GYMNAST

INDOOR/OUTDOOR FLYER.

The purpose behind the design of this aerobatic aeroplane was that with my limited flying skills I would be able to fly it indoor at the International Model Engineers Show 1997. I've tried to fly many types of indoor RC models at the IMS before, all of which only manage to stay in one piece for 3 days and end up in the ground or bin!. So with all the experience gained, I set about designing my own indoor plane, based around my favourite diesel, the M P Jet 0.61 R/C.

The construction had to suit my limited building skills and be quick and easy to build without any special technical skills or expensive materials. One other thing learned was that it must be able to be repaired quickly - immediately or over night, so that I would still be able it fly in my allotted slot the next day. Hence the bolt-on wing. As it turned out I did not have to use any spare parts at the IMS as the plane flew so slowly and smoothly, it was idiot-proof. Even with me flying it!! So, on to the construction.

Start with the fuselage (the easy bit)...

Using 1/4" hard balsa sheet that is not warped and the top edge square and straight. This is the datum line for the whole construction. Cut the fuselage to a full rectangle (DO NOT TAPER THE REAR END YET), place the 1/4" ply on top at the front end and tape on with Sellotape, mark and cut the scarf joint through both pieces of wood. Remove tape and using Zap flexi-cyno, glue scarf joint together. Using a biro, mark out engine slot and servo holes to match your choice of equipment and cut out the unwanted area. Lay the fuselage on top of the 1mm ply and mark around with a biro, use slow cyno to fill in the fuselage outline on the 1 mm ply - align and place the fuselage on top and weigh down until the cyano sets. Cut around the fuselage, cutting out the servos and engine slots, turn over fuselage and do the same again. Now you can cut the taper to the rear end. Keep the off-cut. You will need it for the wing strut fuselage spacing. There you are - one completed fuselage, was that easy, or WHAT?

The Wing...

The section is Ritz 3-30-10 using 3% camber and is best for slope floaters and scale models, I think we now have to include slow indoor areobatic fun fly! You're going to love this easy build: - Trace the wing rib onto 1/8" ply. Cut and shape them carefully including the spares and the tab at T/E, as this will pay dividends later. Using this pattern cut out 5 ribs from 1/8" balsa and 4 ribs from 3/32" balsa. Cut a few 1/4 chord L/E & T/E ribs of varying thickness - I'll tell you what to do with them later (packing the wing struts). Lay down a 1/4" by 1/4" hard wood spar over the plan on a flat board, mark the centre, place ribs on spar and square them up. Don't forget the 2 x 1/4 length ribs on the centre ribs. Now fit the top 1/4" by 1/4" hardwood spar, square up and then cyano everthing in place. Fit and cyano the L/E and T/E. Lift the wing from the plan, turn over and glue the last spar in place. Cut off the lower building tabs. Using a small plane shape the L/E, but leave the T/E square. Now we fit the

