



HOW TO MAKE A JACK PLANE

Carpenters throughout the developing world are involved in a wide range of activities, from boat building to roofing, to making furniture and ox-carts. They all face the same basic problems, but the scale of each problem varies from country to country and from area to area. The high cost of tools and equipment is a major factor in starting up or expanding a carpentry shop. It is very unlikely that you will see new tools in a small workshop, except where they have been donated by an agency. The majority of tools have been handed down from generation to generation since the time when foreign exchange was less of a problem, or when training institutions presented tools to graduates. The tools you will see are old, worn out, broken, but highly valued examples of imported steel tools.

Traditional skills are being lost throughout the world as Western mass-produced tools are equated with excellence. (In fact the West only switched from wooden tools recently because metal tools were cheaper to mass produce. Many craftspeople treasure the wooden planes that they have left.) This was not always the case: tool-making skills were once commonplace all over the African continent. Blacksmiths not only forged a wide range of utilitarian and ceremonial objects, but they were also able to mine the ore and smelt it into iron long before this technology reached Europe. Sadly, 'development' has made many of these skills redundant; popular western-style furniture needs to be made from western-style tools.

Traditional African woodworking tools have now been replaced almost completely by tools developed by Western manufacturers, but the skills to make these tools have not been part of the development process. This has left carpenters in most East African countries, for example, totally dependent on purchasing mass-produced hand tools, which unnecessarily drains the country, as well as the pockets of the artisans, of foreign exchange.

Overcoming prejudice

Mass produced tools are usually durable. They will last for many years of hard work, they have a good weight and precise adjustment mechanisms, and their quality can be assured. Their major disadvantage is cost, which puts them out of reach of the majority of individuals and institutions.

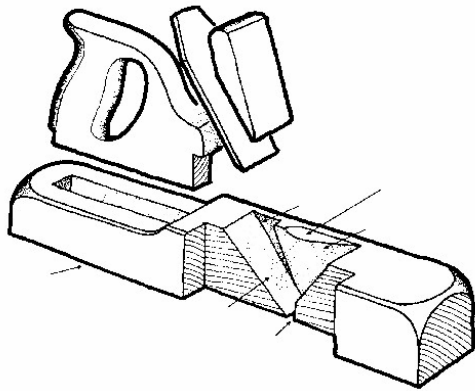
On the other hand, most hand tools can be made using locally available materials and techniques which are well within the abilities of competent artisans. They are cheap to make and to repair. They allow a carpenter to build up a comprehensive kit of tools, which in turn can dramatically increase the range of woodworking methods available. They do need careful maintenance – but then so do metal tools.

The most effective way to change attitudes is to educate the younger members of society, although the benefits may not be apparent for many years. Secondary schools, youth polytechnics, technical colleges, and teacher training colleges are all institutions where carpentry is taught in formal training environments, and where locally made tools could be introduced.

Making planes

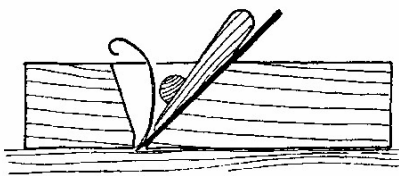
All woodworking planes have a number of similar elements, and if you are to make a plane that works well then you need to understand the function of each element. This applies to plough, rebate, moulding, smoothing and jack planes.

technical brief



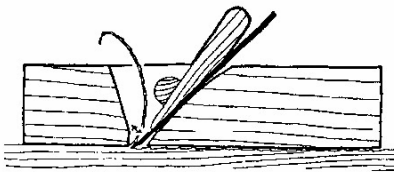
The sole: Unless the plane has been designed for curved work, the sole must be straight and flat. It is very difficult to produce a straight surface if the sole of the plane is twisted or bowed.

The mouth: The mouth of the plane is where the blade passes through the sole. It should be as narrow as possible if the plane is to leave a smooth finish. When downward pressure is applied to the plane, the front of the mouth helps to prevent the workpiece splitting ahead of the cutting edge.



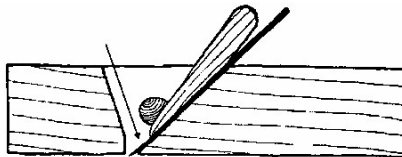
The frog

A large mouth allows the split to develop, and will leave a rough surface on cross-grained timber (see below). A well-placed cap iron will also help to give a finer finish by breaking the fibres in the shaving and taking away the strength that would be needed to form a split.



