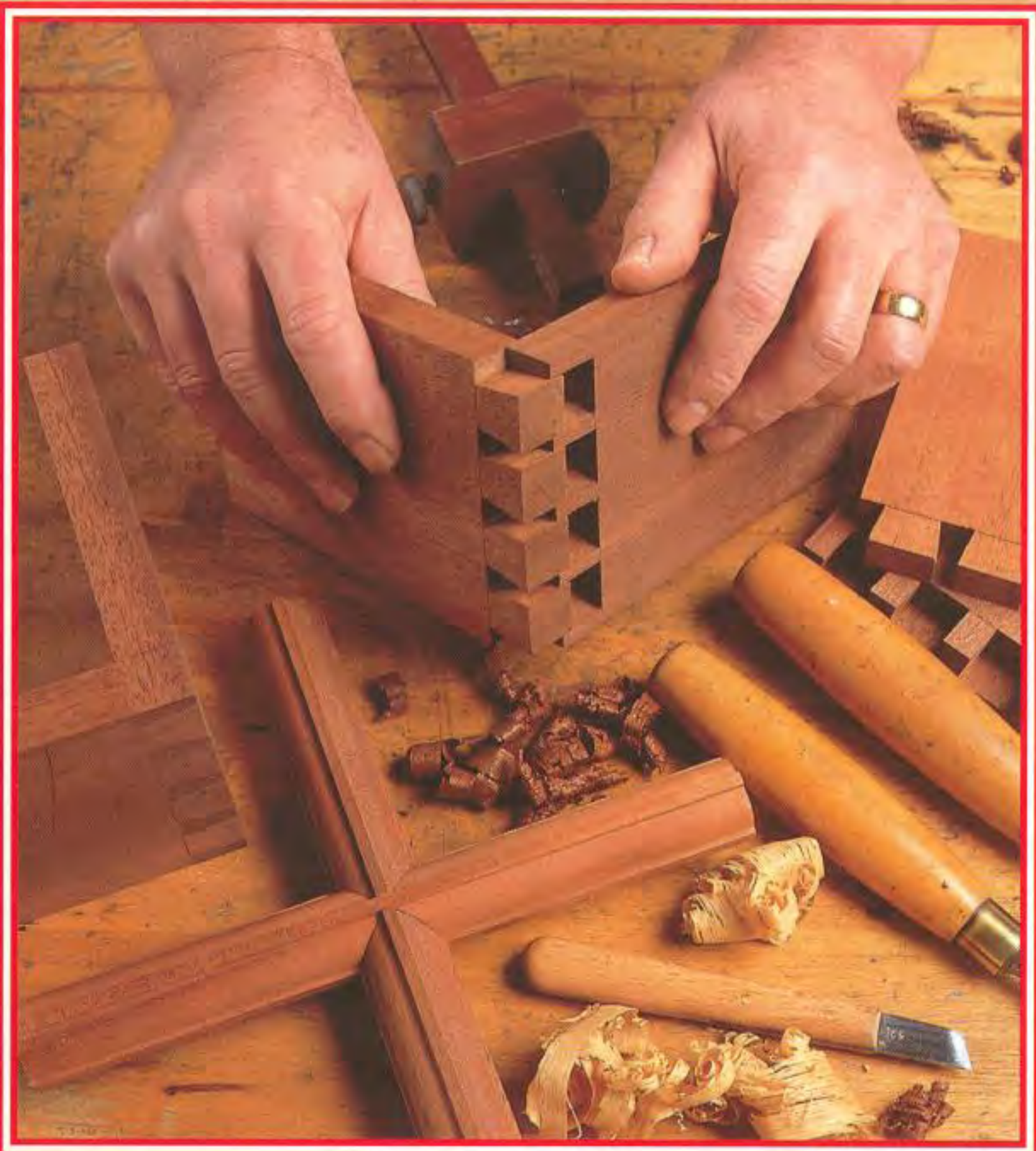


COLLINS

GOOD WOOD JOINTS



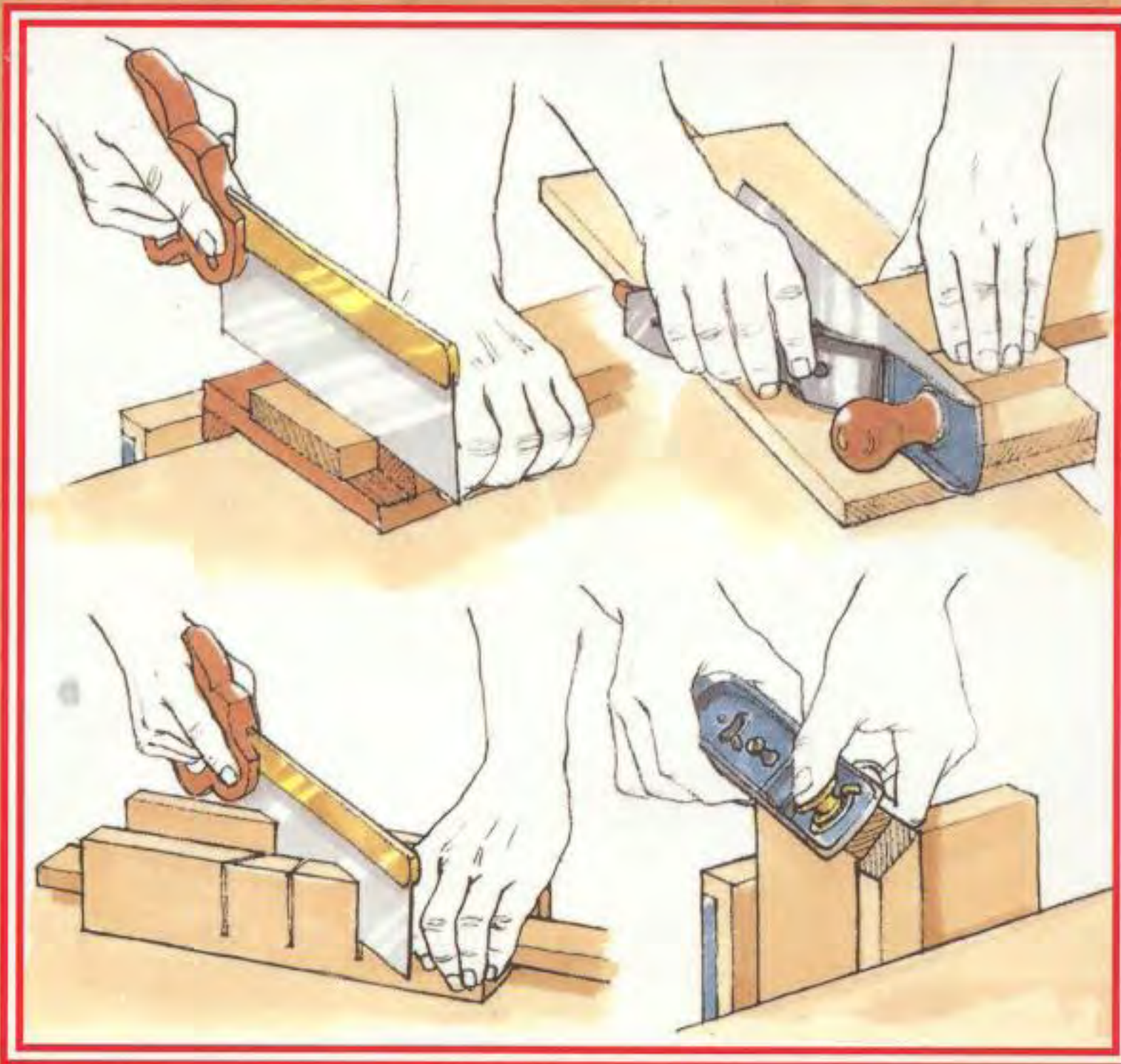
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Greenwich, London, England**

Text: Albert Jackson and David Day

Design and art direction: Simon Jennings

Text editors: Ian Kearey
and Albert Jackson

Illustrators: Robin Harris and David Day

Examples of joints: William Brooker

Studio photography: Paul Chave, Ben Jennings
and Neil Waving

Indexer: Ian Kearey

Technical consultant: John Perkins

**First published in 1995 by
HarperCollins Publishers, London**

9 8 7 6 5 4

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For HarperCollins:

Editorial director: Polly Powell

Senior production manager: Bridget Scanlon

A CIP catalogue record is available
from the British Library

ISBN 0 00 412780 3

Text set in Franklin Gothic Extra Condensed, Univers Condensed
and Garamond Book Condensed by Inklinc, London

Printed in Malaysia

Jacket design: Simon Jennings

Jacket photographs: Paul Chave

Jacket illustrations: Robin Harris and David Day

ACKNOWLEDGEMENTS

*The authors would like to thank the following for the supply of reference
material and equipment used in the production of this book.*

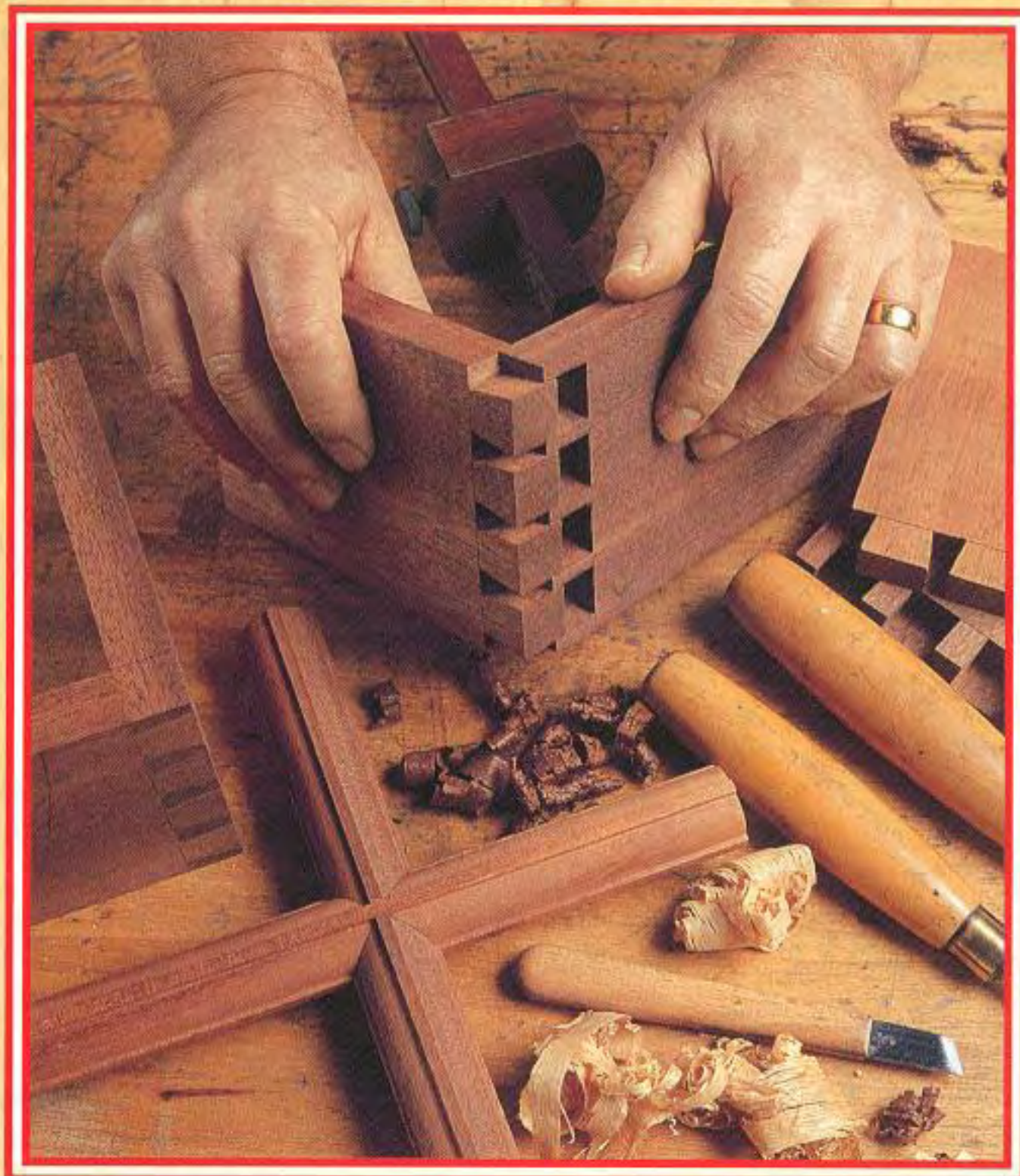
Kenneth Grisley,
Leigh Industries Ltd,
Port Coquitlam, BC,
Canada

Ramon Weston,
Leigh Industries (UK) Ltd,
Chippenham, Wilts, UK

Jim Pankhania,
Elu Power Tools Ltd,
Slough, Berks, UK
(also for the photograph on page 91)

Jim Phillips,
Trend Machinery and Cutting Tools,
Watford, Herts, UK

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INTRODUCTION

What is a cabinet-maker, if not a skilled maker of joints? The colour of the wood, or perhaps a near-perfect surface finish, may be the initial things that draw our attention to a piece of work, but it isn't very long before we slide open a drawer or begin peering inside a cupboard to see and feel the quality of the joints. This is hardly surprising, because many people consider joint-making to be the true measure of a craftsman, not least because cutting fine

joints requires in-depth knowledge of one's materials and a degree of proficiency with a wide variety of handtools or machines. In addition, there is the choice of joint, which reveals something about a woodworker's level of experience. A joint must, first of all, be functional to provide sufficient strength, but it should also be in keeping with the overall style of the piece for which it is intended — in short, it must be the right joint for the job.

CHAPTER 1

This book does not set out to be a manual on woodworking. It assumes that you are familiar with the basics, yet want to know more about which joints you can use to achieve your goal and how best to make them. The book also aims to provide you with a variety of options, suggesting a number of different joints that you could choose for a specific purpose and, where appropriate, alternative methods for cutting those joints with handtools, power tools and woodworking machines.

FIRST PRINCIPLES

SELECTING THE RIGHT JOINT

Before you can exercise your woodworking skills, you have to decide which joint will best suit your needs; given that there are so many to choose from, making the right choice is not as easy at it might seem. These charts suggest not only which joints to consider for a wide variety of applications, but also what tools you can use and what materials will be suitable.

Finding recommended joints

From the diagrams ranged along the top of the charts, select the application that most closely represents the item you want to make. For example, do you want to join chair legs to a seat rail, or the corners of a cabinet, or do you want to know what joints to use for constructing frames or drawers? Having found the diagram that includes the type of joint you need, match the numbers below it with those found in the top left-hand corner of recommended joints illustrated in the chart.

Ease of making

Each illustration also includes a colour box that indicates whether it is possible to make that particular joint with handtools or machine tools. The letter on the colour box indicates whether it is relatively easy (E) or difficult (D) to make with those tools (see key below).

