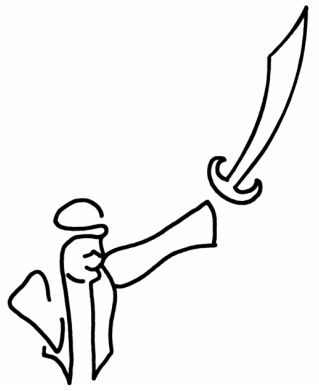
Scimitar

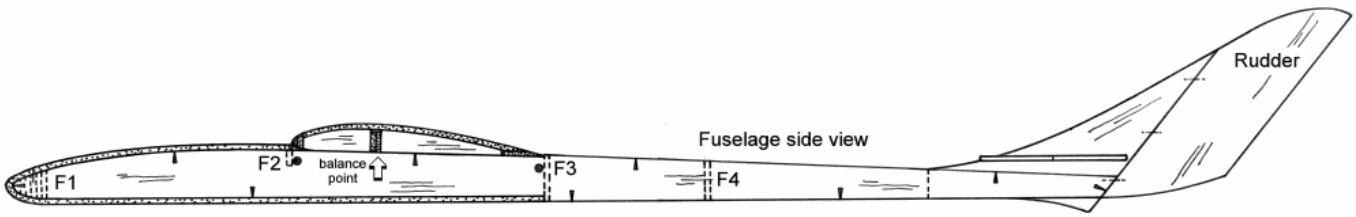
Armada Model Designs Ltd

Free-Flight Model Glider - MA06A

www.armadamodels.co.uk



Scimitar is an elegant 687mm span free-flight model glider that evokes the nostalgia of a pre radio-control age. The model employs conventional balsa wood construction and the plan fits neatly across two sheets of A4 paper. The shopping list of materials isn't vast - the whole thing can be built from a single sheet of balsa wood, some heat-shrink covering and a few minor fittings. Alternatively, this project is ideal for making good use of the collection of scrap balsa that builds up in every model aircraft builder's home. Construction is straightforward for anyone with a little aeromodelling experience and performance can be enhanced by simply adding a tow-hook for some relaxing tow-launched gliding.



Note: operating model aircraft can be hazardous if care is not taken. While this design has been subjected to a thorough Quality Assurance procedure it must be stressed that the builder requires a certain level of skill and knowledge to complete the project successfully.

For questions relating to model aircraft safety please contact your country's governing body. In Great Britain, the British Model Flying Association (BMFA) is the body delegated by the Royal Aero Club to be responsible for all aspects of model flying. Membership brings many benefits, including access to expert advice, a structured achievement scheme and 3rd party liability insurance of up to £10 million. Visit www.bmfa.org for more information.

Instructions

Read these instructions and study the plan carefully before commencing assembly. Use a good flat building board to prevent warps and twists from being built into the structure. Print out the main plan on two sheets of A4 paper and the wing ribs on another sheet. It's best to create a kit of parts first, by cutting out all the components required with a sharp scalpel or craft-knife. Always keep your fingers behind the blade and well out of harm's way and take care to leave sharp instruments in a safe place when not in use.