The throat

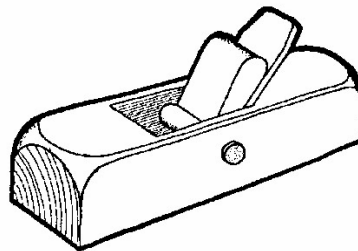
Shavings leave the plane through the throat. On a jack plane this is the opening at the top of the stock. It is essential that this opening is large enough for the shaving to pass through easily, or the plane will 'choke up' and require constant clearing. A common fault is that the fixing device is placed too close to the front of the throat.



On all jack planes the width of the throat should be 3mm wider than the width of the blade to allow it to be adjusted laterally.

The fixing mechanism

Whichever method is used to hold the blade to the frog, it must be held securely but also allow a certain amount of adjustment. (This version of the jack plane will use the crossbar and wedge.)



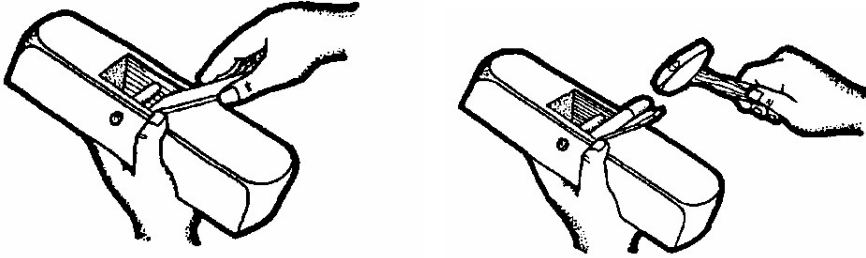
The blade

This must be straight and flat to fit tightly onto the frog. The cutting edge must be ground to an angle of 25 degrees or there will be no clearance behind the cutting angle.

The hand hold: The plane must be comfortable to hold. This means that there should be no sharp edges on the upper surface, and if a handle is to be fitted it should fit the hand and not get in the way of the blade.

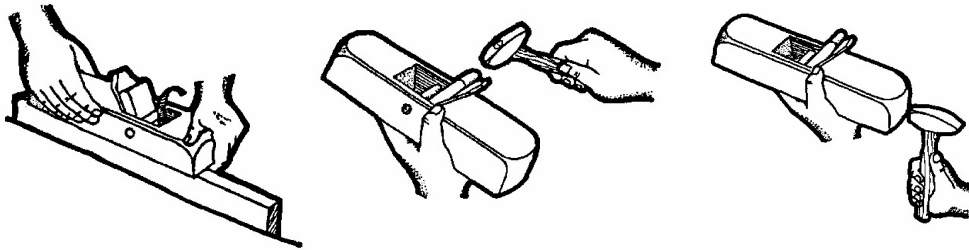
technical brief

Adjusting a wooden plane



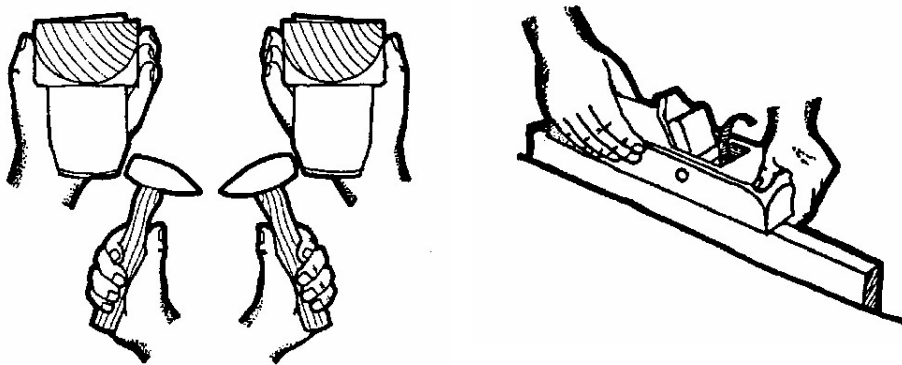
Hold the stock of the plane with one finger underneath the mouth. Put the blade into the throat and let it rest on your finger, so that it does not project below the sole of the plane. Place the wedge between the blade and the crossbar. Tap the wedge gently with a hammer to tighten it.