Hand tools	Machine tools
E Easy	E Easy
D Difficult	D Difficult

Materials and suitability

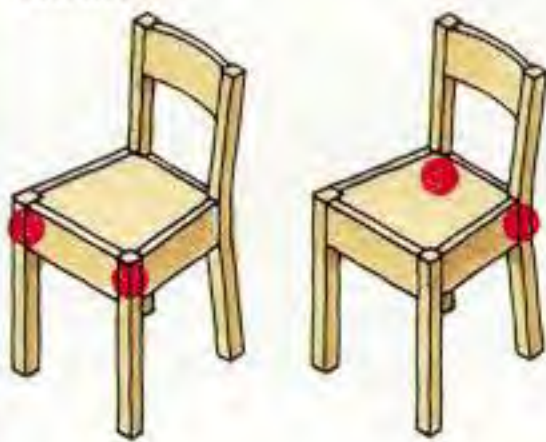
The number-rated colour banding below each illustration is designed to help you decide whether the joint is suitable for the material you are intending to use. Thus, a red box containing number 2 indicates that the joint will be good for solid-wood construction (see key below).

Material	colour code	Suitability
Solid wood		1 Excellent
Plywood		2 Good
Blockboard		3 Fair
Chipboard		4 Poor
MDF		

Page references

Finally, the numbers in the top right-hand corner of each illustration refer you to the page or pages where the construction of each joint is described in full.