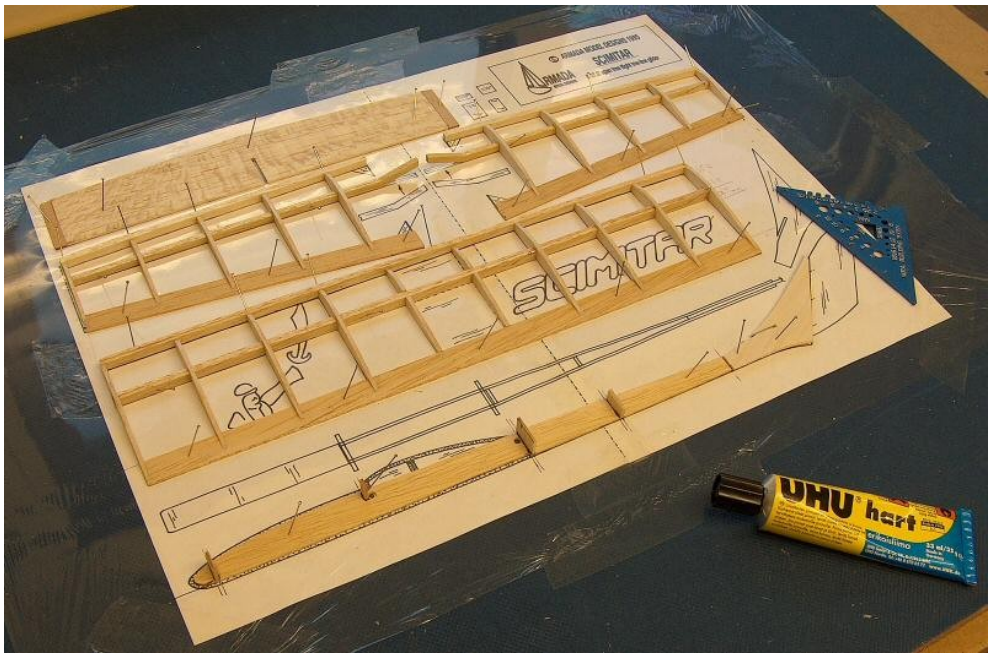
Ensure that scaling is set to “none” when printing. Join the two parts of the main plan with transparent tape and then pin this to the building board. Cover the plan in clear polythene sheet or cling film to prevent glued parts from sticking to it. Use either balsa cement or PVA adhesive throughout construction. All wood is 1.5mm balsa unless otherwise stated. Transferring the components from plan to balsa can be done in a variety of ways. If the plan is printed on a laser printer or photocopier then it is sometimes possible to run a hot iron over the back of the plan to transfer the printed image to the balsa, but be careful as this can make the balsa curl. Carbon paper could be used and the components traced onto the balsa or the plan could be cut up and stuck to the balsa using a low tack adhesive. Finally, it is also possible to make pin pricks through the plan directly onto the balsa to produce a series of dots that can then be joined up.

Shopping List

- 1 x 100mm wide sheet of 1.5mm balsa (or balsa from your scrap box)
- Glue – e.g. Balsa cement or PVA adhesive
- 1 x pack of Solarfilm So-Lite plastic heat shrink covering or equivalent
- 30 amp fuse wire, or similar, for rudder hinges
- Elastic bands for retaining wings
- Dowel for fixing wing-bands - although it is possible to dispense with the dowel and loop elastic bands directly over the fuselage to retain the wings
- Ballast, such as small fishing weights
- For tow-line launching: wire hook (1mm piano wire or paper clip), wooden plate and fixing screws

WING

The wing is composed of a single centre panel and two tip panels. First, glue together the two components that make up each of the laminated spars and leading edges. Pin the main spars and the trailing edges onto the building board and glue all wing ribs in place. Glue all leading edge pieces in position and then finally add the top sheeting over the centre two ribs – the rear of the sheeting will have to be chamfered with a sanding block to fit in accordance with the plan.