1.) Test the setting



2.) If the plane is not cutting, hit the top of the blade gently and tap the wedge to tighten it again.

3.) If the plane is cutting too deeply, hit the back of the plane to bring back the blade, and tap the wedge gently to tighten it again.

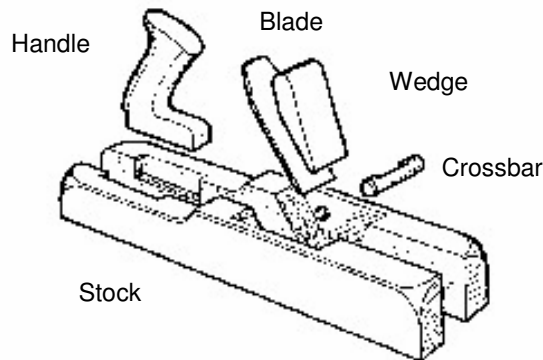


Look along the bottom of the plane to make sure the cutting edge is parallel to the sole. If one corner is too high then tap the opposite side of the blade. Repeat these actions until the plane cuts a fine, even shaving.

To remove the blade, simply hit the back of the stock until the wedge becomes loose.

Making the jack plane

A jack plane is an invaluable tool for all joinery work. The stock in this example is made from two identical pieces of timber. This method is slightly easier to make than a one-piece stock, and it should be easier to find timber. Care is needed when preparing and gluing the joint between the two halves, as there is a danger that the glue will fail. The design is similar to the traditional European pattern that was used for centuries before the introduction of mass-produced metal planes.



The stock of the plane is made of two pieces of timber. The mouth and throat are cut equally from both pieces. The crossbar passes through holes in the side of the throat and acts against the wedge to hold the blade in position. The wedge fits behind the crossbar and holds the blade in position. A blade can be bought from a hardware shop, or it can be forged by a blacksmith from high carbon steel. A cap iron can be fitted, but it is not essential. Cutting list

Item	Quantity	Material	L	W	T
			(mm)		
Stock	2	Hardwood	400	65	40
Wedge	1	Hardwood	200	50	20
Crossbar	1	Hardwood	80	18	18
Handle	1	Hardwood	100	115	25

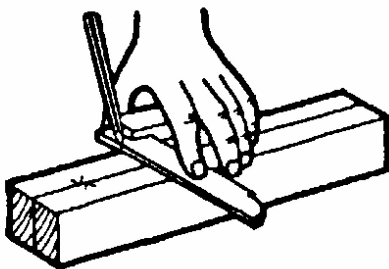
Also needed:
50mm-wide plane blade
PVA wood glue

Preparing the joint between the two halves of the stock

Take the two 400mm x 65mm x 40mm pieces prepared for the stock. Choose the faces to form the joint between the two halves, and mark the front and the sole of the plane. The grain should rise towards the front.

Plane the two inside edges to form a well-fitting joint. There should be no visible gaps between the two pieces.

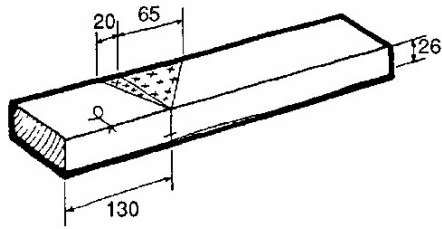
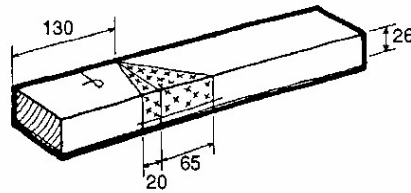
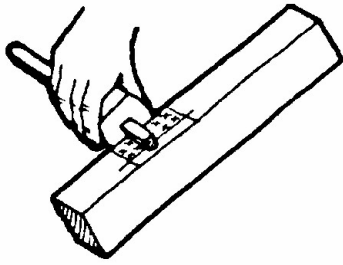
Marking out the stock



Gauge each piece to a thickness of 38mm. The waste will be planed off after the stock has been glued together.

Hold the two parts of the stock together and mark the position of the mouth on the sole of the plane, 130mm from the front.