CHAIRS

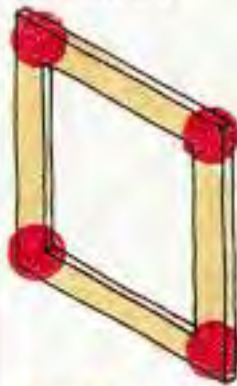


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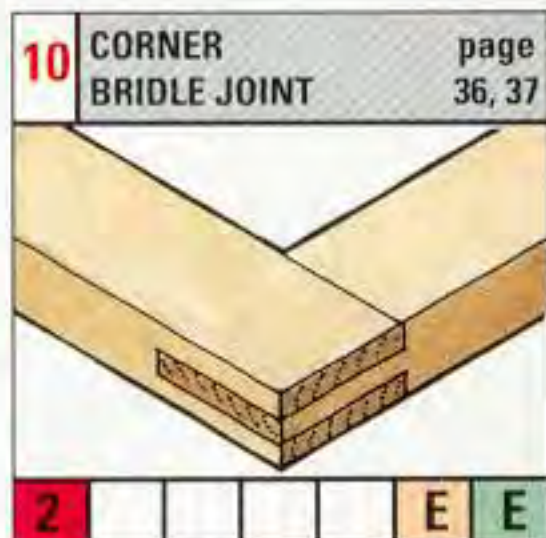
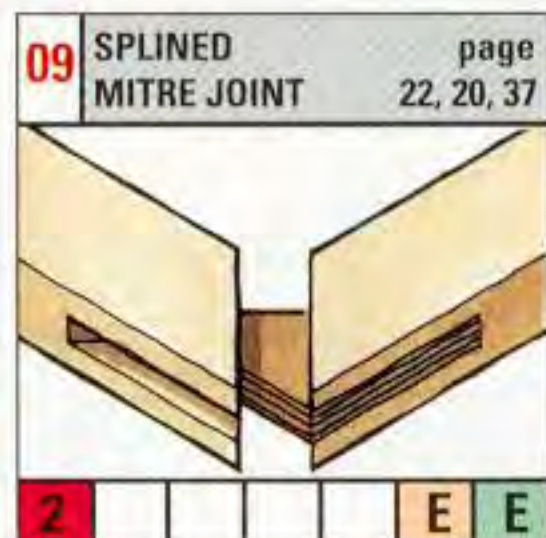
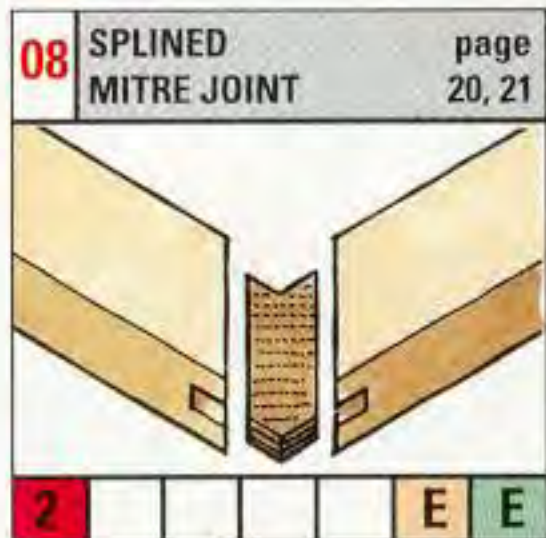
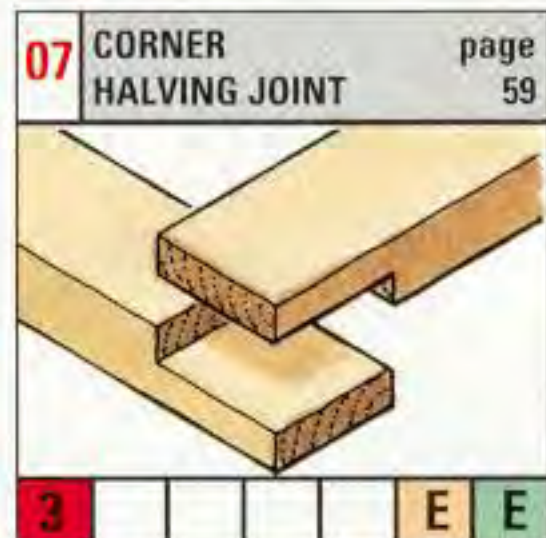
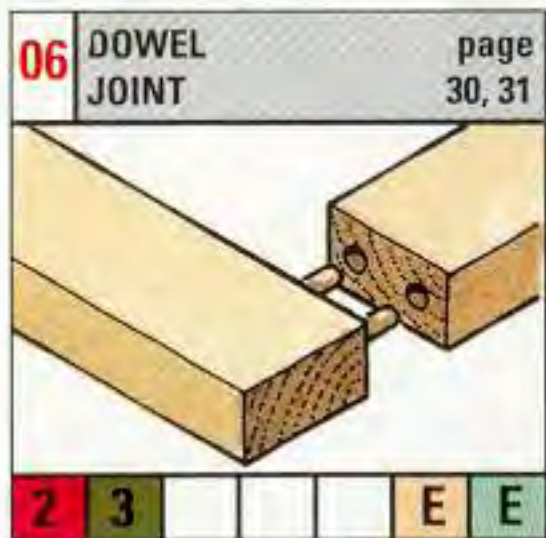
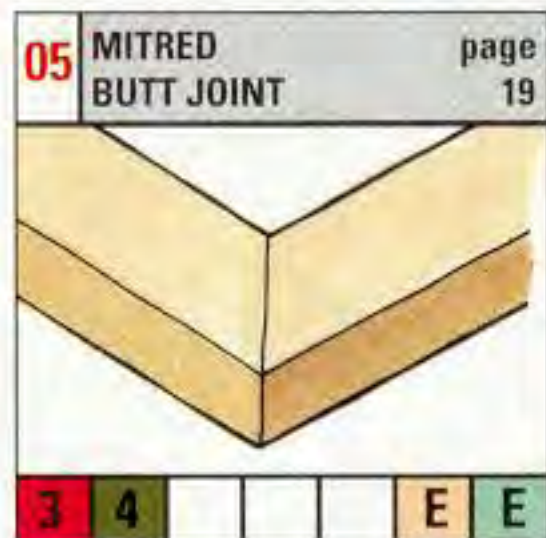
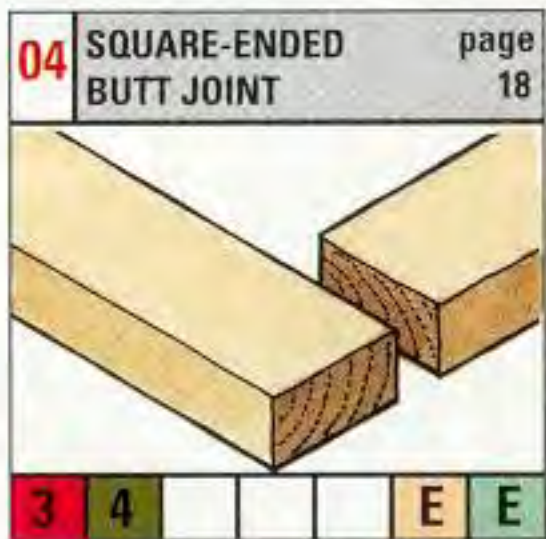
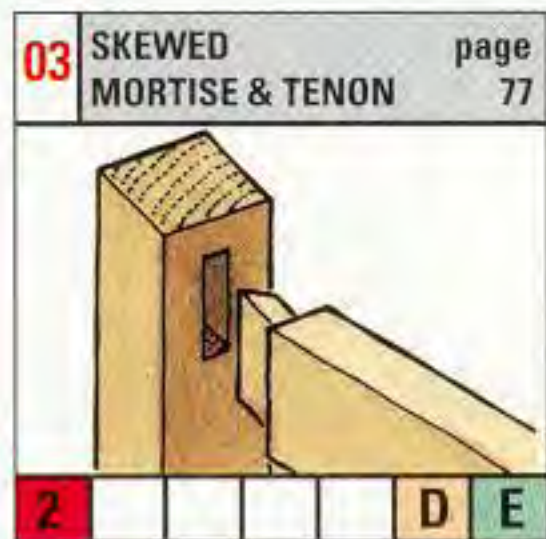
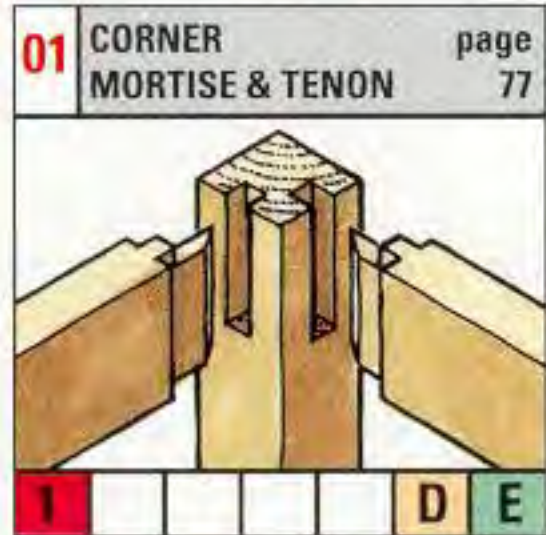
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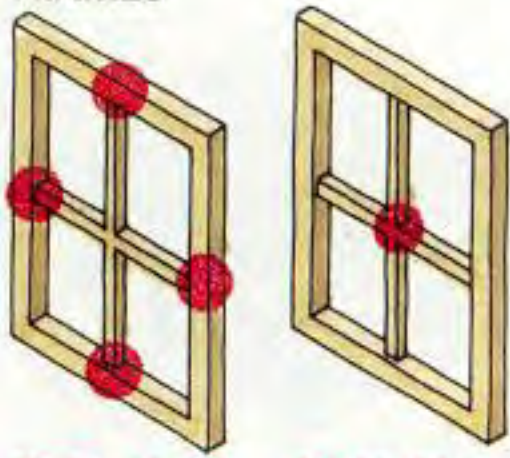
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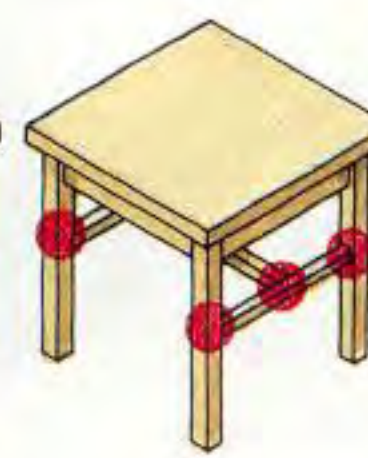
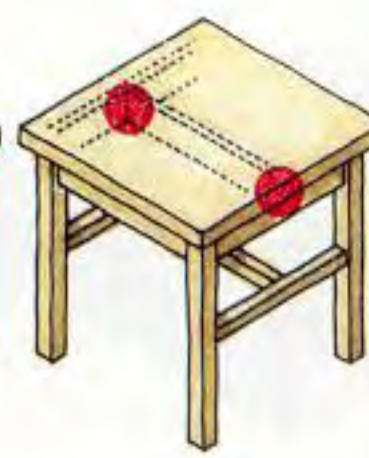
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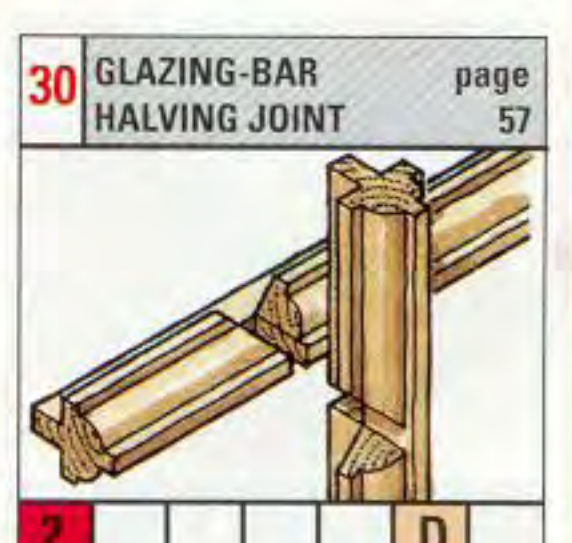
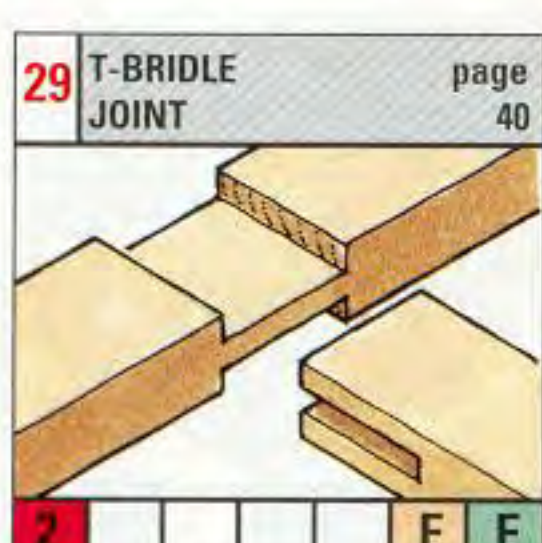
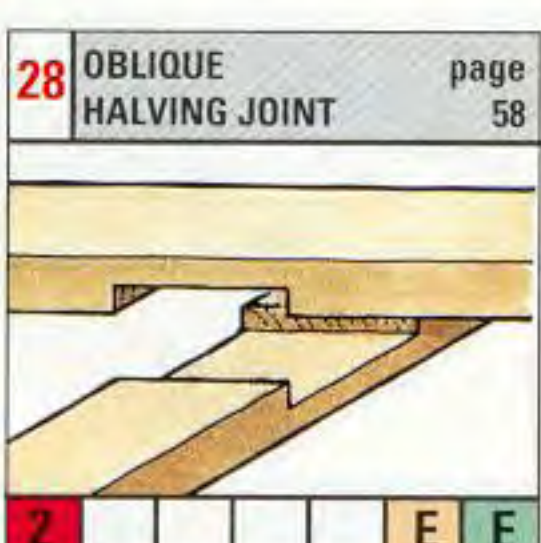