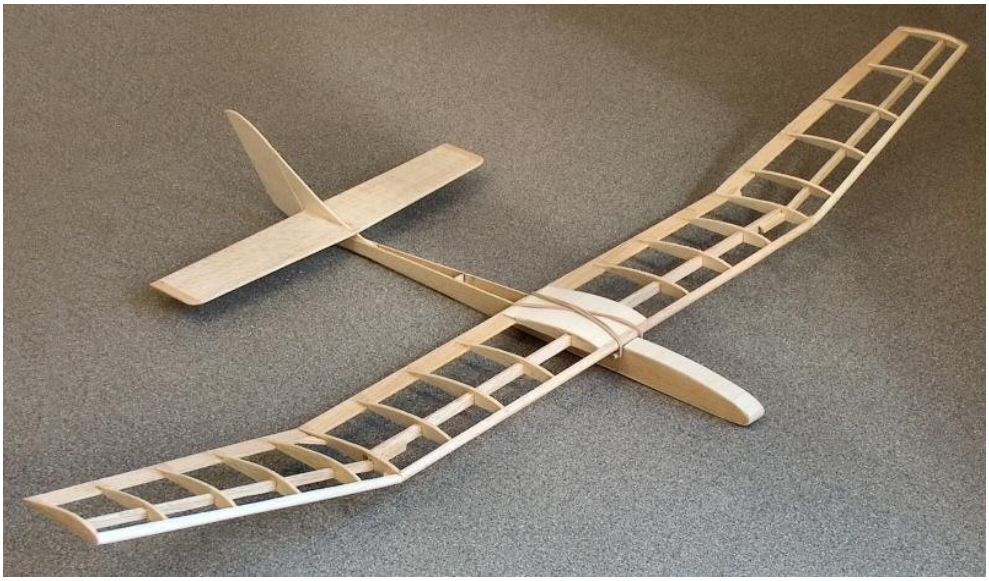


Leave the wing panels to dry thoroughly before removing them from the building board. Sand the leading edges to the correct profile and make sure that the leading edge, trailing edge and gussets of the each wing tip panel are chamfered to accommodate the required dihedral angle. Glue scrap balsa to the tips of the wing and sand to the correct aerofoil shape when set. Lay the

wing centre section on the building board and glue the wing tip panels in place, accommodating the dihedral angle (19 degrees for each panel) by propping up each tip 56mm above the board. Once the structure has completely dried ensure that the wing balances at its centre. If there is a small difference in mass either side of the wing centre-line then simply remove some material by sanding the outside surface of the wing tip on the heavier wing. If the difference in mass is much larger, then some form of ballast will have to be glued inside the tip of the lighter wing.

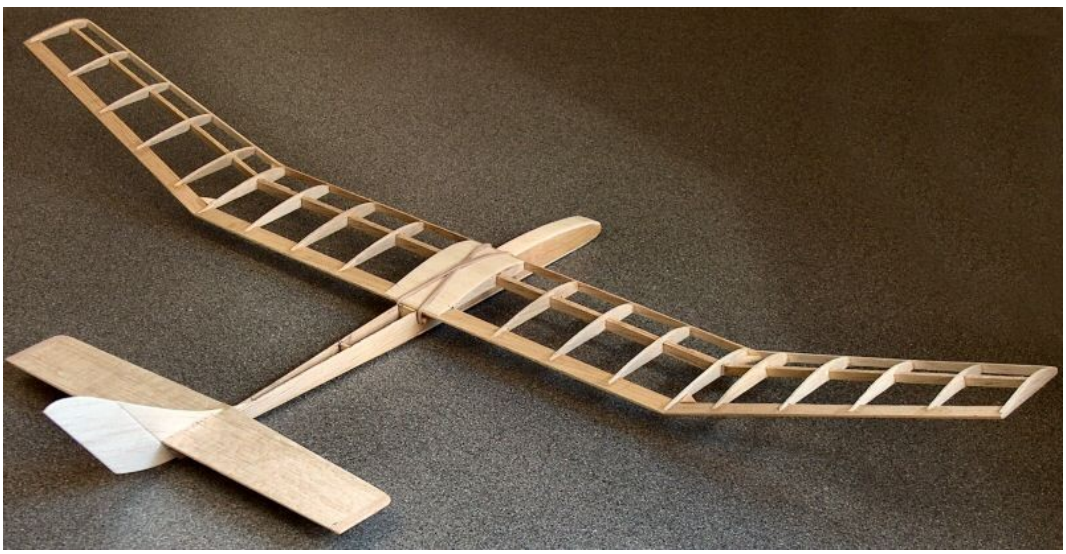
FUSELAGE

The fuselage is constructed from the two sheet balsa side panels held together by the fuselage formers F1 to F4. From the side view on the plan mark the positions of the formers on the inside of the right hand side fuselage side panel. Pin the right hand side panel flat over the the plan and glue in place the formers and the tail fin. Note, when attaching the fin, it is important to ensure that the tailplane slot is at the correct angle. When this is dry, remove from the board and position over the fuselage plan view and glue the other fuselage side in place – first at formers F1 – F3 and then when these are dry, bend the rear fuselage in line with the plan and glue F4 and the tail fin. Fill in the nose area ahead of F1 with scrap balsa and then sheet the top of the fuselage from F2 forward and the lower fuselage from F3 forward. Note that the grain of this sheeting runs at 90 degrees to the fuselage length.