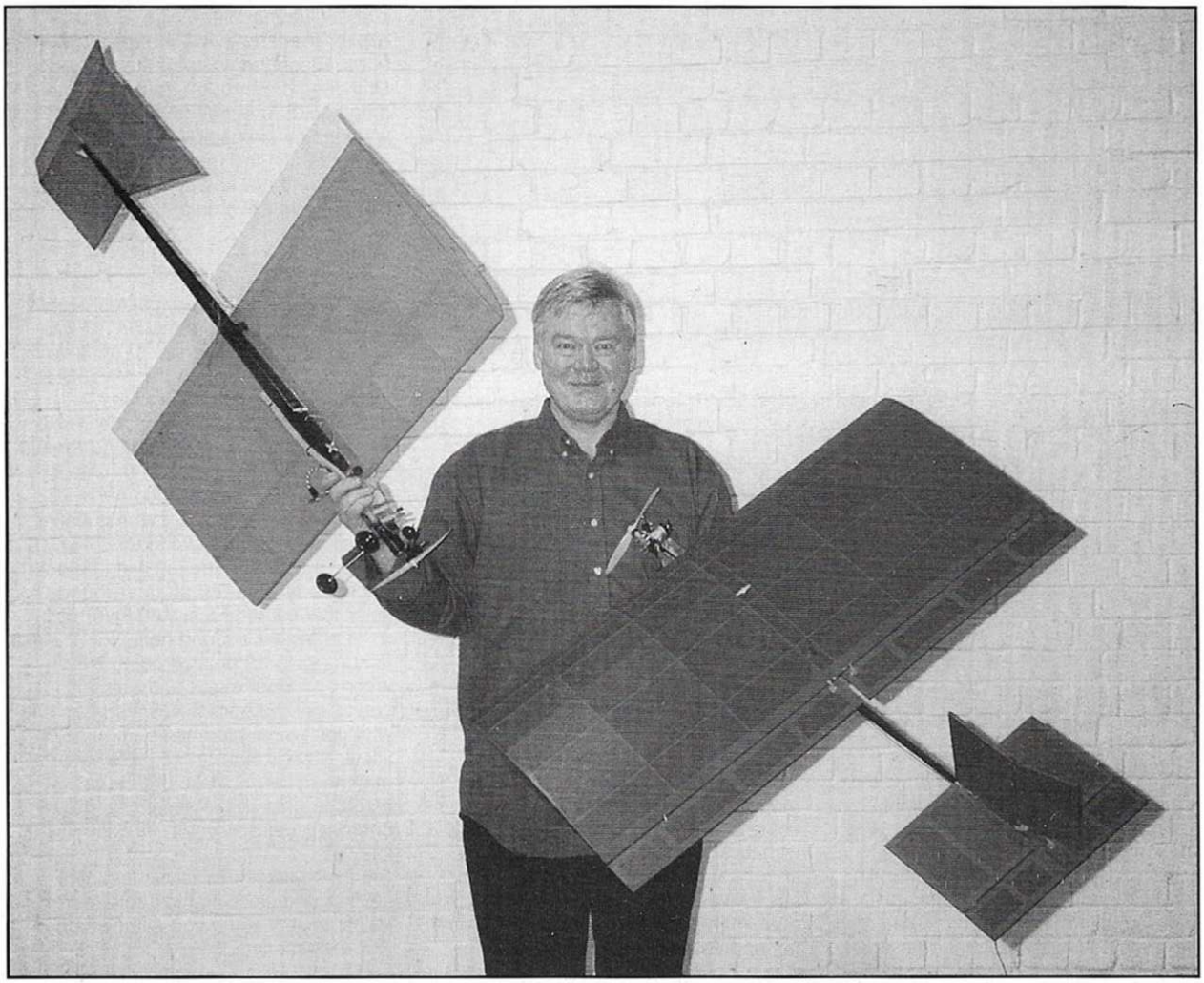
DATAFILE

Kit Specifications

Name:	Gymnast
Designed By:	Richard Harris
Aircraft Type:	Indoor fun fly
Wingspan:	36"
Wing Chord:	17.375"
Wing Area:	625sq.in.
Wing section:	Ritz 3-30-10
Dihedral At Each Tip:	0
Fuselage Length:	34.5"
Tailplane Span:	12"
Tailplane Area:	96sq.in.
Tailplane Section:	Flat plate
Fin Height:	9"
Engine Range:	.61cc diesel
Fuel Tank:	Flair 15cc team race tank
Control Functions:	Ailerons, elevator, rudder and throttle
C.G. (from L.E.):	4.5" - 5.0"
Elevator Throws:	1/4" up & down
Aileron Throws:	1/4" up & down
Rudder Throws:	1" either way
Sidethrust:	0
Downthrust:	3°

Materials Used in Construction

Fuselage:	Ply, balsa
Wing:	Built-up balsa
Tail Surfaces:	Balsa strip
Weight, Ready to Fly:	23.6 oz
Wing Loading:	5.5 oz per sq. ft
Engine used:	M P JET 0.61 Diesel RC
Battery:	Sanyo 4.8 volts 270 mah
R.X.:	Multiplex Micro 5/7 35 Mhz
Servos:	3 x Hi Tech HS/80, 1 x HiTech H/S 101 (aileron)
Wheels:	1.5" dia. black plastic F/F



Richard and a brace of Gymnasts (or should that be team of gymnasts?). Regular performers at this years IMS at Olympia, with Richard and Ali Machincy twiddling the sticks, the Gymnast really proved it's aerobatic ability.

wing to the fuselage and make use of the 1/4 chord ribs that I mentioned earlier. The 4 struts are made of 1/8" ply, slightly over length. Using a off-cut of fuselage as a spacer, make wing strut boxes in wing with the 1/4 chord ribs to correct spacing and depth, trial-fit over the fuselage, ensuring that the fit is nice and snug! Remove the struts and put them in a safe place. DON'T GLUE THE STRUTS IN UNTIL YOU HAVE COVERED THE WING! - Easy isn't it?.