Mark out the front of the throat and the frog as shown in the drawings.



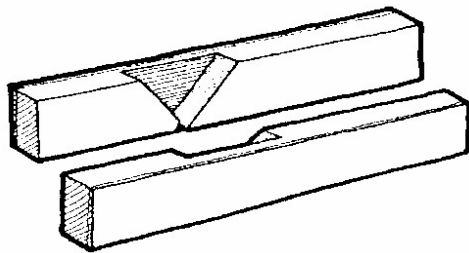
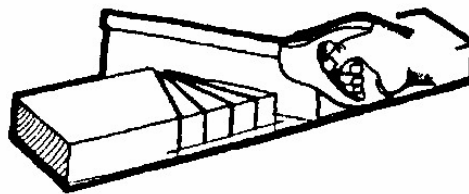
Set a marking gauge to 26mm and gauge the width of the throat on each piece, top and bottom.

Note that the two pieces are mirror images of each other. Mark the waste.

Cutting the throat

Use a tenon-saw to cut down the waste side of the lines at the front and the back of the throat.

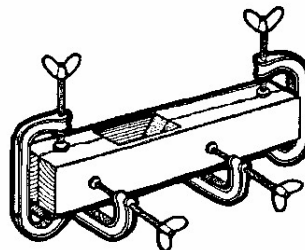
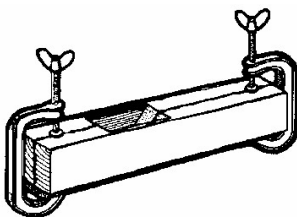
Make three or four cuts in the throat to make it easier to chisel out the waste. Take care not to cut below the gauge line.



Use a 25mm chisel to remove the bulk of the waste. Square a line across the front of the throat, 6mm from the back of the mouth. Use a tenon-saw to open up the mouth. Chisel out the remainder of the throat with a 6mm chisel and check that the cheek is straight. Repeat this process on the other half of the stock. The two parts of the stock should look like this.

Gluing the stock together

Clamp the two pieces of the stock together and make sure the joint still fits well. Do not apply glue yet. Use at least one clamp at the front and two clamps at the back. Unclamp the stock and spread a thin layer of glue over both pieces. If the timber is very dense it is a good idea to first sandpaper the surfaces to be glued, lightly, across the grain. This tears the fibres and will help the wood to absorb the glue.



Place the two parts of the stock together with a small piece of scrap timber below the join.

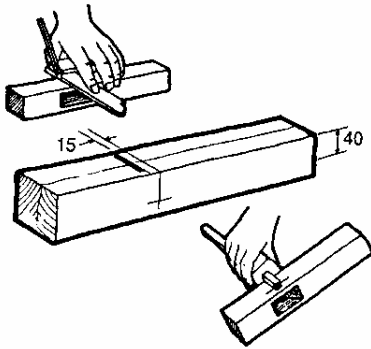
Line up the two halves of the throat and position a clamp at each end so that the shoes are above and below the join. This prevents the two pieces sliding across each other. Next, place one clamp across the front, and another across the back, and tighten until some of the glue is squeezed out of the joint. The first clamps can now be removed and placed on the back of the plane. Check that the throat is still aligned. Wipe off the excess glue with a wet rag, and allow it to set for six hours.

Planning the stock and truing up the throat

Plane the sides of the stock down to the gauge lines. Mark one side as the face side. Plane the top and bottom of the stock square to the new face side. Use a 25mm chisel to true up the front and back of the throat. Check that the frog is flat using a plane blade or a straight edge.

Drilling the holes for the crossbar

Square a line on the sole of the plane, 15mm behind the back of the mouth, and continue this line on both sides of the plane.



Gauge a line on each side of the stock to meet the pencil lines, 40mm from the sole. This marks the centre of the holes for the crossbar.

To prevent the drill bit splintering the inside of the throat, a piece of scrap timber, roughly 55mm x 50mm, should be planed to fit tightly into the throat.

Place this piece of wood in the throat. Centre an 18mm drill bit on the two lines just marked and drill right through the cheek. Ask for assistance to make sure the drill is square.