TAILPLANE AND RUDDER

The tailplane is a single piece of wood with tips created from balsa that has its grain running at 90 degrees to the main panel. These cross-grain tips help keep the tailplane flat and warp-free. Once the tailplane tips are set, glue the assembly to the fin, ensuring that the tailplane sits square. Use a pin vice with an appropriately-sized bit to drill the holes in the rudder and fin for the fuse-wire hinges, then glue the hinges and rudder in place.



FINISHING

Sand down the entire model, rounding off all flying-surface edges.

Before covering, test assemble the model by holding the wing on with rubber bands looped over the dowels (if that method of fixing is chosen - otherwise simply loop the bands over the fuselage). Check that the flying surfaces (wing and tail) are square to the fuselage and to each other, if necessary pack the wing-seating with slivers of balsa and when satisfied glue them in place. However, whilst doing this do not alter the incidence of the wing, i.e. keep the wing at the angle, relative to the fuselage, as that marked on the plan.

Cover the model's wing, tail and fuselage. This can be done with either traditional tissue and dope or with a modern plastic heat-shrink covering. The prototype was covered in “Solarfilm So-lite”. This is an attractive, lightweight heat-shrink film that is available in opaque or transparent colours. It also comes with a comprehensive instruction sheet explaining how to use it. Check that no warps have appeared in the wing or tailplane during covering, and if these have occurred then remove them by heating the affected surface and then gently twist them out.

To prepare the model for flight, suitable ballast is added inside the nose. Small fishing weights are one possible option. Ballast the model such that, when fully assembled, it balances at the Centre of Gravity (C.G. or balance point) shown on the plan (25mm aft of the leading edge). Use some lightweight foam rubber, or similar material, inserted into the nose, to keep the ballast in place.

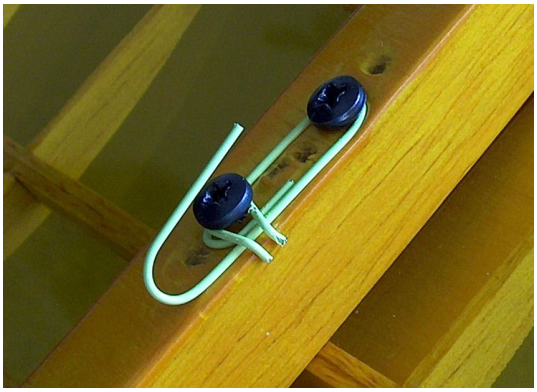
FLYING

Choose a relatively calm day for the test flights. Hand launch the model directly into wind, slightly nose down from just above shoulder height in a smooth flowing motion. The model's trimmed flying speed is relatively slow, so don't throw the glider – a gentle push is all that is required. Even a correctly trimmed aircraft will climb, stall and dive if the initial launch speed is too high. A little practice will soon give the correct result and provide a true reflection of the model's state of trim.

If the glider tends to stall i.e. climbs then dives in a series of swoops, add a little more ballast inside the nose. If on the other hand the model just dives rapidly to the ground remove a little ballast from inside the nose. Aim to achieve as shallow a flight path as possible.

The direction of the model is controlled by the rudder - by bending it slightly to the left for a left turn and right for right turn. The rudder is very sensitive and only needs moving the merest fraction. If too much rudder is used then the subsequent flight will simply end in a spiral descent. Start off with the rudder straight and give the model a test glide. Use very small rudder adjustments to provide a straight flight path.