A quick way to make up the ailerons, is to use a small mitre and saw, - measure and tack glue a small balsa stop in your mitre block at the correct length of the aileron ribs. Cut lots of ribs because they are the same cross section as the elevator, fin and rudder. Now you have all your ribs, build your ailerons over the plan using medium cyno glue only. Sand the front edge of ailerons to a "V" so they pivot and hinge freely, leaving the rear edges square.

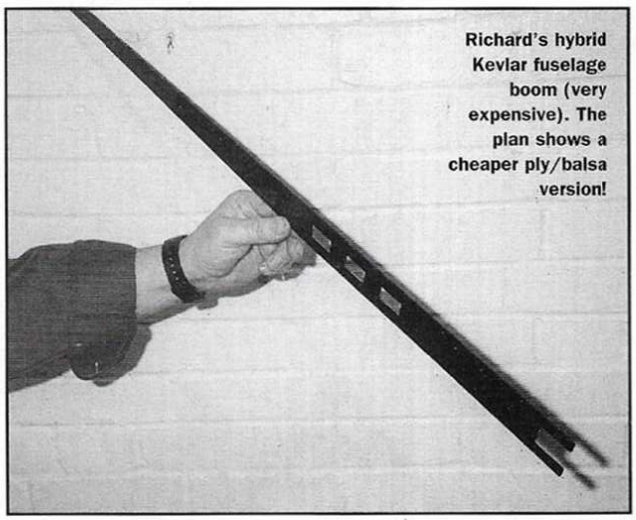
Build tailplane over plan and don't leave out the triangular fillets as these are needed. Note the slot offset near the centre, this is for the rudder post to pass though. Build the elevator in the same way again, chamfer the L/E of the elevator to a "V" so that it can pivot and hinge freely, the T/E, as for the ailerons, is square. When building the fin, note that the rudder post extends down through the tailplane and glues to the fuselage side. Don't leave out the triangular fillets, because you will need the strength in the rudder when you make inverted touch and goes. Dry fit the tailplane and rudder and fill in any gaps.

Richard Harris has designed a handlful of fun for the IMS and other big halls...

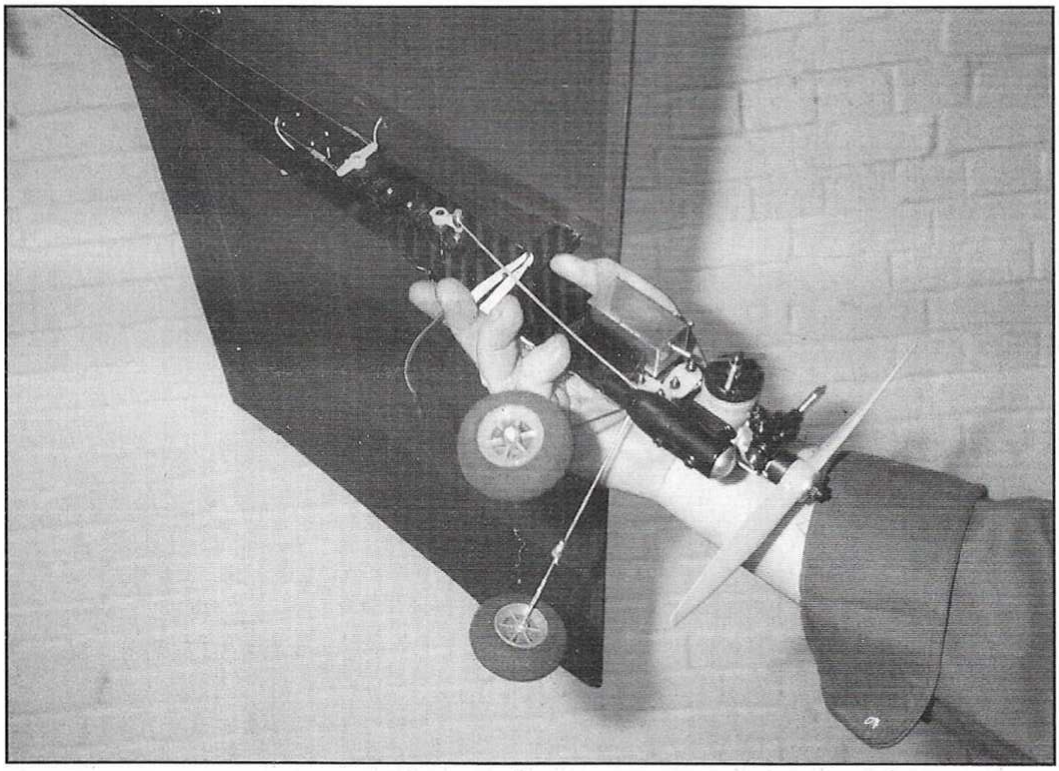
The landing gear is nice and simple, just bend to shape. Use 4 saddle clamps to hold in place directly behind engine, fit a cross brace and solder in place. Free-flight wheels are soldered on with small washers.(- save weight, no collets).