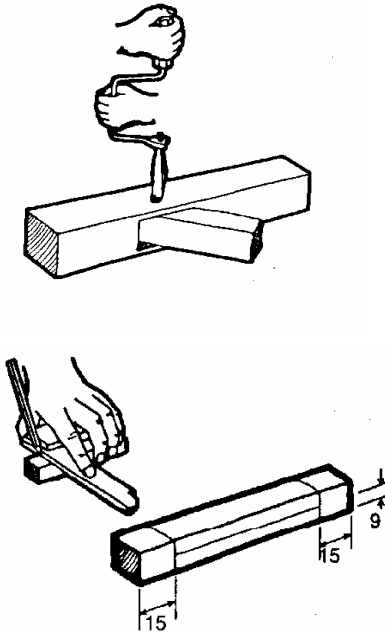
The hole on the other side of the stock is drilled in the same way.

Making the crossbar

Take the 80mm x 18mm x 18mm piece prepared for the crossbar.

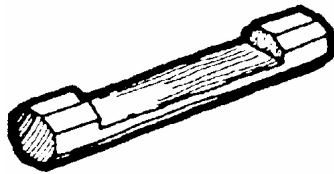
Square lines all round the piece, 15mm from each end, to mark the ends of the housing. Gauge a centre line on two opposite sides to mark the depth of the housing.

Plane the crossbar to an octagonal section. Fit the crossbar into the holes in the side of the stock. Make a series of saw cuts down to the gauge line, and chop out the waste with a chisel, first by driving the chisel along the grain from both ends and then by paring down across the grain. The finished crossbar should look like this.



Shaping the back of the stock

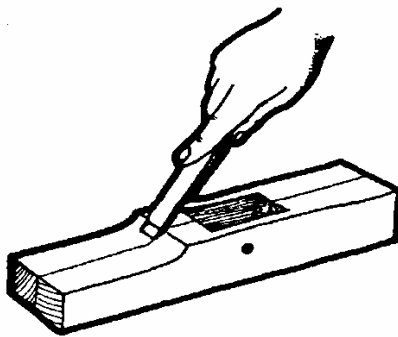
By removing a section from the back of the stock, and allowing the handle to be closer to the sole, you will find that the plane is easier to control.



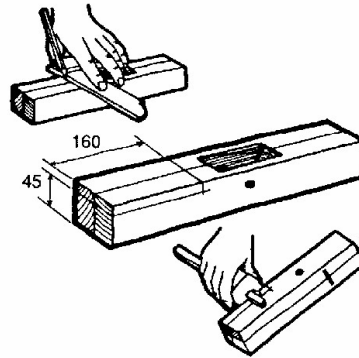
Square one line across the top of the stock 160mm from the back. Square this line down both sides.

Set a marking gauge to 20mm and gauge all round the back of the stock up to the pencil lines.

Use a small tine to mark a radius from the pencil line down to the gauge line, on both sides.

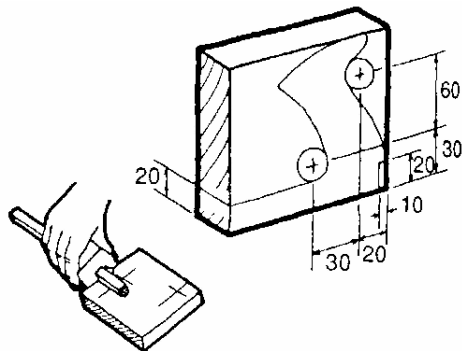


Remove the bulk of the waste with a ripsaw as close to the marks as possible. Plane and scrape the sawn face down to the gauge line. Use a 25mm chisel to cut and smooth the curve. The bevel of the chisel should be on the inside of the curve. Use the bevel of the chisel or the top edge of the stock to control the cut. Scrape and sandpaper the back of the stock smooth.



Cutting out the handle

Take the 100mm x 115mm x 25mm piece prepared for the handle. Gauge a line all round, 20mm from the bottom. Mark a 10mm-long shoulder in the back of the handle, and mark the position of the two holes as shown in the drawing. Drilling these holes will help to mark out the handle and makes it easier to cut the tight curves.



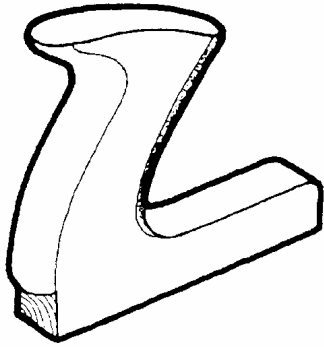
Use a brace and a 20mm bit to drill out the two holes. The shape of the handle can then be drawn in.