If the model is to be tow-launched, a towline can be made from 30 to 50m of lightweight nylon line. One end will need a metal ring of approximately 10 – 15mm diameter and the other end will require a handle, not unlike that from a child's toy kite. About 30cm from the ring, attach a small piece of ribbon to the line – this will help to release the line from the model and enable the end to be found more easily when it falls to the ground.



The tow hook can be fashioned from 1mm piano wire or even a paper clip. Bend the hook as illustrated in the adjacent photo. It will need to be screwed to the fuselage, therefore some spruce or 1.5mm ply will need to be glued inside the lower fuselage under the wing. Screw the hook in place as indicated in the photo. Use additional wire, wrapped around the forward screw, to hold the hook in place.

The hook on the prototype is offset slightly to the right, and this makes the model tend to yaw to the left while on the tow-line. Now, the aim of tow-launching is for the glider to ascend straight ahead on the tow-line and then start to circle once the tow-ring has detached, with a shallow angle of bank in a continuous turn of approximately 30m diameter. By adjusting the rudder, the glider can be made to fly straight on the tow-line and then begin to circle once released. If the rudder deflection required to keep the towing phase straight is too great for the subsequent flight, then the rudder angle can be reduced and the front of the tow-hook bent towards the centre of the fuselage in order to compensate.

Carry out a test launch using the tow-line. Get an assistant to hold the model directly into wind with the tow-line attached by means of the ring slipped over the tow-hook. Make sure the nose of the model is held slightly raised and at head height. Hold the handle at the other end of the line and keep the line taught between you and the glider. When ready, signal your assistant to release the model as you begin to walk or run directly into wind. The rate with which you move will depend upon the prevailing wind speed. Do not run if there is a significant wind as the resulting aerodynamic forces will be likely to over-load the glider's lightweight structure. The model will kite up. If it is tending to weave i.e. swing to one side , be prepared to slacken off and move in the opposite direction to correct. A little practice at this and the model can be worked to maximum height, then with a little pause and a flick backwards the line can be released.

If during the tow, the glider turns rapidly in one direction and cannot be corrected by moving in the opposite direction, slacken off and release the model immediately to avoid damage.

By adjusting the tow-hook position and rudder angle, the model can be made to fly correctly both on the line and after release.

Since the model has a very good performance for normal sport-flying, it is capable of travelling a long way downwind. It is therefore important to match tow-line length to flying field size. Start off by paying out only a short length of tow-line, e.g. 15m, until you get a feel for how the model performs.

Simplicity, and hence ease of construction, has been prioritised in the design of this model, and to that end the tail surfaces have been created from sheet balsa. Although Scimitar's flying performance is very good, it could probably be enhanced by cutting circular holes in the rudder and tailplane so as to reduce the mass of these components without reducing their strength significantly. Don't forget, the geometry of this type of model dictates that a small amount of material removed from the tail leads to a larger amount of material (in the form of ballast) being removed from the nose. This is because the distance from the model's centre of gravity (C.G.) to the tail (rear moment arm) is much greater than that from the C.G. to the nose ballast location (forward moment arm). Therefore, a relatively modest reduction in mass at the tail leads to a proportionally greater reduction at the nose and hence the overall saving is generally well worth the effort. In any case, the main purpose of this model is having fun – whether enjoying the basic model or tweaking it to extract extra duration, the Scimitar certainly has the potential to satisfy different tastes.

Prototype details

Wing span	687mm	Wing loading	7.7g/dm^2
Centre section chord	74mm	Total lateral dihedral	38° (19° per tip panel)
Tip chord	50mm	Height of wing tip	56mm
Wing area	4.66dm^2	Longitudinal dihedral	1.5 degrees
Model mass without ballast	26g	Balance Point	25mm aft of leading edge
Ballast mass	10g	Tow-hook position	19mm aft of leading edge
All up mass	36g		

SCIMITAR

Armada Model Designs

Wing Ribs (1.5mm balsa)

In addition to component outlines, ribs R2 to R8 also show wing construction details

R1 (2 required)