Covering

Before covering the wing, fit the aileron servo in place. This makes it a very neat and tidy finish. I covered all the flying surfaces with LiteSpan. It doesn't need fuel proofing. It keeps it light and won't warp any of the flying surfaces. Coat all the balsa parts to be covered with Covergrip or Balsaloc. Glue wing struts in place with 15 min epoxy, making sure that they are set 90° square to the lower surface, leave it to set. After covering, glue the tailplane and the rudder in place. Fit tailskid. Hinge all the surfaces with Great Planes rough woven mylar hinges. Fit all hinges in place, check for alignment then use thin cyno whilst they are in place(- no pinning needed). Fit 1/2A control horns to all moving surfaces. Fuel proof the bare wood fuselage and then fit servos, the RX, battery and tank are rubber banded in position.



Richard's hybrid Kevlar fuselage boom (very expensive). The plan shows a cheaper ply/balsa version!



The engine and radio installation. Note the C/L team race tank, the throttle pushrod friction mechanism (rubber band!) and the closed loop tail control runs from mini servos.

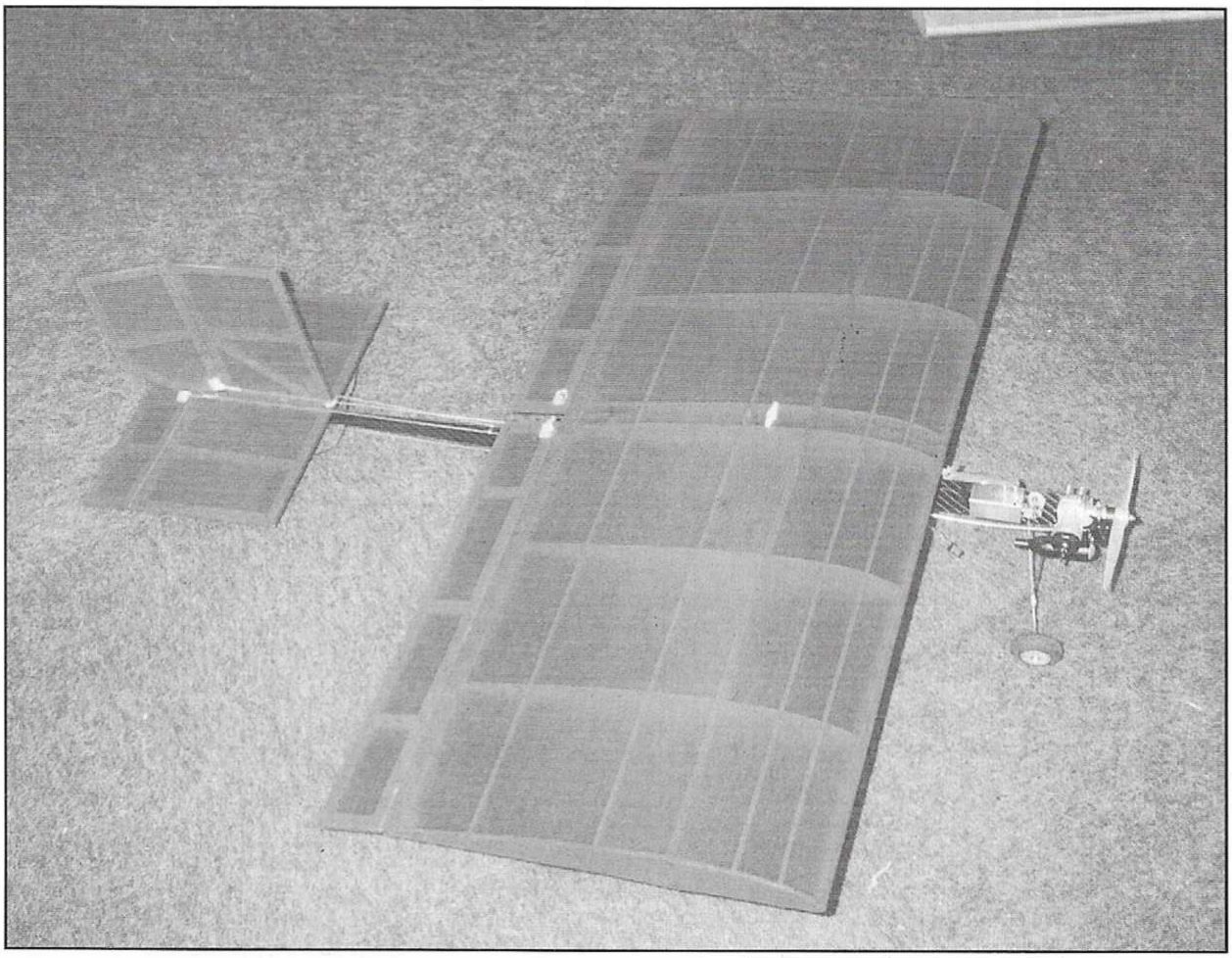
Turn on the radio and centre the servo horns, using 3-core 7lb lightweight closed loop wire for rudder and elevator controls. No adjusters are needed, just add a light tension and crimp. 'Z' bend the ends of the threaded aileron push rods at the servo end and fit quicklinks at the horn ends.