Clamp the handle in a vice, and cut out the shape with a bow saw, remembering to keep the blade square to the work piece.

Use a tenon-saw to remove the shoulder from the back of the handle.

Shaping the handle

Use a chisel or a spokeshave to smooth the top edge. Thumb-gauge lines 6mm from the edge on the back and front of the handle, but do not mark the two top edges or the bottom. Chamfer the edges down to the pencil lines with a chisel, remembering to cut with the grain.

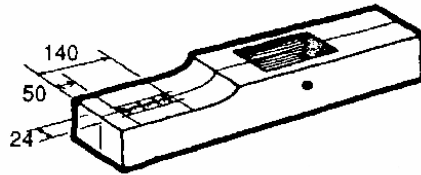
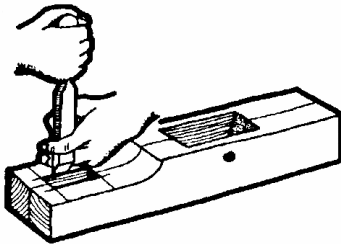


Finally, carve the handle smooth and round. The chamfers should help to make the curves even. A fine half-round file and some sandpaper will help to finish the handle well. When the handle is finished it should look like this.

Cutting the mortise for the handle.

Square one line across the top of the stock, 50mm from the back, and another 140mm from the back.

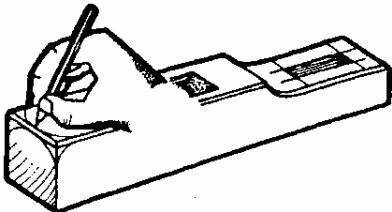
Gauge two lines in the centre of the stock, 24mm apart, between the two pencil lines. Mark the waste.



Check the gauge lines by holding the handle up to the stock. Chop out the mortise to a depth of 20mm. Carefully pare the sides of the mortise to the gauge line. Fit the handle into the stock, but do not glue it in place yet.

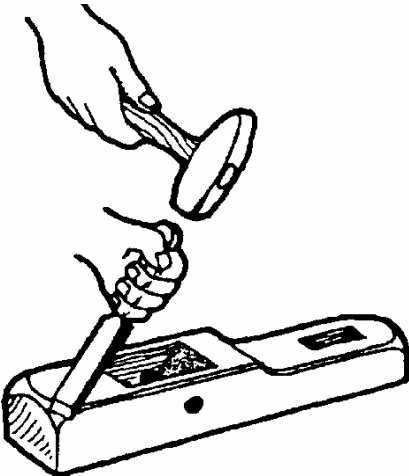
Chamfering the stock

To help make the plane comfortable to use, the sharp edges around the top of the plane need to be removed. Thumb-gauge a line all round the top of the stock, 4mm from each edge, to mark the chamfers.

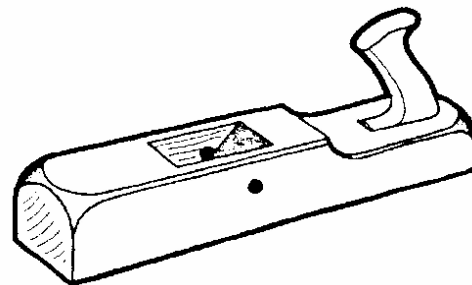


Mark radii on the top, the sides, the front, and the back of the stock. Tracing around a small tin will help to make the curves even.

Plane the chamfers down to the pencil lines on both sides. You will have to use a chisel on the curve in the middle of the stock. Then use a wide chisel to round off the corners.



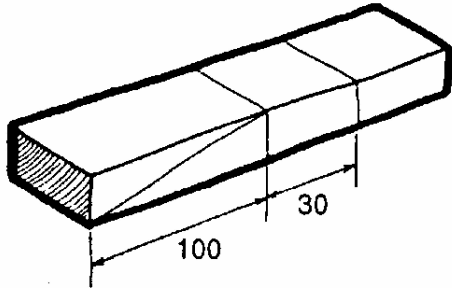
The handle can now be glued into position. Use a clamp to push it tightly into the mortise. The finished stock should look like this.