R2 (6 required)

R3 (2 required)

R4 (2 required)

R5 (2 required)

R6 (2 required)

R7 (2 required)

R8 (2 required)

key to drawing notation

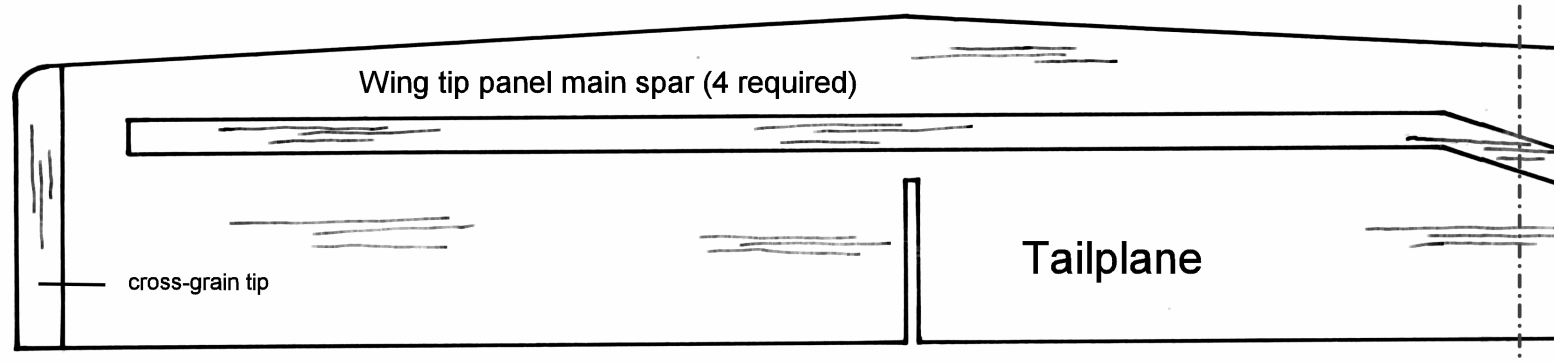
Indicates outline of fuselage side

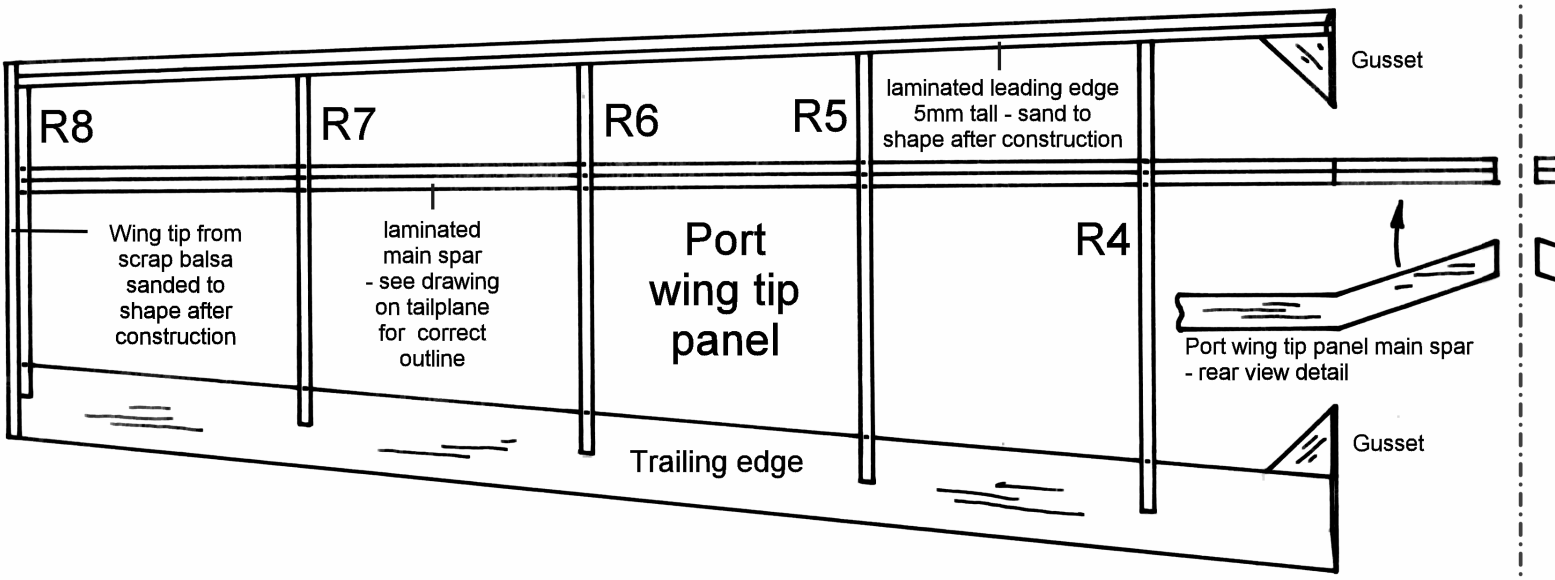
Indicates balsa with grain running into paper

