he should apply enough power to drag the chute downwards. This keeps a tension on the wire and ensures that it will continue to wind correctly onto the drum. It also ensures that the wire does not become tangled as it falls.

As soon as the drogue hits the ground, the throttle should be closed and the drum brake applied. This prevent the drogue being dragged over the ground and possible damaged.

When the retrieving vehicle pick up the drogue en of the wire, the drum brake should be released. As the retrieve begins, the driver should maintain just enough brake pressure to prevent the drum from free-wheeling and thus pay out the cable too quickly, causing tangles. The brake pressure should not to be too much as this causes excessive wear on the brake shoes and also requires the retrieve vehicle to use extra fuel to pull the wire.

When the retrieve vehicle reaches the launching point it should be slowed gradually to alert the winch driver to be ready to apply full brake when the cable stops moving. This prevents the drum over running and creating excess slack and possible tangles.

To be continued. Next issue: Car towing.

DO-IT-YOURSELF...The Early Thirties

Learning to Fly

Training on the primary type glider in the 1930s and 1940s was mostly a matter of trail and error, with lots of error, since few people in Australia knew much about gliding and even fewer knew anything about soaring. The student pilot was strapped into the seat, usually by a broad band around his middle, though the Sutton harness came into use after World War 2. Trouser cuffs were stuffed into socks, goggles were clamped on to the face to provide protection from dust, grass seeds and stray insects, and often the feet were shod in football boots or other heavy footwear to prevent wrenched ankles as a result of the pilot putting his feet on the ground before the glider stopped moving.

Initial training usually consisted of 'wing balancing'. This involved pointing the glider into the wind and having the student endeavor to keep the wings level. If there was insufficient wind, an instructor would stand at a wingtip and raise and lower the wing while he watched how the student responded with the controls. A refinement of this method was to balance the glider on a brick. This allowed use also of the elevators and rudder, though they were not nearly as sensitive as the ailerons in a light wind and frequently led to problems later on through the student over-controlling.

When he had mastered this elementary lesson, the student would get a few encouraging words from the instructor or his fellow-students and then be catapulted or towed off. At the beginning of training, speed was kept low so that the glider would not take off, though there was usually enough breeze over the wing to provide some measure of control. After half a dozen ground slides, the student usually got the hand of what to do and the speed of the launch was increased. As confidence and skill increased to did the speed of the launch until the student could lift the glider into the air a couple of feet and put it down again without too much of a bump. With practice, the height of the launch increased until straight flights were made from several hundred feet. With a glide ratio of 10 ore less, there was seldom danger of running out of runway from 200 feet. When he had mastered straight and level flight, the student progressed to turns.

As a general rule, students were lifting off the ground after a dozen ground slides, doing high straight flights after another dozen or two and doing turns after about 50 launches. If there was sufficient room on the field, early turns were limited to 90 degrees, progressed to 180 degrees (on calm days) and finally the student was allowed to make his first circuit. It would be quire impossible for a modern student pilot to experience, or even imagine, the unique mixture of excitement, terror and pride of achievement that accompanied the successful completion of that initial circuit of the field.

The student of today takes off, accompanied by an experienced instructor, fully confident that, no matter what crass errors he may perpetrate during his period of instruction, he will eventually be returned safe and sound to mother earth. But it was not always so, and learning to fly in a primary glider was literally a matter of pitting yourself against the unknown. Learning to fly on a Zogling in 1945 did more to strengthen my prayer life than any subsequent experience,

The training schedule was interrupted often by minor and major crashery which delayed progress and often resulted in the student having to start from scratch again. Throughout the training flight the instructor, if there was one, stood near the proposed landing point or rode on the towing vehicle and gave instructions to the student by arm signals or shouted commands. This form of instruction lasted in some parts of Australia until well into the 1950s and some of the senior pilots of today's clubs were trained this way.

Although this method of instruction left much to be desired, it did have some point in its favor. For a start, it kept the members physically fit, providing a mixture of calisthenics, weight lifting, sprinting and marathon running. Then the training was so often fraught with terror that, by the time the student graduated to better machines, there was little that could scare him. Hence the readiness of early glider pilots to enter cumulus-nimbus clouds armed only with basic instruments, and the calmness with which they landed in pot-holed paddocks or carried out circuits at night from an unlit field.

The low wing loading of the primary glider, usually less than three pounds a square foot, resulted in a landing speed of little more than 30 mph. With any sort of a breeze, this gave a ground speed as low as 20 mph at touchdown. Furthermore, the glider itself was very strong, very docile and very forgiving. I have seen them stalled in from height up to five feet, subjected to steeps turns and landed on trees without seriously hurting the pilots. Occasionally they were looped and rolled and even aero-towed. In skilled hands, and sometimes even unskilled hands, they could be thermalled in moderate conditions. The best recorded altitude reached is about 4,500 feet above the ground, and this without instruments of any kind. In Australia, thermal flights of 20 to 30 minutes have been achieved. As a breed, primary gliders have been maligned much more than they deserve. They formed a solid backbone for the gliding clubs which operated in the 1930s.