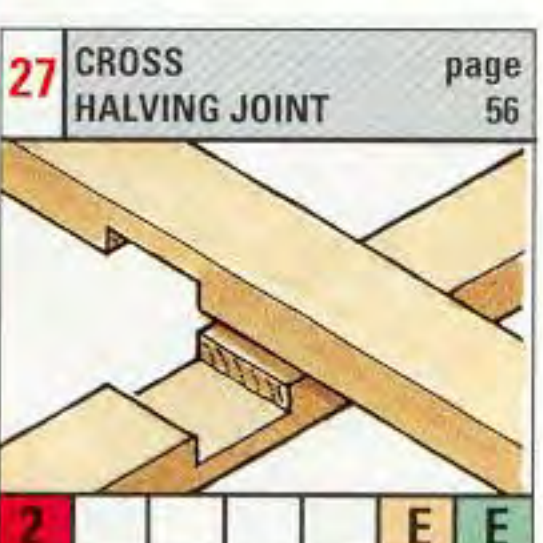
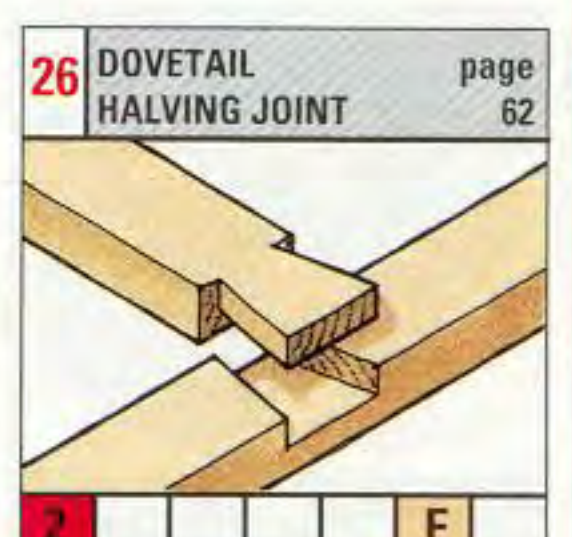
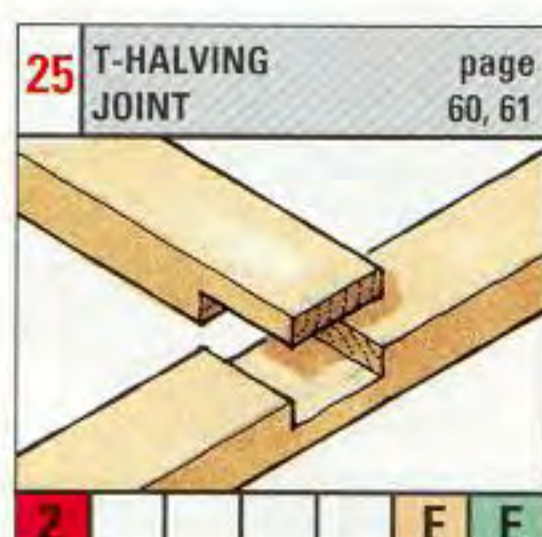
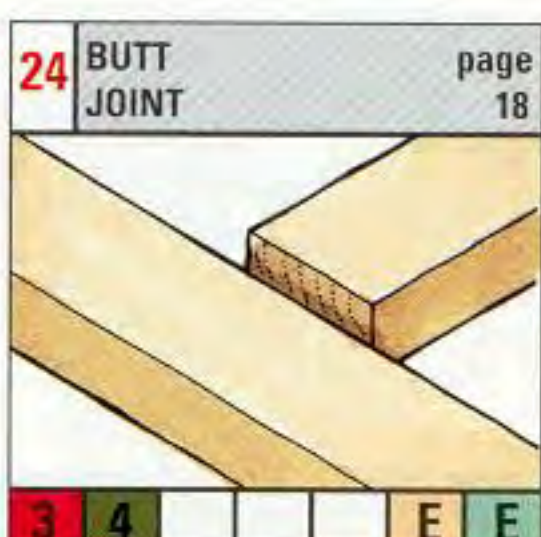
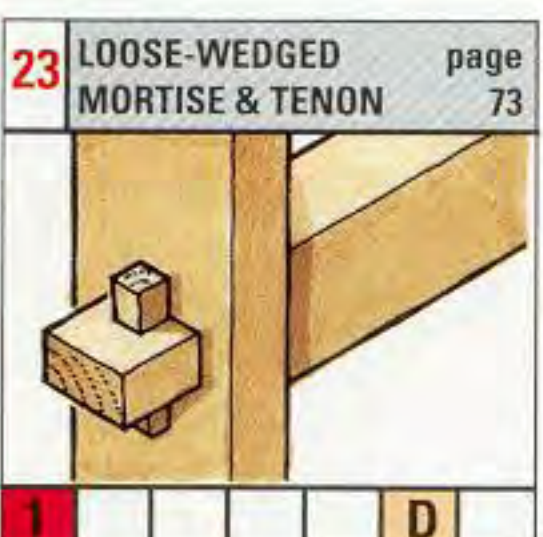
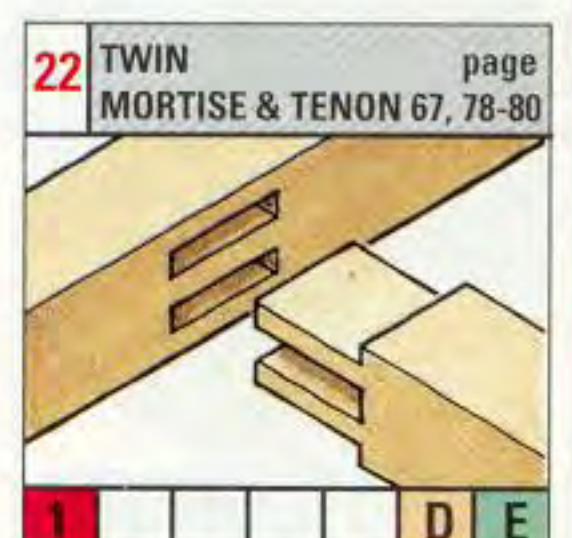
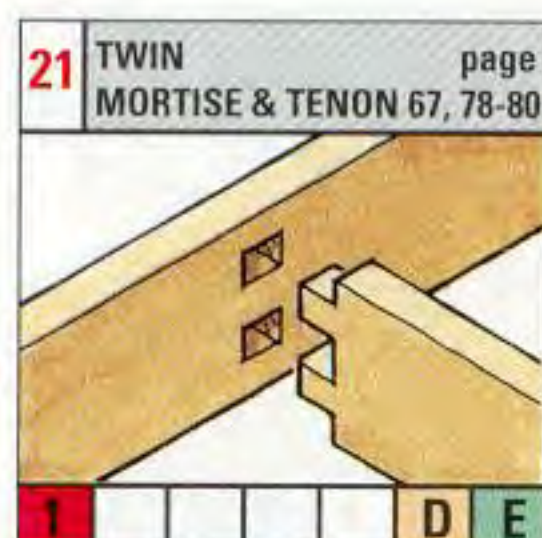
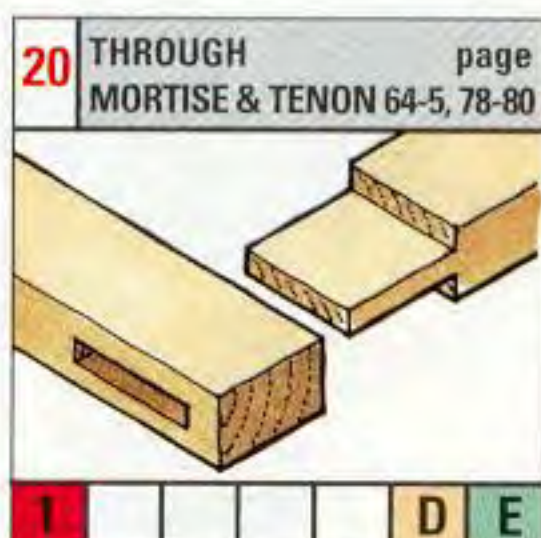
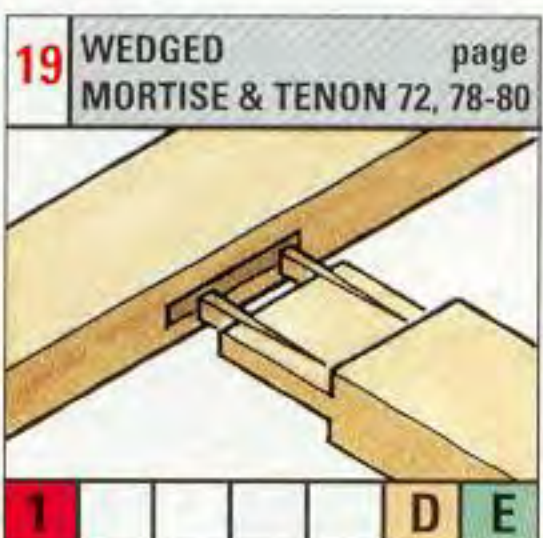
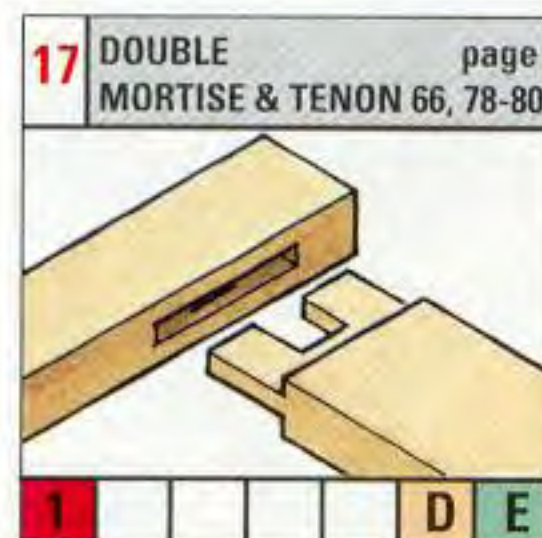
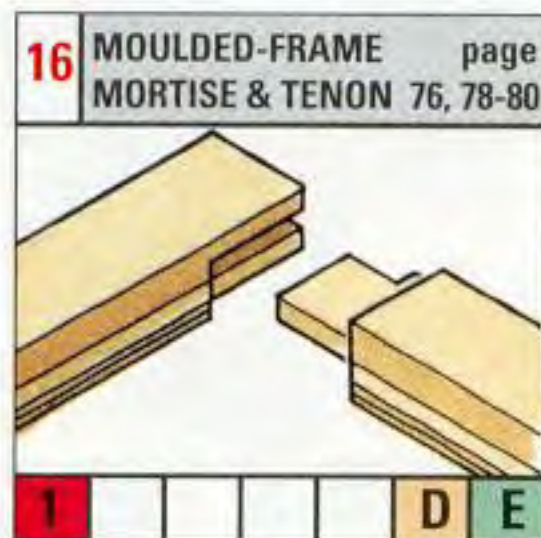
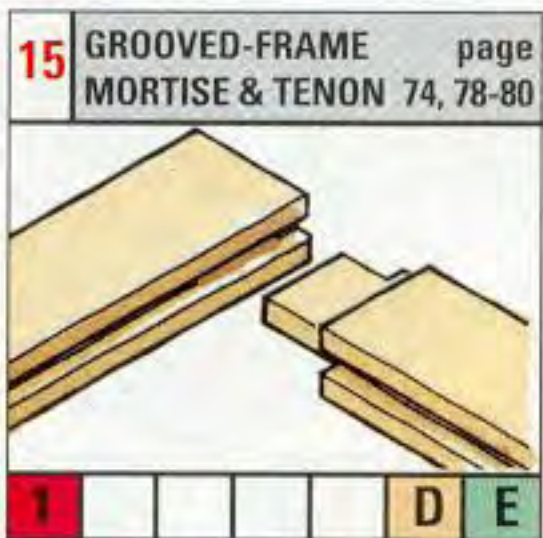
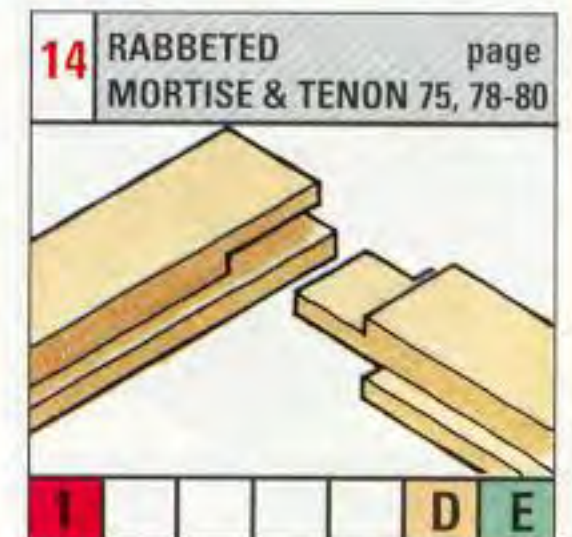
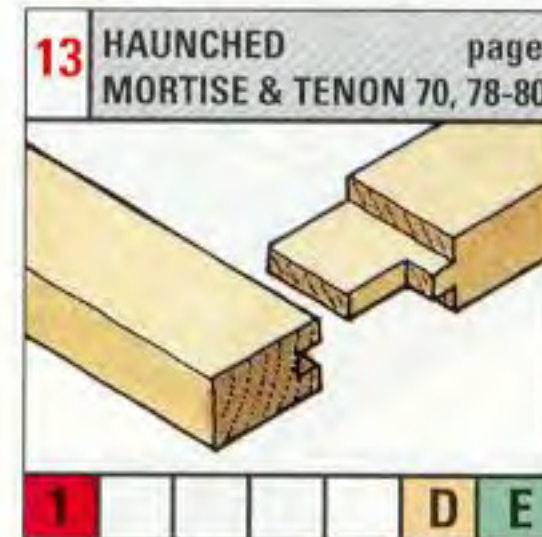
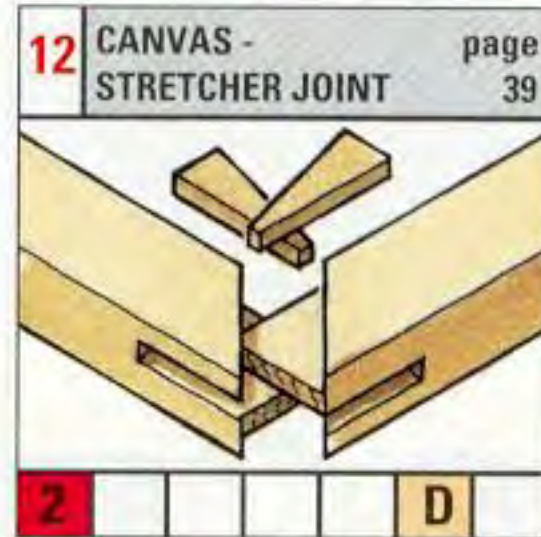
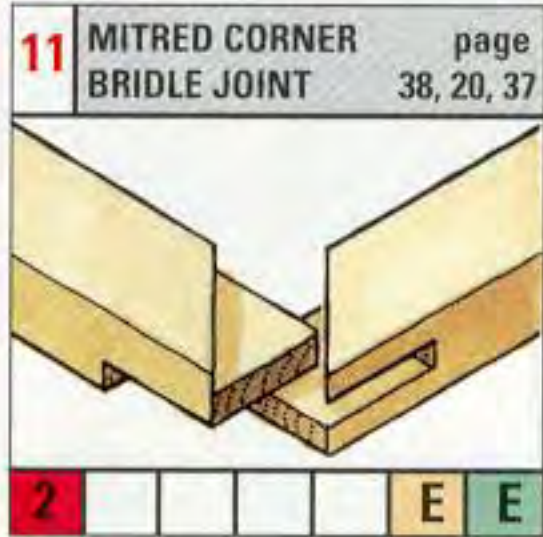
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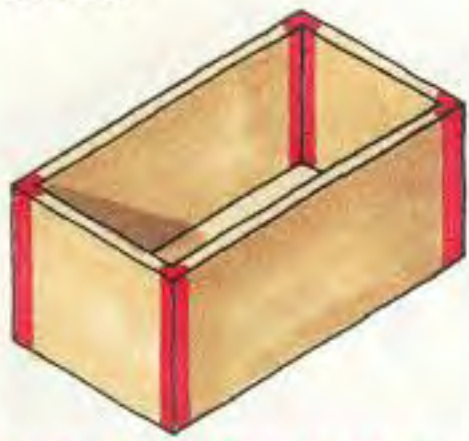
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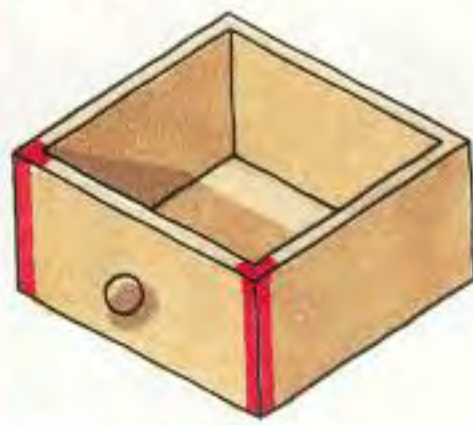