Fit engine in place. Drill through mounting holes, fit engine in place using Great Planes 4-40 by 3/4" bolts with locknuts. Place a long 12" piece of silicone tube over the exhaust, so that all oily waste will by-pass the radio equipment, drill two small holes through fuz and tie strap the silicone tube in place. Use thin piano wire as a push rod for the throttle - 'Z' bends at both ends. Place the wing on the fuselage. Drill one hole through front strut and fuselage, fit one bolt and nut, set the wing incidence using the datum line, drill a hole in the rear strut and fuselage, fit nut and bolt. When happy, drill the other two holes and bolt up.

Flying

Set the controls for the first test flights to the throws given in the DATAFILE, using the battery position to achieve the C.G. as shown on the plan. After the first few flights, change the movements to as much as you can handle. You will need increased throws if you are going to attempt the next maneouvres. SLOW and LOW is it's forté. You are going to love this one - low ground hugging, wing touching figure of 8's - first the left wing tip, then the right. NEXT, - 4ft off the ground, slow, low figure of 8's, with inverted rollover for the second half. NEXT, slow tail-dragging at the stall point. NEXT, inverted rudder touch and go's - if you've got the nerve! Now you can see why you've got all those triangular fillets. Make some spare parts - you may need them! If you break the fuselage (that'll take some doing!), try one out of carbon but it will cost you lots!

Many thanks goes to my test pilot, adviser and structural failure expert Ali Machinchy.Wishing you calm weather and exciting flying. **RM**



Wide chord, wide rib spacing, classic design criteria for successful indoor fun-flying. Note the abscence of corner fillets on the tail surfaces - Richard advises fitting them (this is the prototype - he fitted them to No.2!).