To be continued... Next Issue: The Gliding Club of Victoria

AUSTRALIAN GLIDING MUSEUM. CONCEPT PROPOSAL.

By Graeme Barton

The centenary of manned flight will be celebrated in the year 2003. Aviation has played an extraordinary role in the development of our nation and a fitting memorial to commemorate this contribution is warranted. We have a unique opportunity to develop RAAF Williams Base at Point Cook into a world class "live" aviation heritage site with the establishment of the National Aviation Museum at which all branches of aviation should be represented and at which aircraft in the collection can be flown.

Sporting aviation has made a unique contribution to the development of aviation in our country and its role should be acknowledged with appropriate inclusion of displays in the Museum.

Gliding in particular deserves recognition. The Australian Gliding Museum is preparing a unique collection of aircraft and memorabilia dating back to the 1920's for display and in so doing is working to retain the design and construction skills used to develop these aircraft.
The Australian gliding community is prepared to make this collection available to current and future generations of Australians but it needs a display facility which we believe should form part of the National Aviation Museum.

The Establishment of the Australian Aviation Museum has the potential to enhance development in the Werribee area by becoming a very significant tourist attraction with resultant employment opportunities. Significant education opportunities would also result from its establishment.

Above all, it would encourage interest and participation in the "Adventure of Flight" characteristics which have served our nation so well during the twentieth century.

PRESERVATION OF AUSTRALIA'S GLIDING HISTORY.

Australia has a long and proud history of involvement in the sport of gliding. The first true man-carrying sustained flights in Australia were made by George Taylor in a glider at Narrabeen on December 5,1909. This glider covered distances of less than 200 meters on its initial flights. From this humble beginnings sailplane design has improved to such an extent that sailplanes now cruise for distances in excess of 1.000 kilometers at speeds well in excess of 100 kilometers per hour, being dependent entirely on using the forces of nature to stay aloft.

In response to the interest in gliding flight, a number of gliding clubs were formed in the 1920's. One of these, the Gliding Club of Victoria, has been in continuous operation since 1929, developing into the largest gliding club in Australia with facilities and expertise so outstanding that it was chosen to host the World Gliding Championship in 1987. There is also a number of other clubs in Australia with long histories of active operations.

SMILE ☺

A duck walks into a pub and orders a pint of lager and a ham sandwich. The landlord looks at him and says, "but you're a duck".
"I see your eyes are working" replies the duck.
"And you talk!" exclaims the landlord.
"I see your ears are working" says the duck. "Now can I have my beer and my sandwich please?".
"Certainly," says the landlord, "sorry about that, it's just we don't get many ducks in this pub. What are you doing round this way?
I'm working on the building site across the road" explains the duck.
So the duck drinks his beer, eats his sandwich and leaves.
This continues for 2 weeks.
Then one day the circus comes to town. The ringmaster of the circus comes into the pub and the landlord says to him; "You're with the circus aren't you? I know this duck that would be just brilliant in your circus, he talks, drinks beer and everything!".
"Sounds marvelous" says the ringmaster, "get him to give me a call."
So the next day, the duck comes into the pub.
The landlord says, "Hey Mr Duck. I reckon I can line you up with a top job. Paying really good money!"

"Yeah?" says the duck, "Sounds great, where is it?"
"At the circus" says the landlord.

"The circus?" the duck enquires.
"That is right" replies the landlord.
"The circus? That place with the big tent? With all the animals? With the big canvas roof with the hole in the middle" ask the duck.

That's right says the landlord.
The duck looks confused.....
"What the f*** do they want with a plasterer?"

CLASSIFIEDS

AUSTRALIAN GLIDING MUSEUM.

If you wish to join this project and if you have any question or wish to discuss any aspect of the Proposal or wish to volunteer to assist with any of the Museum's projects, please do not hesitate to contact .

Graeme Barton. 2 Bicton Street. Mount Waverley.Victoria 3140 Australia. Phone: (03) 9802 1098.

Membership AU $ 15 .

WANTED - Study books and/or plans for gliders. Design Building etc. Contact: John Thirwall, P.O.Box 69, Northbridge 2063 Ph. 02 9958 7311 Fax 02 9958 0350

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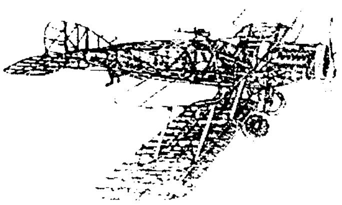

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