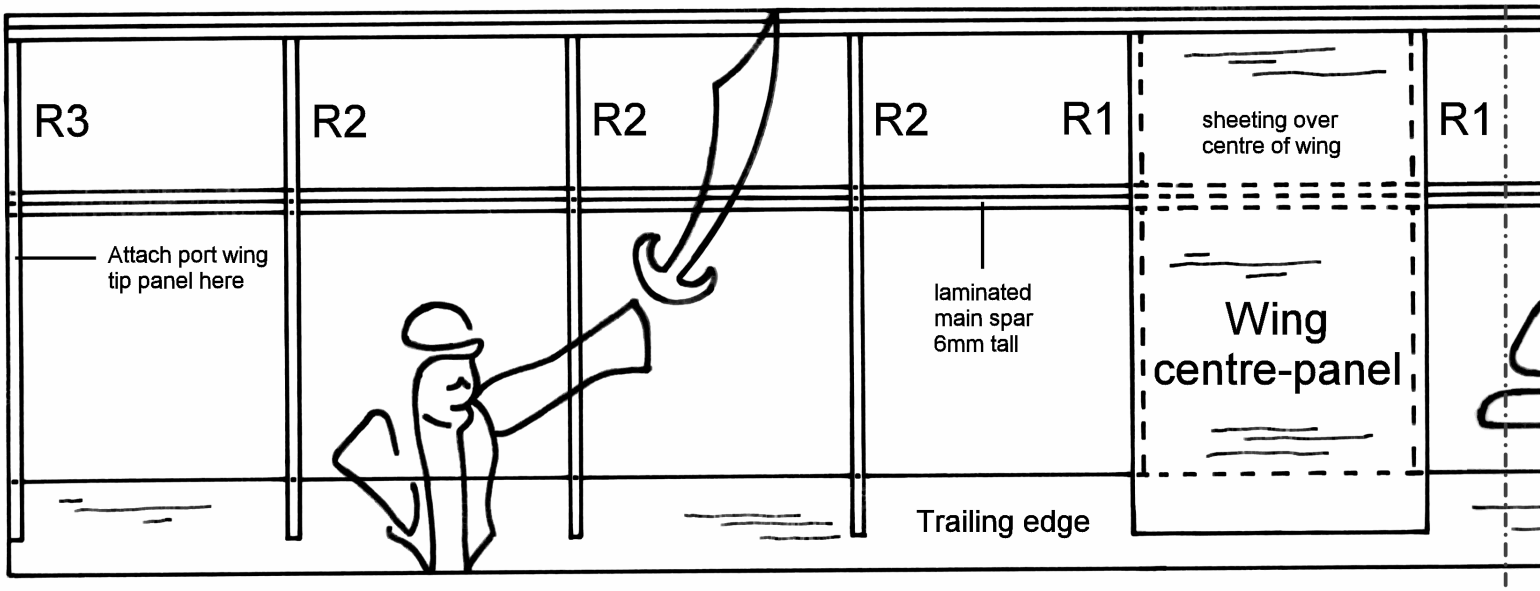
Indicates balsa with grain running across paper