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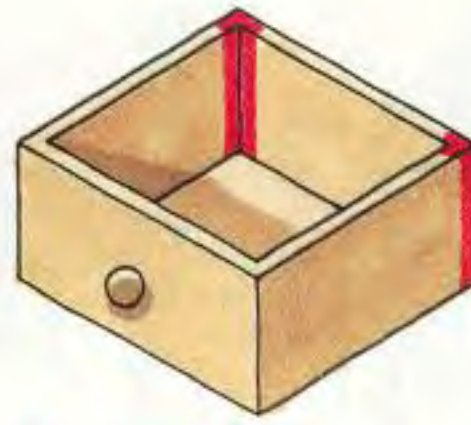


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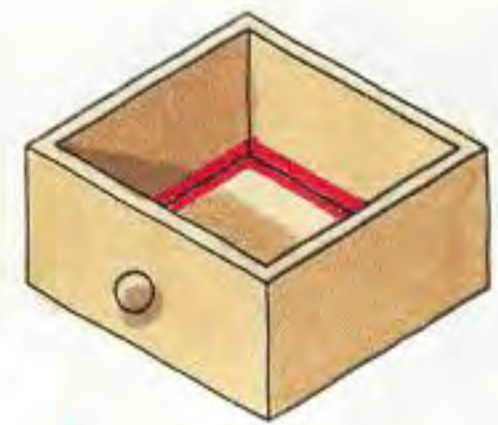
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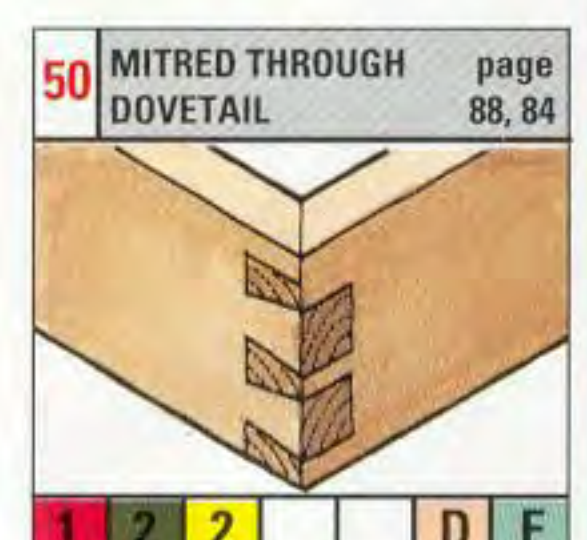
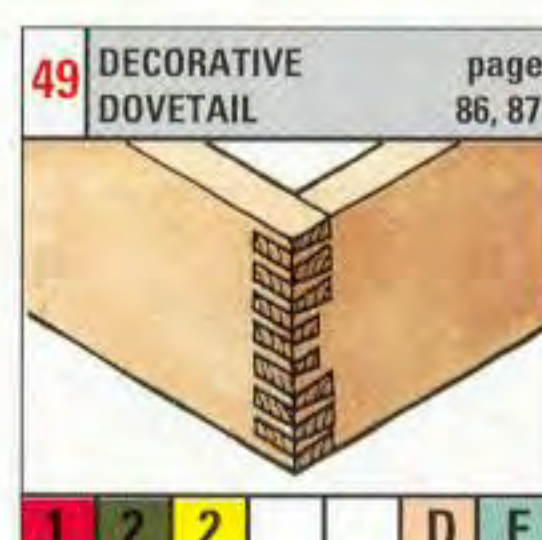
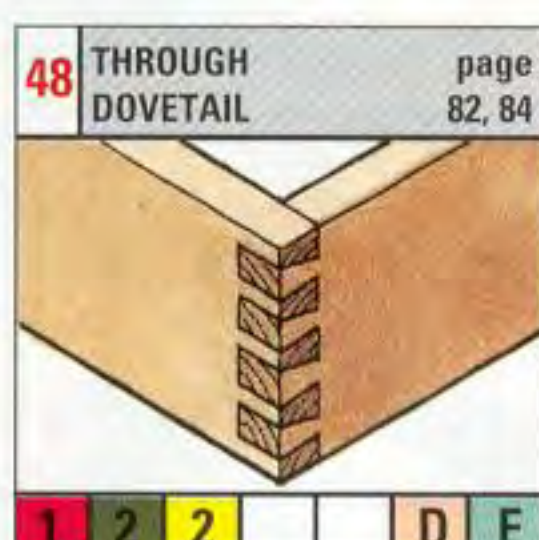
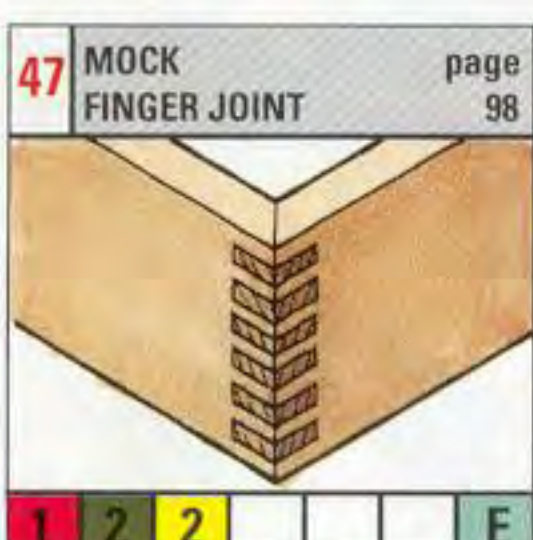
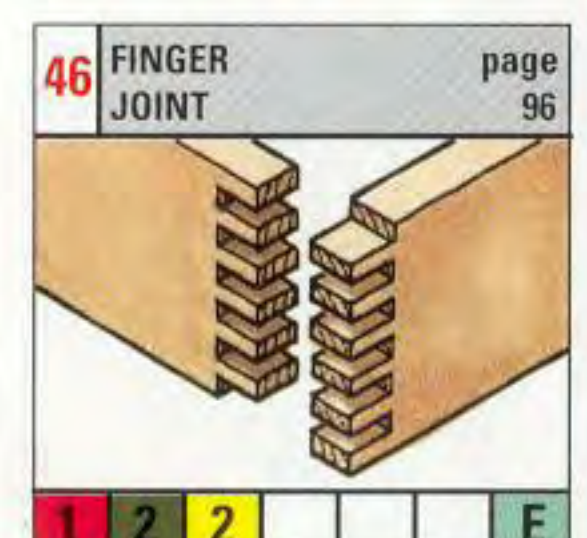
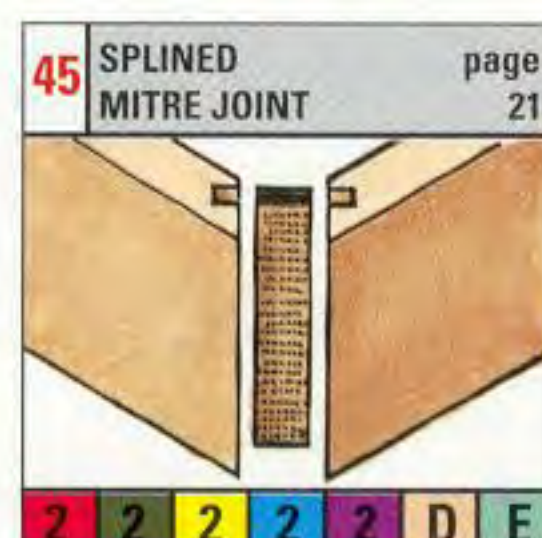
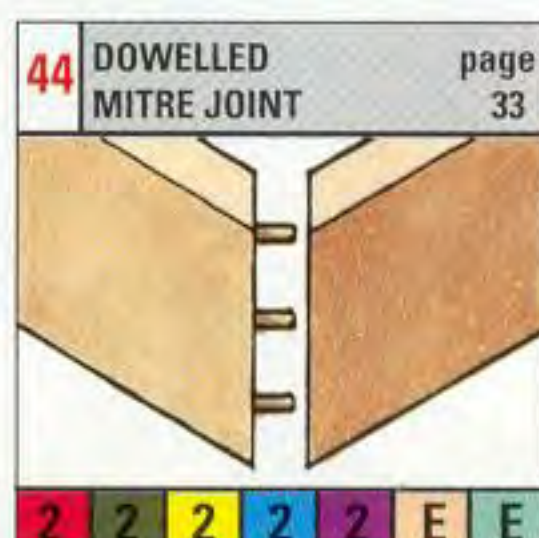
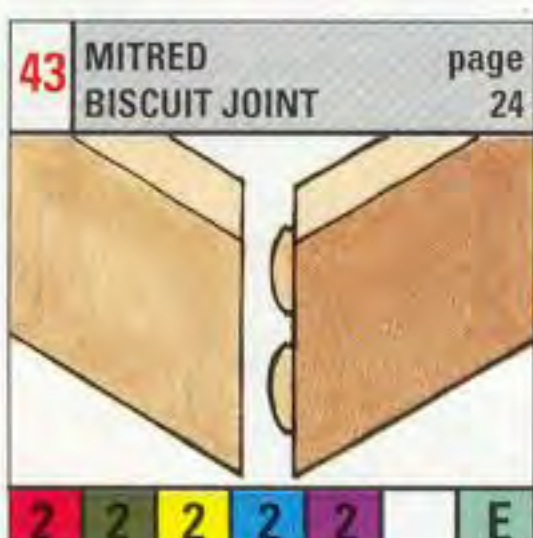
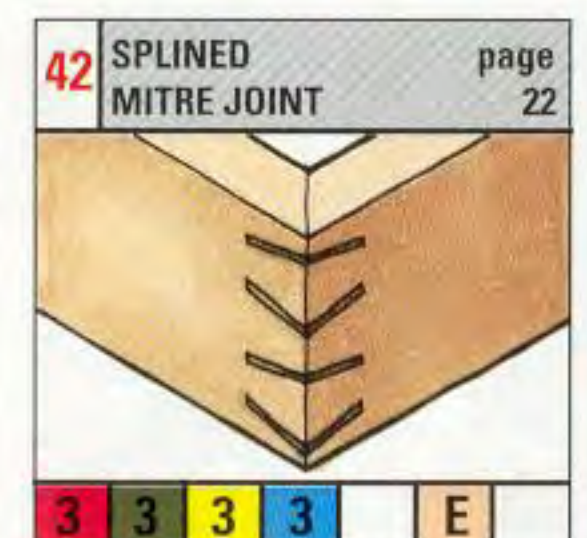
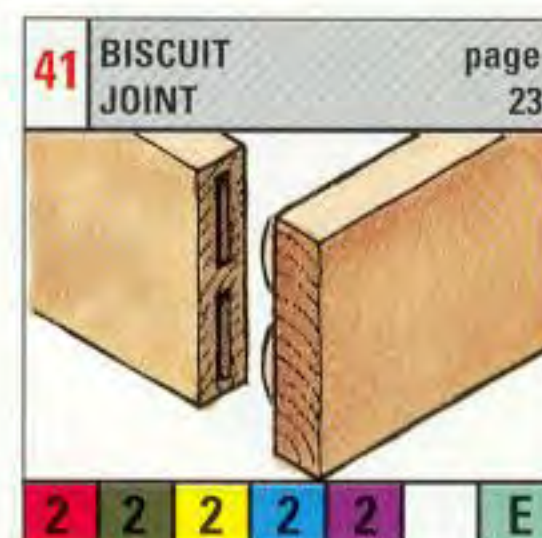
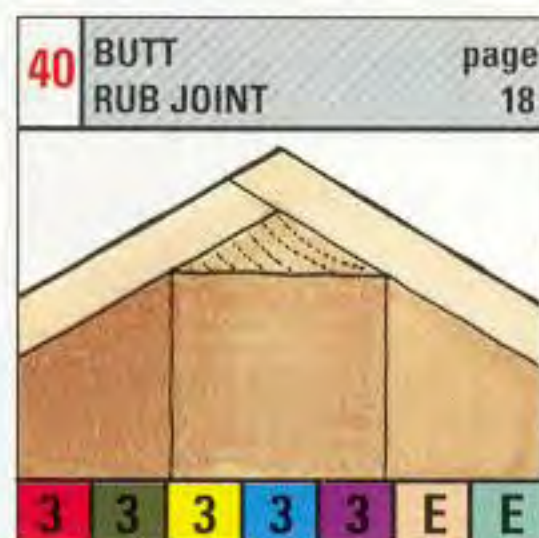
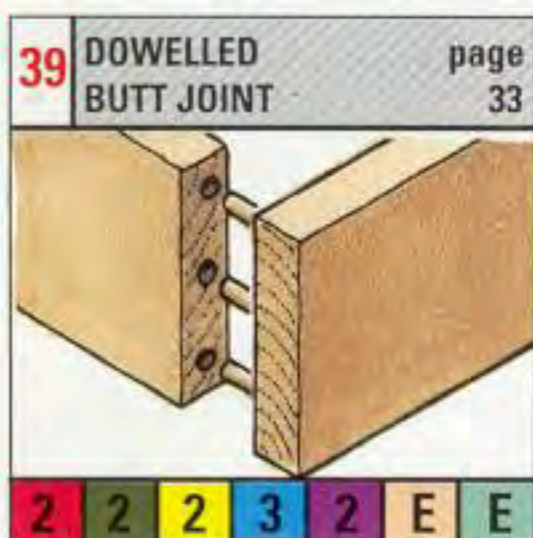
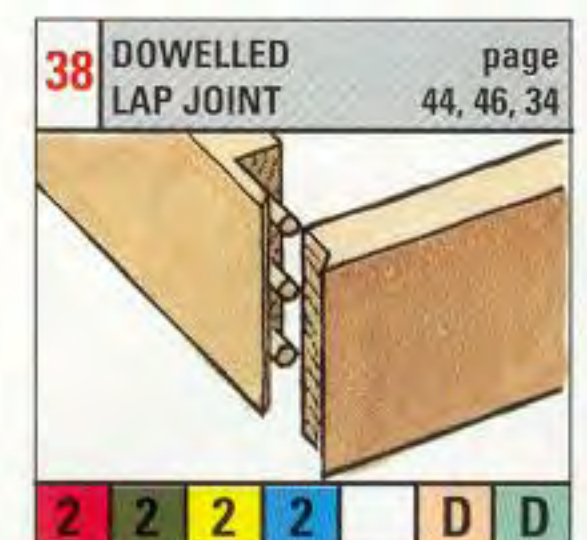
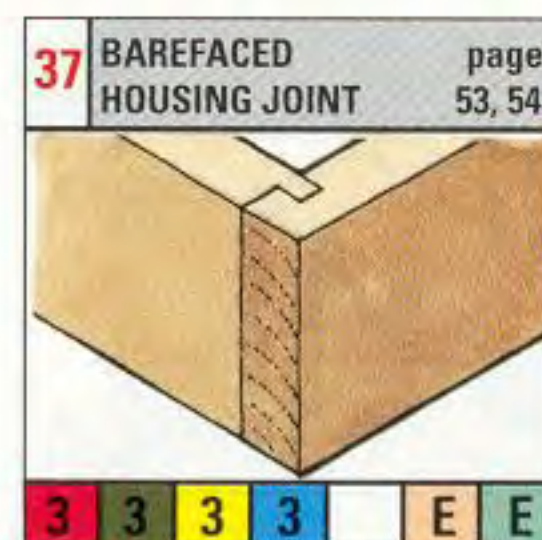
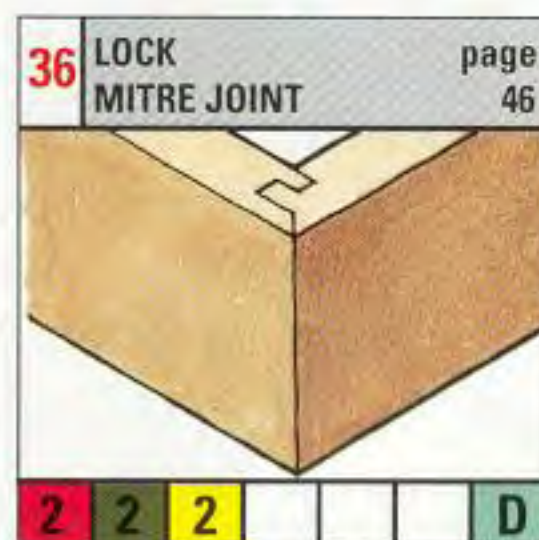
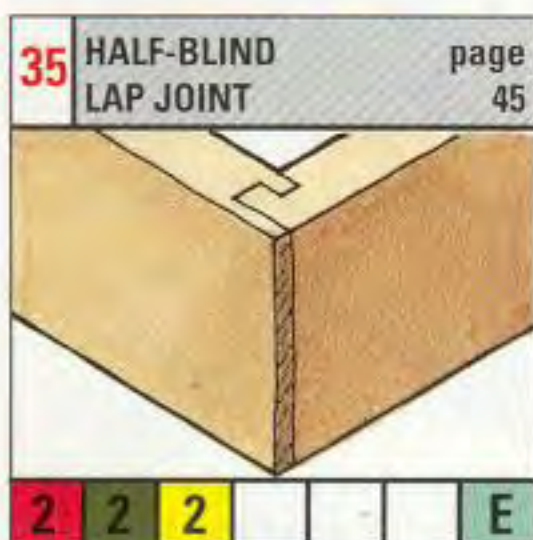
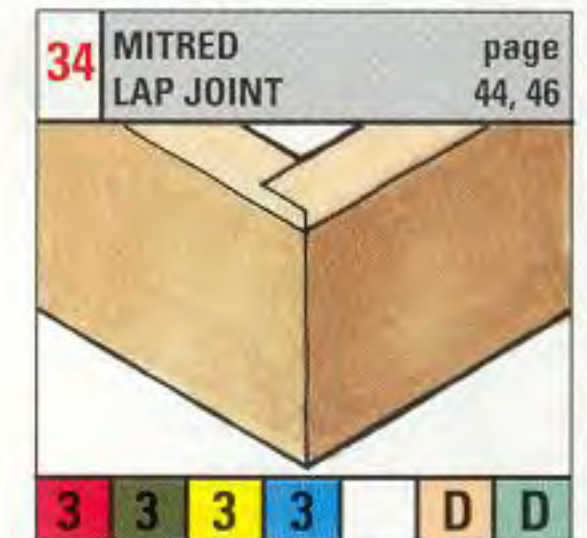
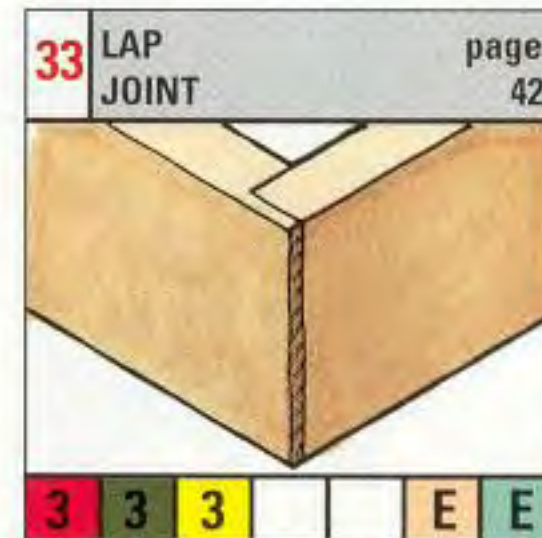
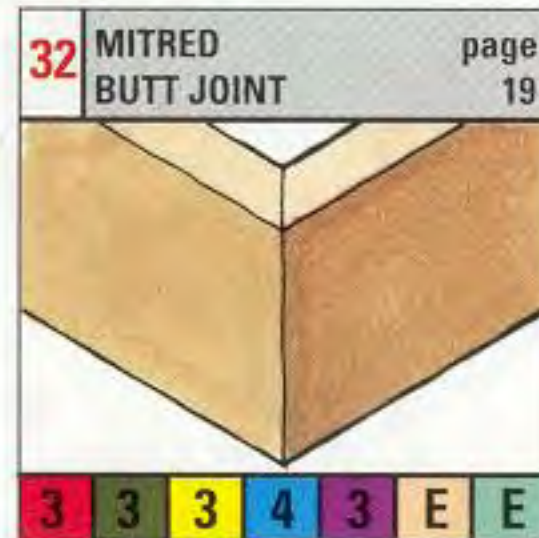
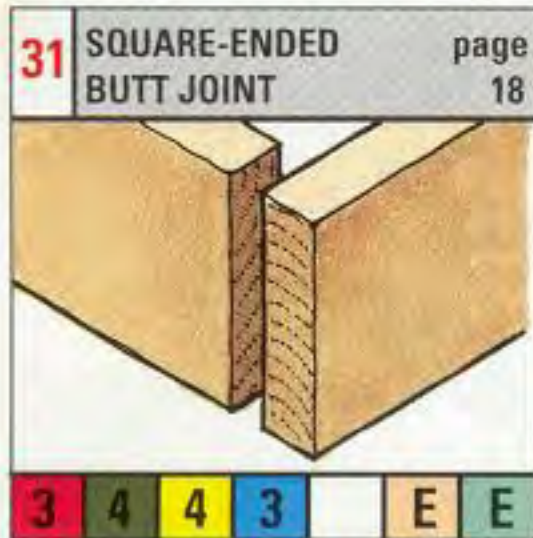
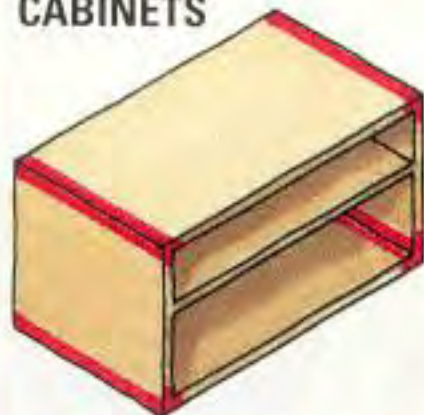