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Making the wedge

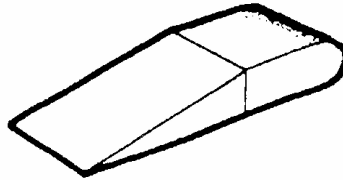
Take the 200mm x 50mm x 20mm piece prepared for the wedge. Square a line all round 100mm from one end, and mark the angle for the wedge. Square another line 130mm from the same end to mark the top of the wedge.



Clamp the wedge vertically in the vice and use a rip saw to cut the angle. Plane the sawn face by clamping it in a vice horizontally, with a small piece of timber to support the thin end.

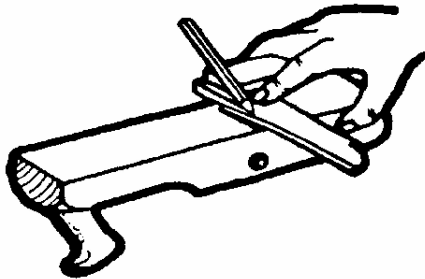
Saw off the top of the wedge with a tenon-saw and round it off with a chisel and sandpaper to prevent it splitting when struck with a hammer.

The finished wedge should look like this.



Fitting the blade

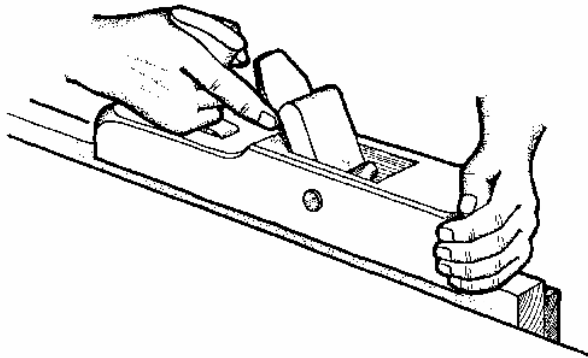
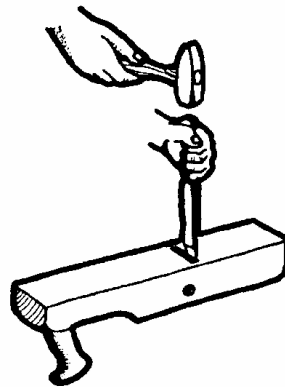
Before the plane can be used the blade will have to be fitted. If you have bought a blade from a hardware shop it should fit easily through the mouth. If the blade you are going to use has been made by a blacksmith it may be too thick. The mouth will have to be opened out to allow it to extend below the sole of the plane.



Square a line on the sole, 2mm from the front of the mouth. Use a wide chisel to pare straight down into the front of the throat. Repeat this process until there is a gap of about 3mm or 4mm between the cutting edge and the front of the mouth.

Position the blade so that the cutting edge is about 5mm inside the throat and wedge it tight.

Finally, clamp the plane upside down in a vice (without the blade in place) and plane the sole straight and true. The plane is now ready to use.



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References and further reading

- *Woodworking* Practical Action Technical Brief.
- *How to Make a Woodworking Bench* Practical Action Technical Brief.
- *How to Make Carpentry Tools: An Illustrated Manual* Aaron Moore, Practical Action Publications, 1992, ISBN 1 85339 1735
- *Carpentry Toolmaking: An instructors' guide*, Aaron Moore, Practical Action Publications, 1993, ISBN 1 85339 196 4
- *Basic Blacksmithing: An introduction to toolmaking*, David Harries, Practical Action Publications, 1993, ISBN 1 85339 195 6
- *Blacksmithing Instructors' Guide: Sixteen lesson plans with teaching advice*, David Harries, IT Publications, 1993. ISBN 1 85339 214 6
- *Made in Africa: Learning from carpentry hand tool projects*, Andrew Scott, Matthew Taylor and Janet Leek, Practical Action Publications, 1993. ISBN 1 85339 209 X

Useful Addresses

This technical brief was originally written for the *Appropriate Technology* magazine Volume 24/Number 2 September 1997 Technical Brief No 21 and Volume 24/ Number 3 Technical Brief No 22, by Aaron Moore.

The information in this brief is from *How to Make Carpentry Tools: An Illustrated Manual* by Aaron Moore, Practical Action Publications 1992.

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