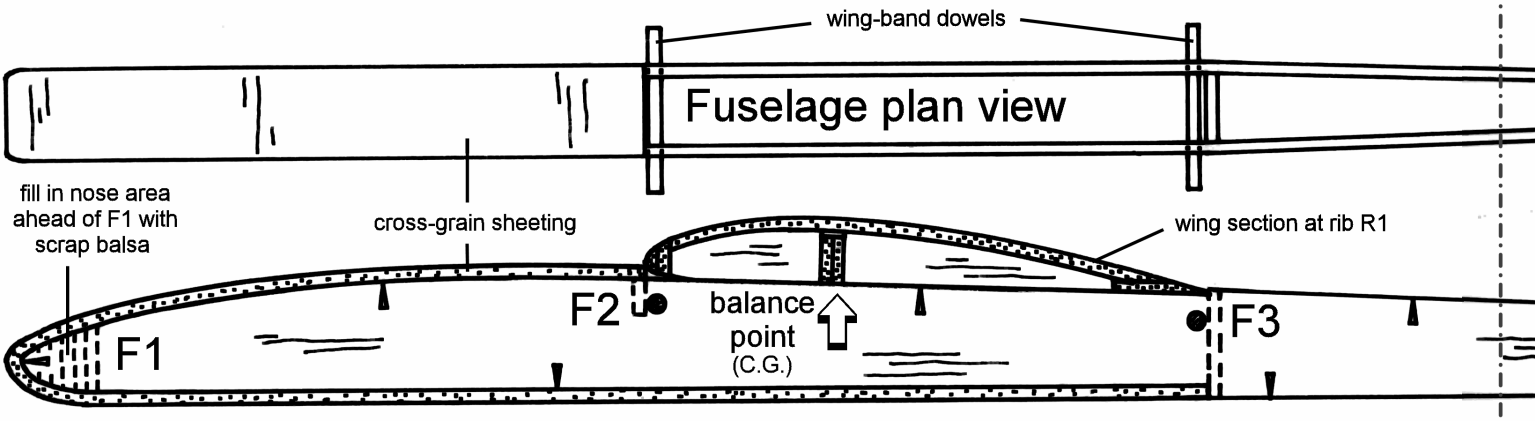
Indicates hidden detail

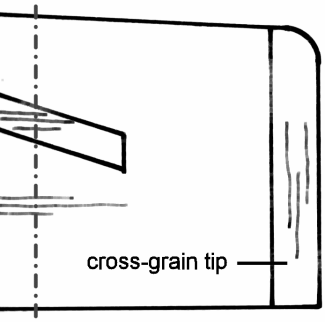
Indicates the place where the A4 sheets that make up the plan are to be joined

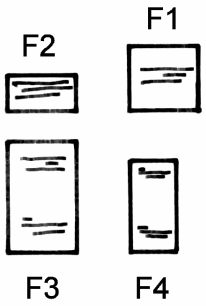

Wing tip panel main spar (4 required)
Tailplane
cross-grain tip


R8
R7
R6
R5
R4
Gusset
laminated leading edge 5mm tall - sand to shape after construction
Wing tip from scrap balsa sanded to shape after construction
laminated main spar - see drawing on tailplane for correct outline
Port wing tip panel
Port wing tip panel main spar - rear view detail
Gusset
Trailing edge


R3
R2
R2
R2
R1
R1
sheeting over centre of wing
Attach port wing tip panel here
laminated main spar 6mm tall
Wing centre-panel
Trailing edge


wing-band dowels
Fuselage plan view
fill in nose area ahead of F1 with scrap balsa
cross-grain sheeting
wing section at rib R1
F1
F2
balance point (C.G.)
F3





SCIMITAR

MA06 revision 0

680mm span
free-flight glider

All components are cut from 1.5mm sheet balsa unless otherwise stated.