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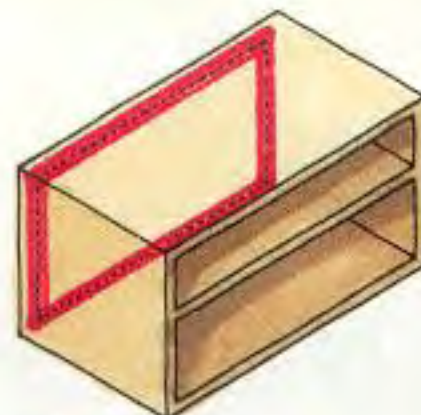
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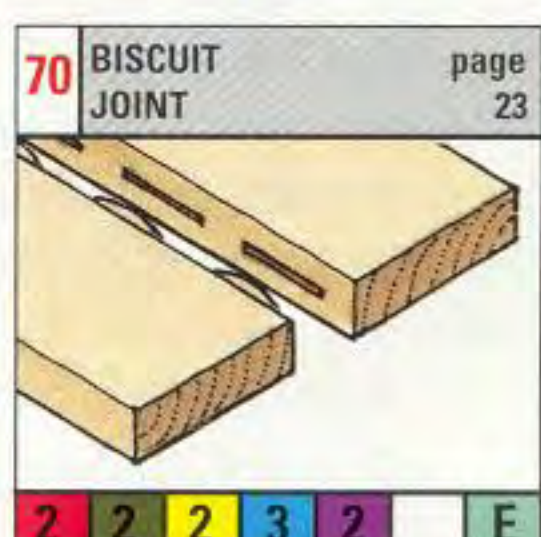
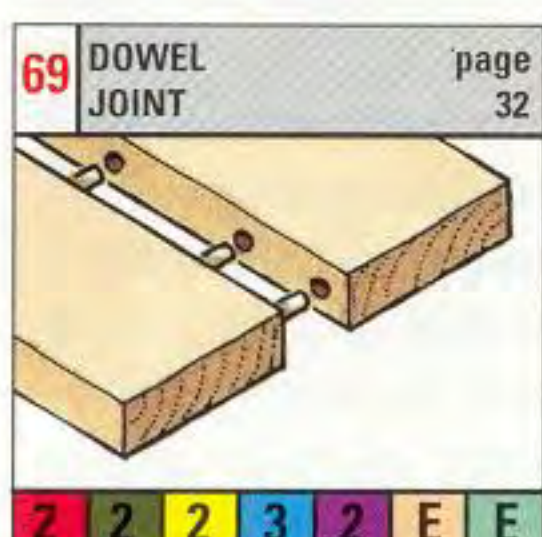
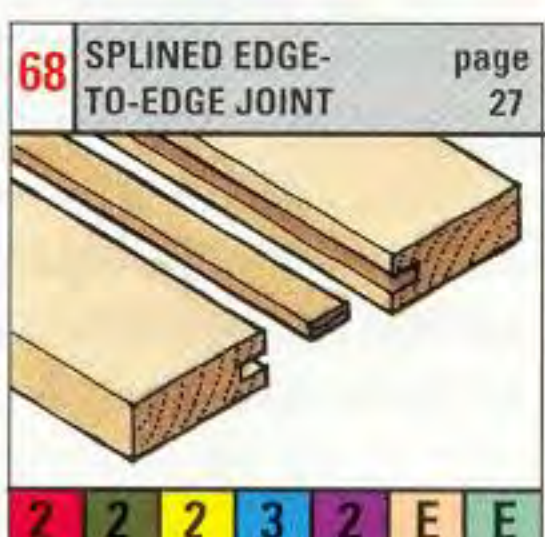
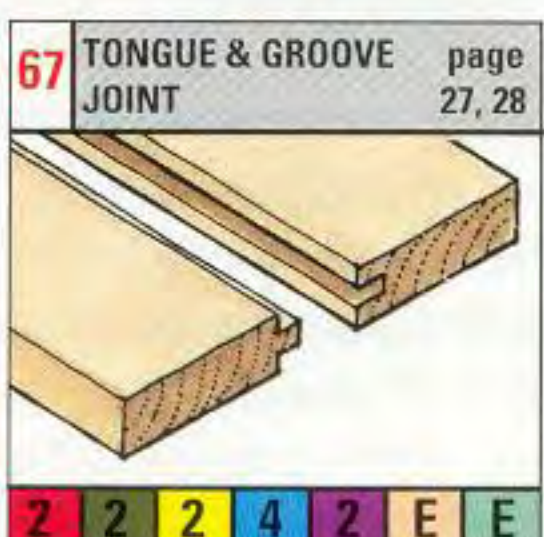
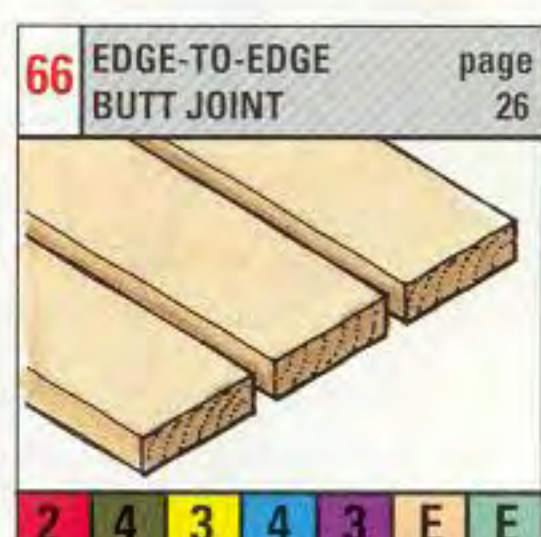
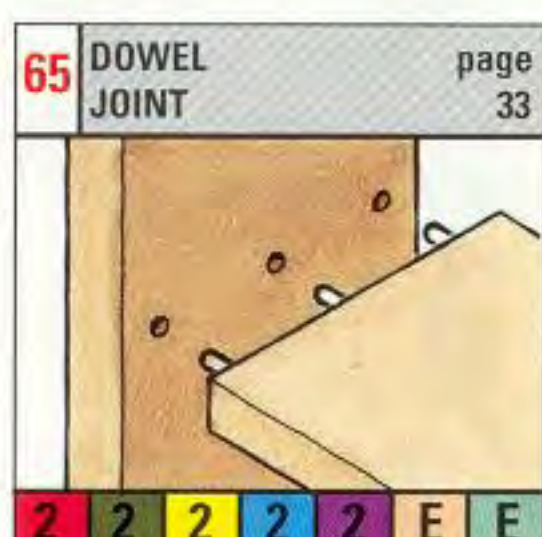
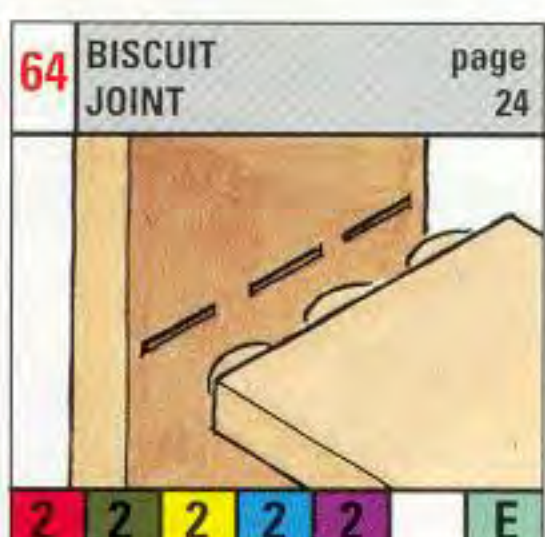
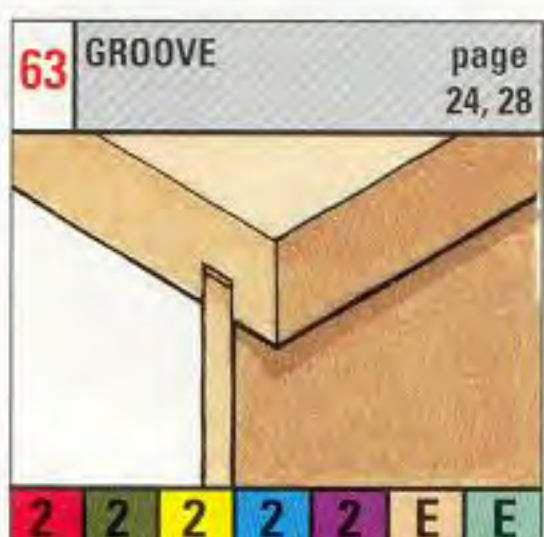
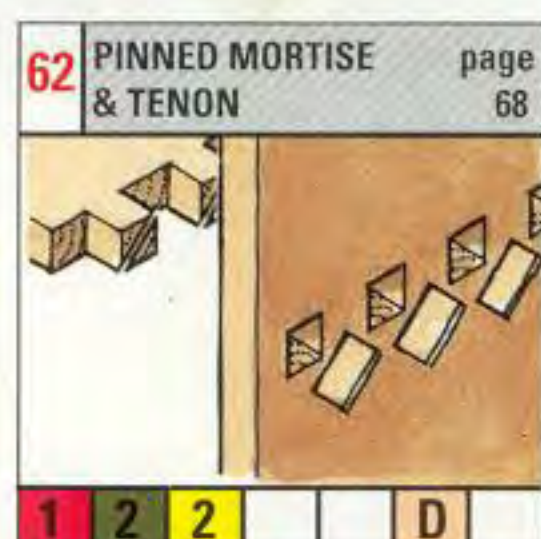
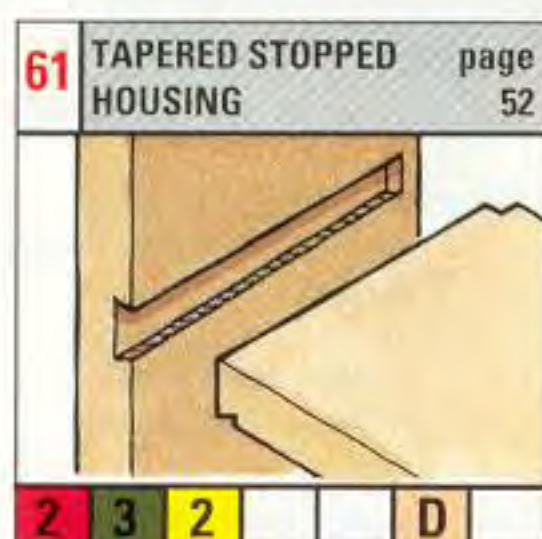
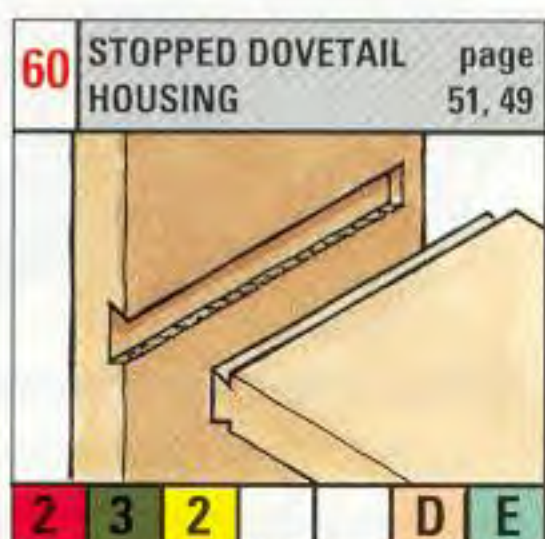
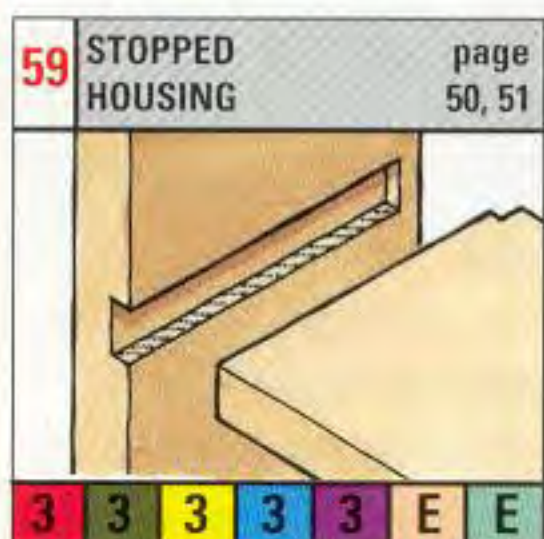
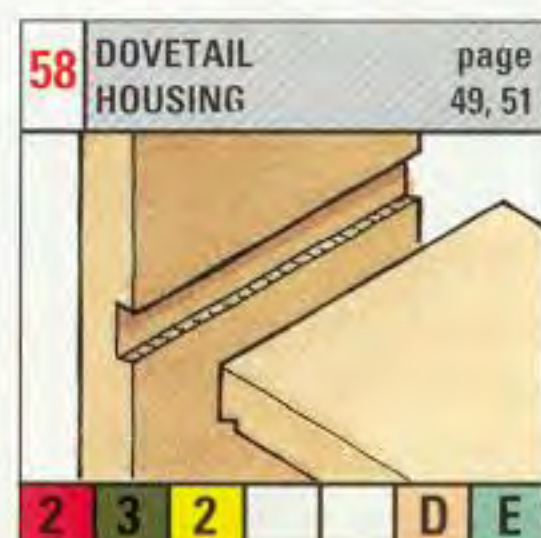
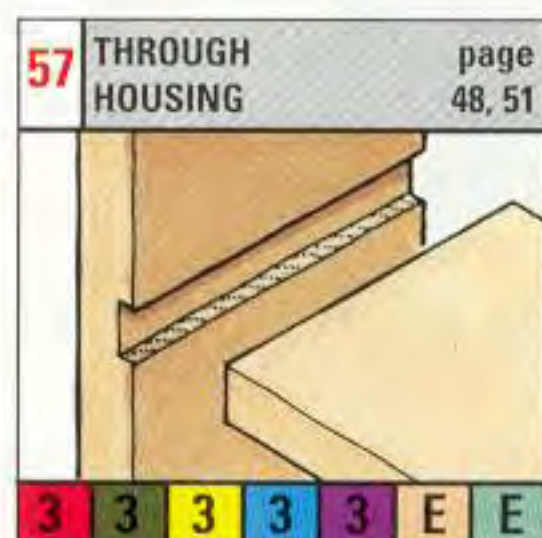
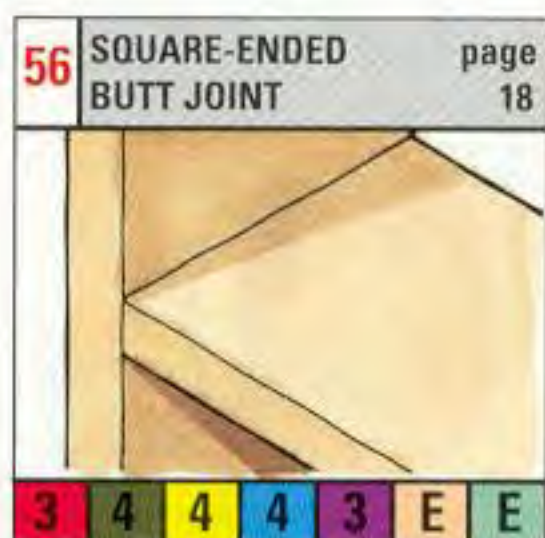
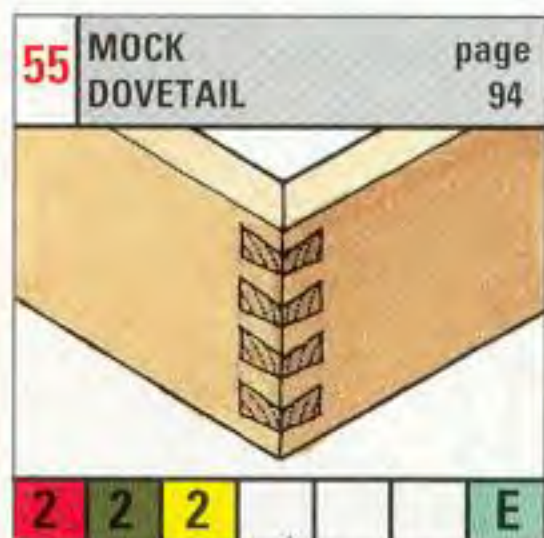
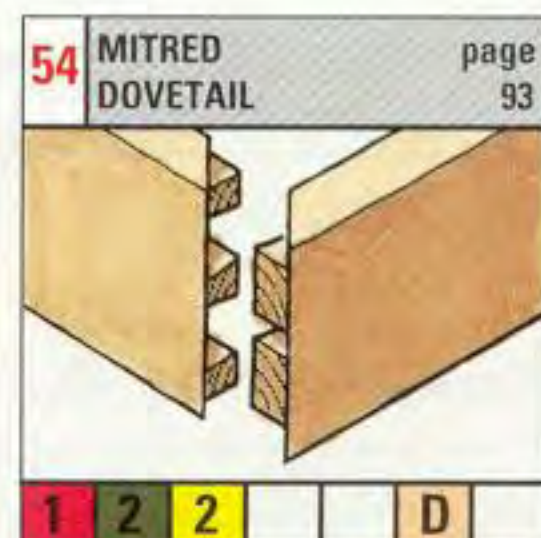
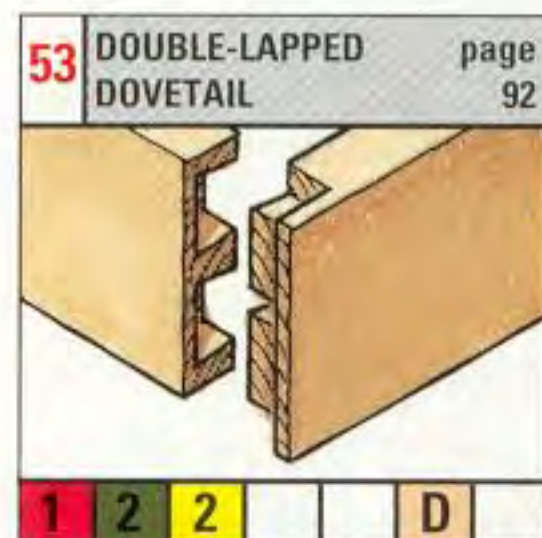
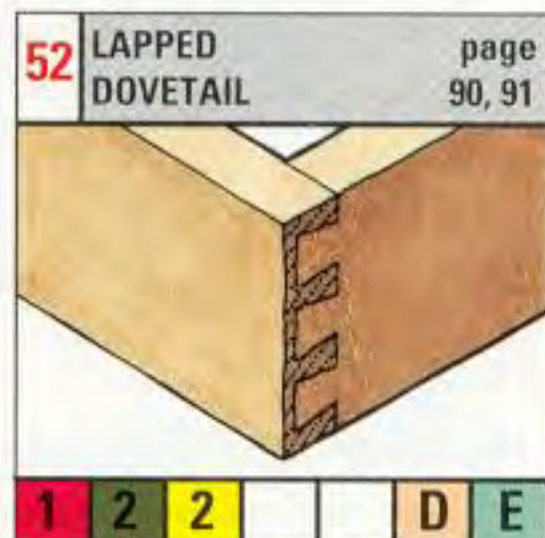
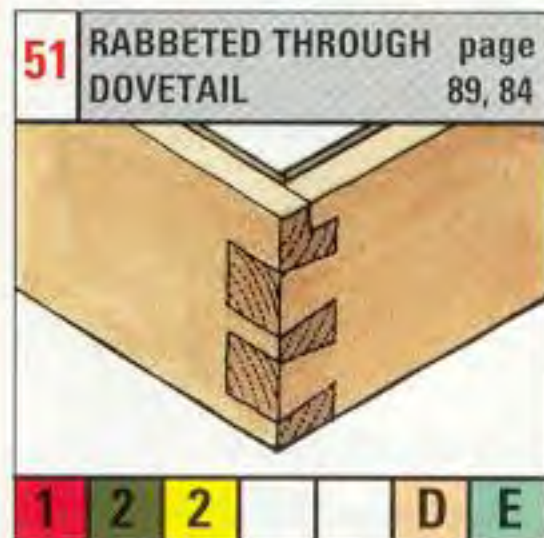
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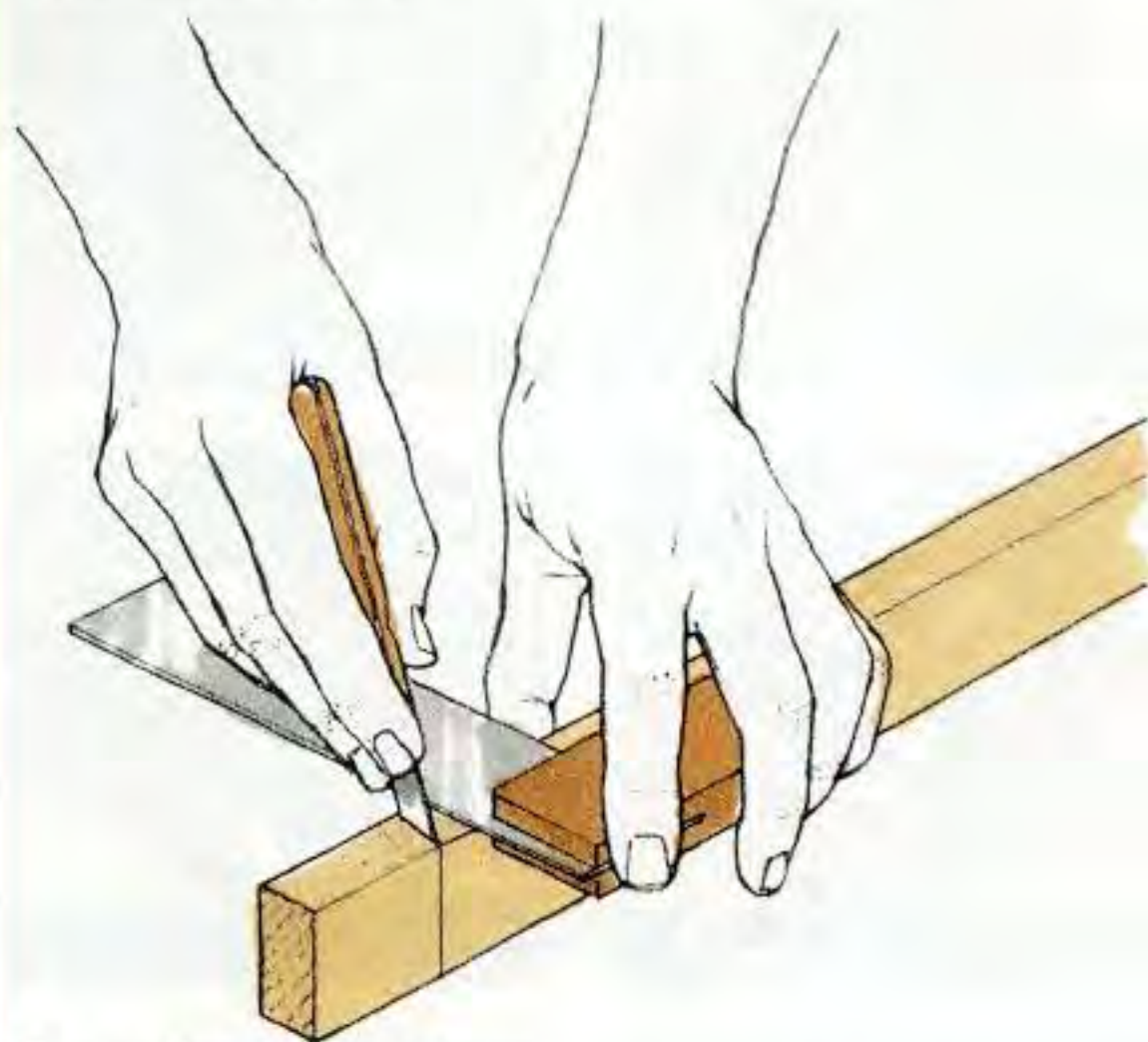


BASIC ESSENTIALS

As with most craft skills, there is hardly ever only one way to cut a joint. With experience, every woodworker adapts the basic methods, incorporating small personal variations that make the job easier or produce a better result for them. Nevertheless, there is a hard core of accepted procedures and techniques that are consistent with snug-fitting joints.

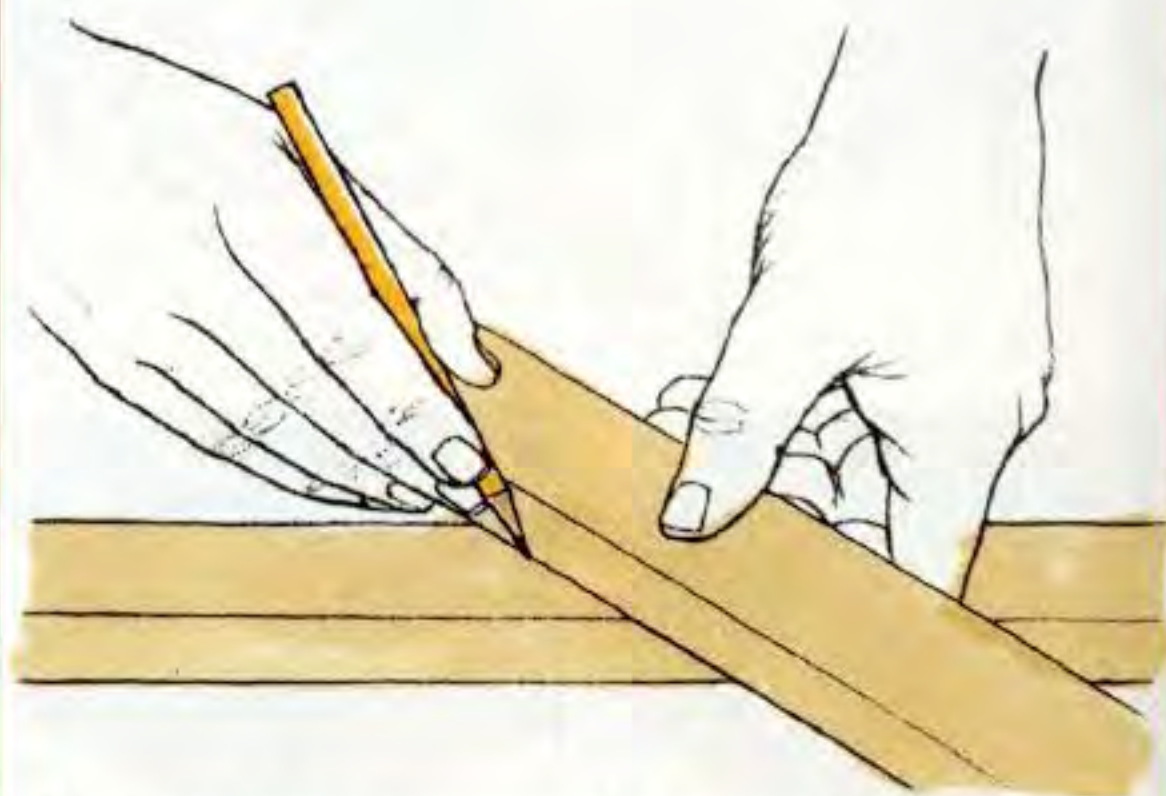
Accurate marking-out

The old adage, 'measure twice and cut once', is good advice. Hurried, inaccurate work when marking out joints leads to all manner of problems. Buy well-made rules and tape measures, and always stick to either the imperial or metric systems of measurement – the conversions quoted in this book are approximate only. Mark out overall dimensions with a sharp pencil, but use a marking knife to score lines that are to be cut, so as to avoid leaving a rough edge of torn wood fibres. Always run the flat face of the knife against the try square or straightedge. Use a sharp pencil to emphasize a knifed line that is difficult to see; on dark-coloured woods, rub the surface with white chalk to accentuate the line.



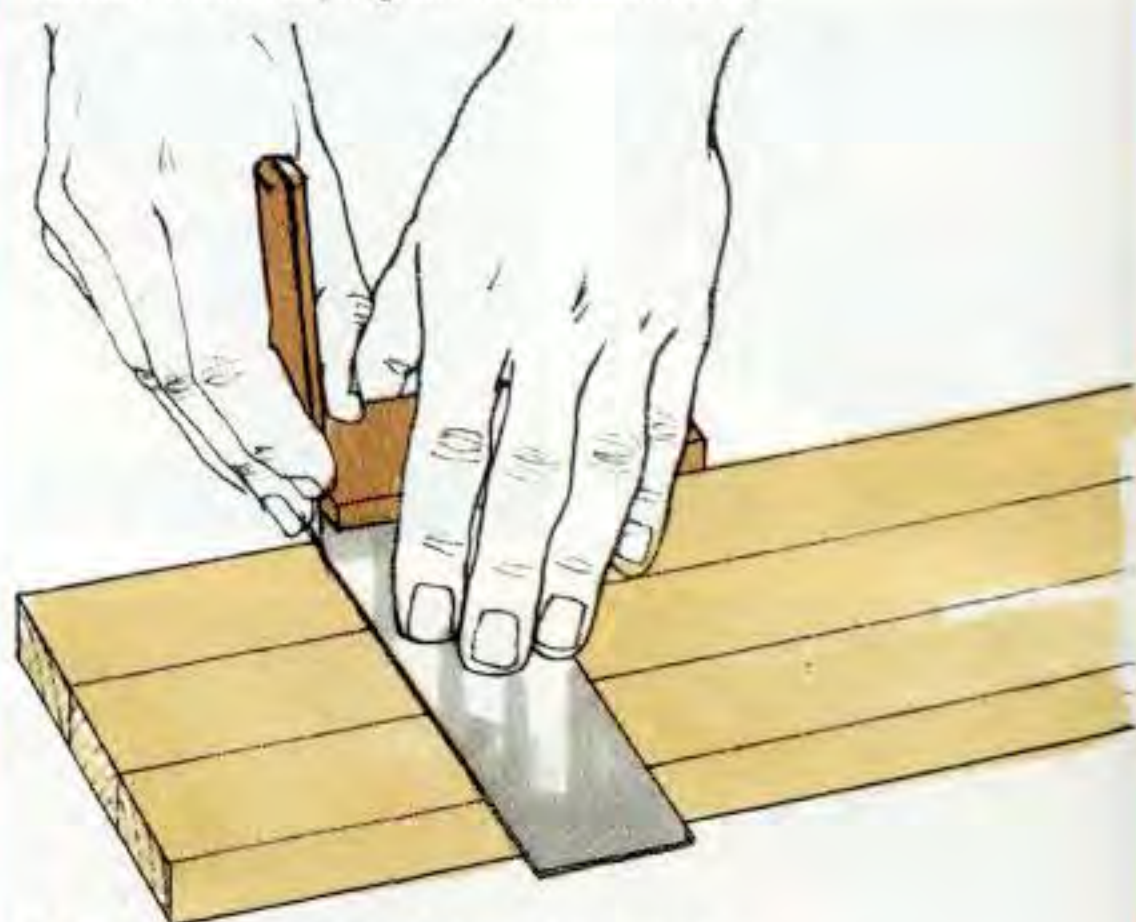
Extending knifed lines

When cutting shoulder lines all round a piece of wood, locate the point of the knife in the cut you have just made, then slide the try square up against the blade.



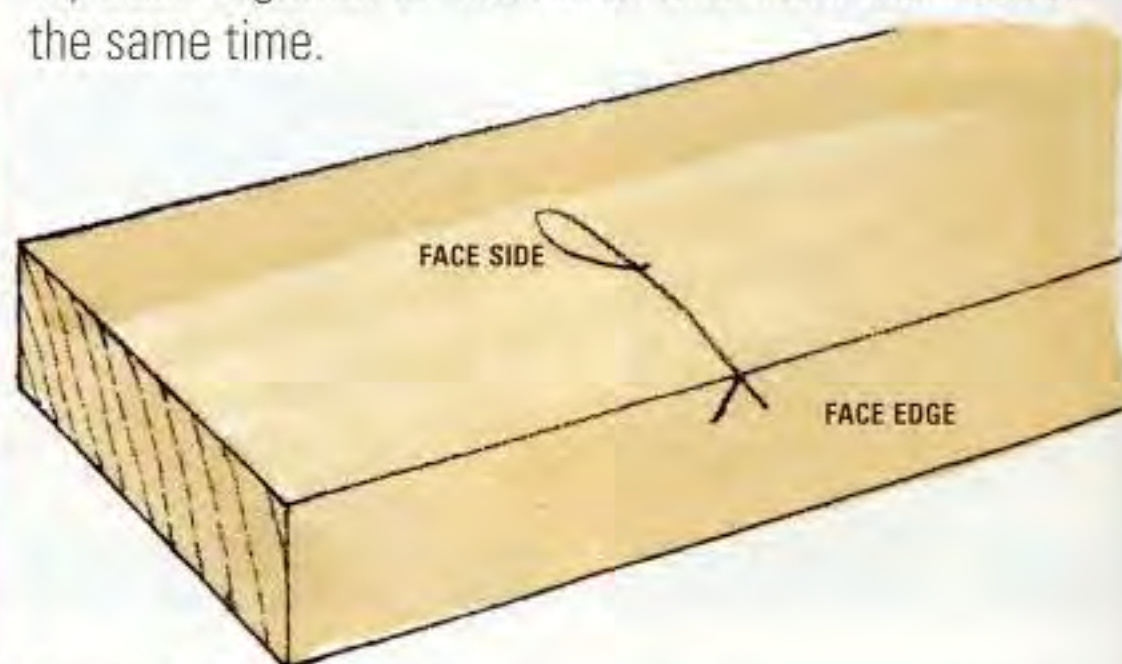
Marking one component from another

Whenever possible, mark one component from another, rather than relying on measurements.



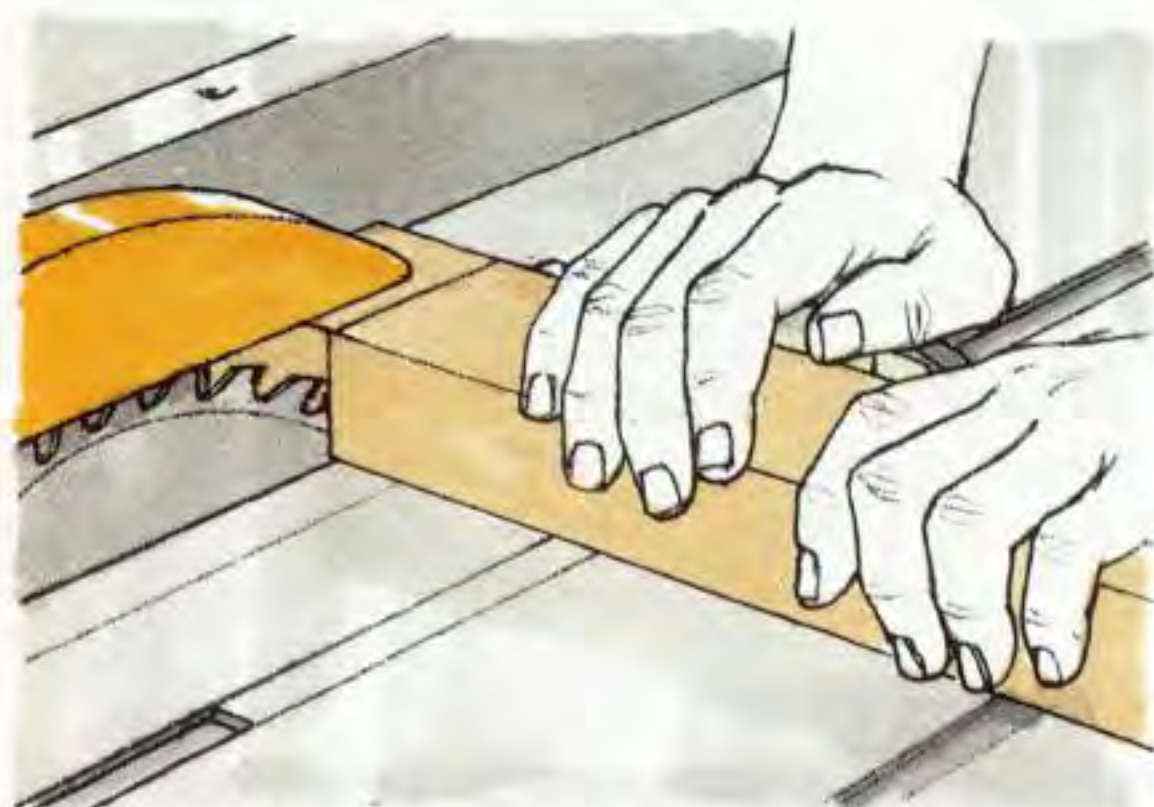
Marking identical components

If an assembly includes several identical components, lay them together on the bench and mark them out at the same time.



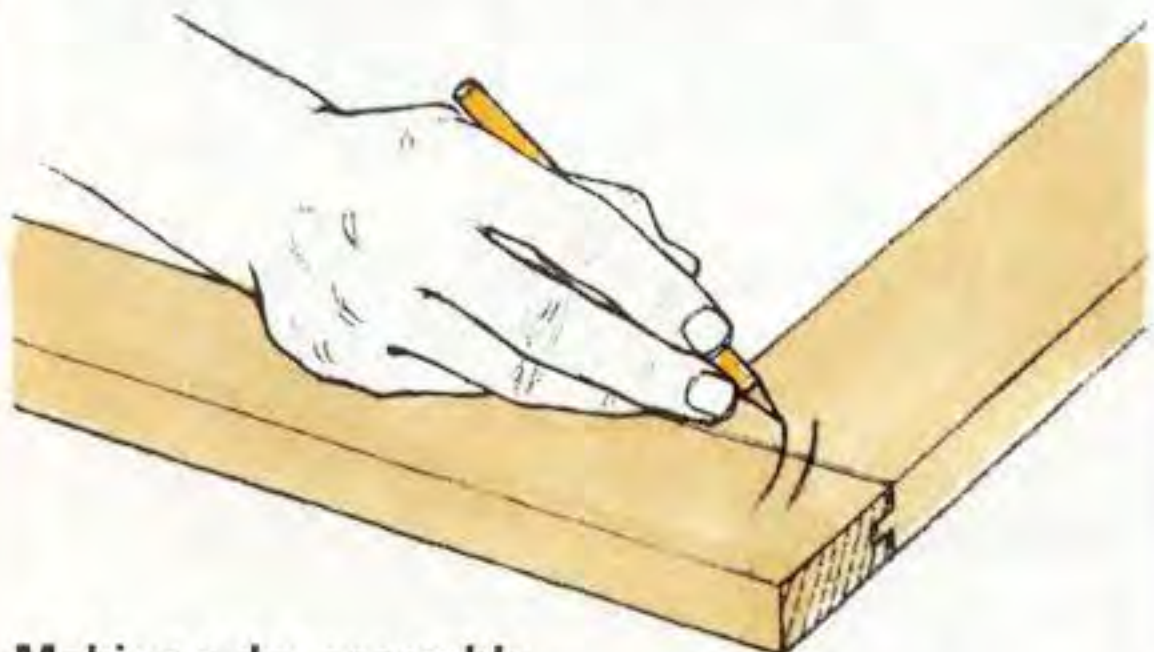
Squaring timber

When preparing timber for jointing, plane two adjoining surfaces perfectly square, taking all subsequent measurements and angles from them. Conventional symbols are used to denote these surfaces as face side and face edge.



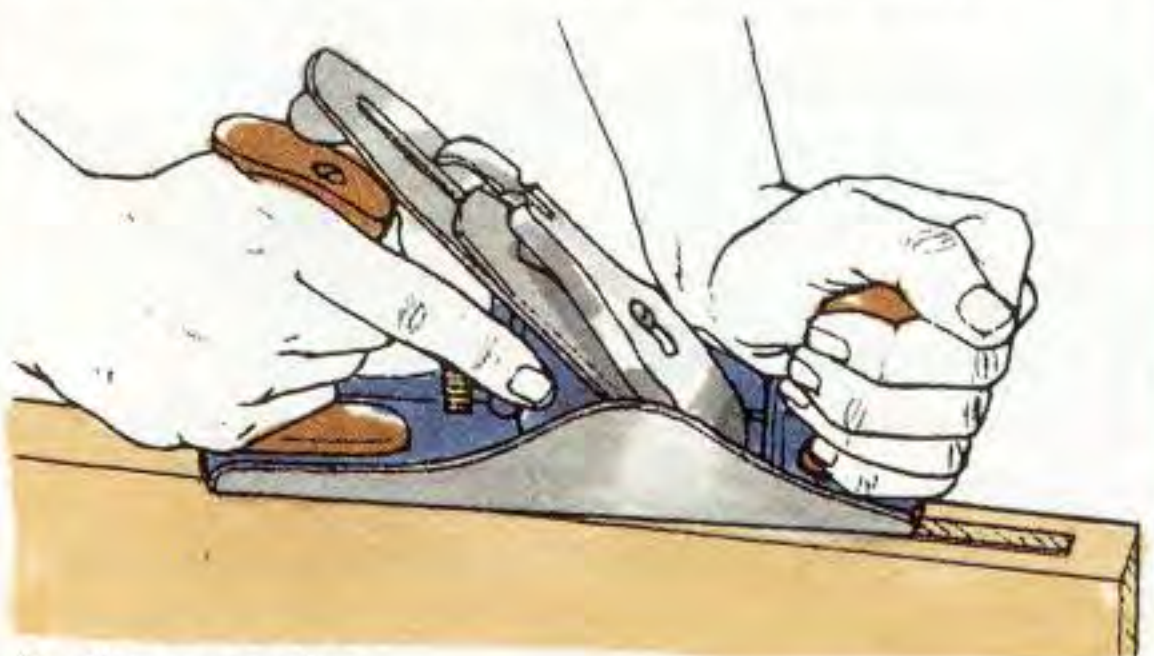
Cutting on the waste side

Allow for the width of a saw cut (the kerf) by always cutting on the waste side of any marked line.



Making a dry assembly

Some professionals claim to be able to glue up an assembly without ever having to check that the joints fit. More cautious woodworkers want to be sure that the shoulders meet snugly, and that they won't have to force a tight joint and risk splitting the wood. Identify each joint with pencil marks so that there is no confusion when it comes to gluing the assembly.



Cutting oversize

When making certain joints, it is good practice to deliberately leave specific elements oversize so that they can be planed flush once the glue has set – the end of a through tenon, for example, or the tips of through dovetails and finger joints.

SELECTING WOOD AND BOARDS

Poorly seasoned, substandard wood adversely affects the strength of a joint. Reject any timber with large knots, splits or other blemishes, and examine your chosen timber carefully, to ensure that there will be no weak short grain at the critical parts of a joint.



Avoid the following blemishes:

- 1 Large or dead knots
- 2 Growth-ring shakes
- 3 End splits
- 4 Surface checking
- 5 Honeycomb checks

Don't buy warped or twisted lengths of wood, and check with your supplier that the timber has been seasoned carefully. If it shrinks at a later stage, joints can work loose, and high moisture content may prevent glue setting properly.

Hardwoods

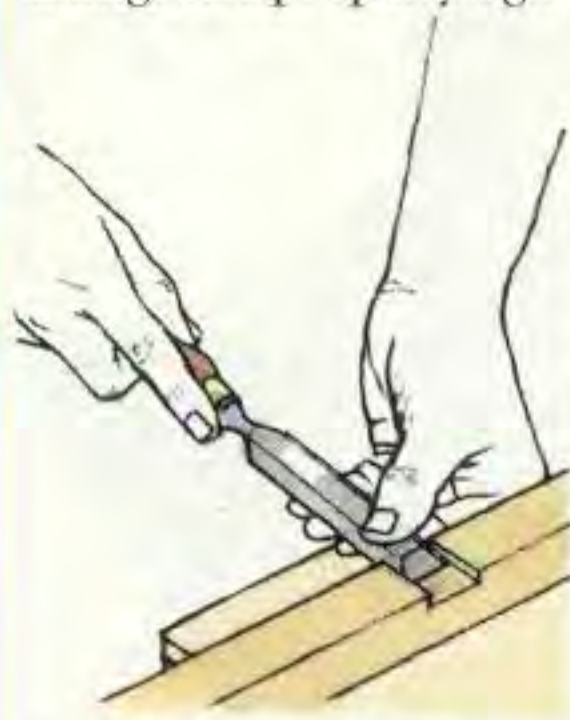
These are generally preferable for finely cut joints; however, provided you make the joints proportionally larger, there is no reason why you shouldn't use good-quality softwoods.

Man-made boards

As a rule, man-made boards do not suffer from the same defects as solid wood, but since most boards lack any real long-grain strength, they are not suitable for the more complex joints (see pages 10-13). In addition, reject any board with a soft crumbly core.

SAFETY IN THE WORKSHOP

Follow basic safety procedures to avoid accidents in the workshop. Blunt tools that you have to force through the wood are potentially more dangerous than sharp ones that cut effortlessly. Always keep your tools and machinery in good condition, checking that spanners and adjusting keys are removed from machines before switching on. Periodically check that all nuts, bolts and other fixings are properly tightened.



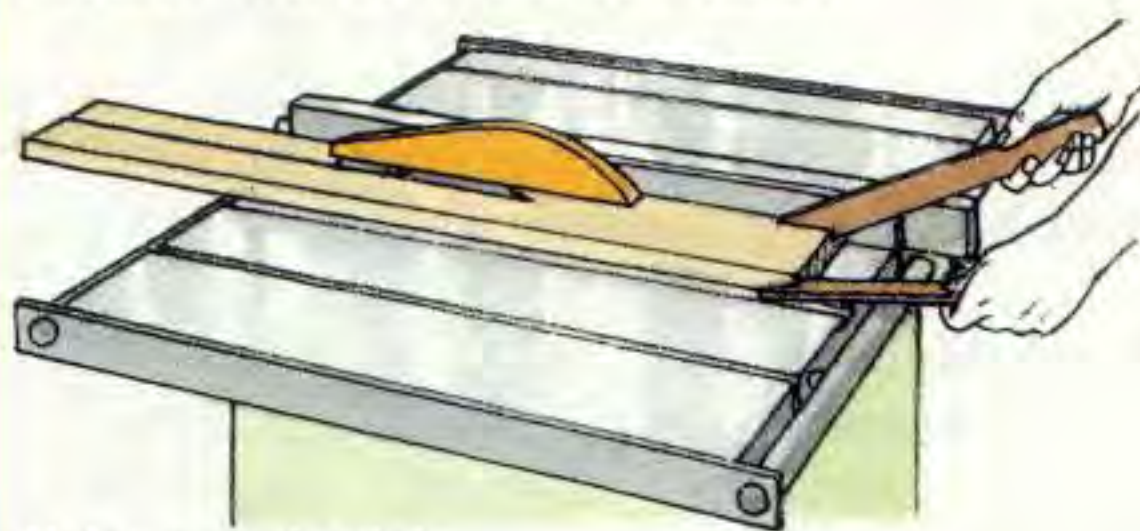
Cutting away from you

For safety, clamp the work or steady it against a bench hook, so that you can keep both hands behind a cutting edge.

OPERATING A MACHINE SAFELY

Make a test cut to check the accuracy of machine settings before cutting an actual workpiece. Either feed the workpiece into the blade, just nicking the edge so that you can check the dimensions, or, for more complicated work, such as a dovetail joint, make a complete test piece out of scrap wood.

Support the work properly when passing it over or through a machine, feeding the work against the direction of rotation of a blade or cutter.



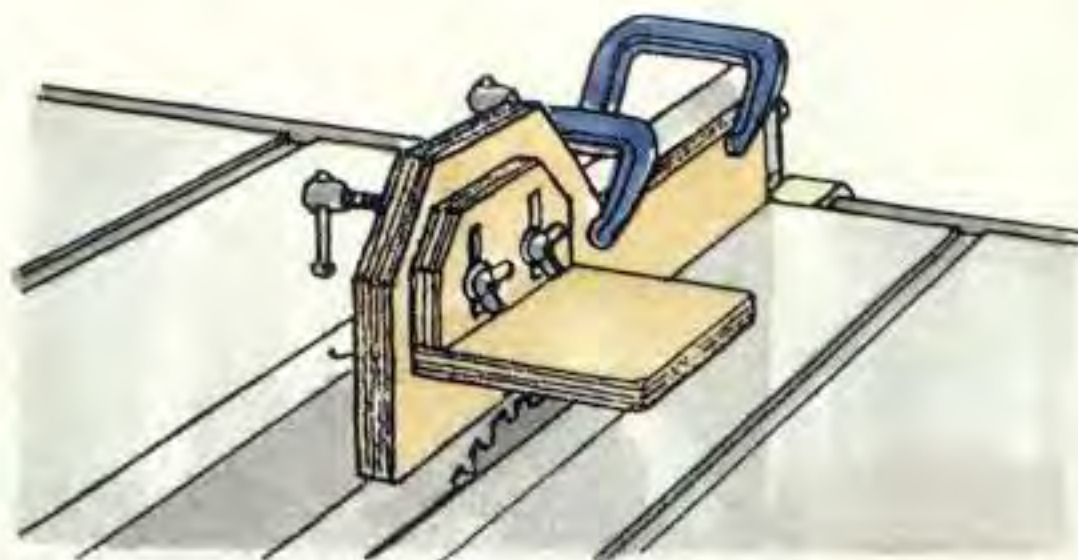
Using a push stick

Use a push stick to feed a workpiece, rather than risking touching a blade with your fingers. Never reach over a blade to remove offcuts.

Guarding blades and cutters

Whenever possible, use proper guards recommended by the machine's manufacturer.

In some of the illustrations in this book, the guards have been omitted for clarity.



Making a temporary guard

If you must remove a fitted guard in order to complete a procedure, make a temporary plywood guard to cover the blade, and attach it to the rip fence. Alternatively, make a sturdy jig that holds the work securely and keeps both hands well away from the blade or cutter.

Changing and adjusting blades

- Don't make adjustments to a machine while cutters or blades are moving, and never slow or stop a blade with a piece of wood; if the machine is not fitted with a brake, switch off and let it come to rest naturally.
- Do not attempt to free a stalled blade or cutter before switching off the machine.
- Disconnect a machine or power tool from the supply of electricity before changing cutters or blades.

PERSONAL CARE

- Tie back long hair, and don't operate a machine or power tool while wearing loose clothing or jewellery that might get caught in moving parts.
- Fit dust extraction to machinery and power tools, or wear a face mask. Use protective eye shields whenever you are doing work which could throw up debris.
- Don't operate a machine under the influence of alcohol or drugs, or if you are feeling drowsy.

WORKSHOP MANAGEMENT

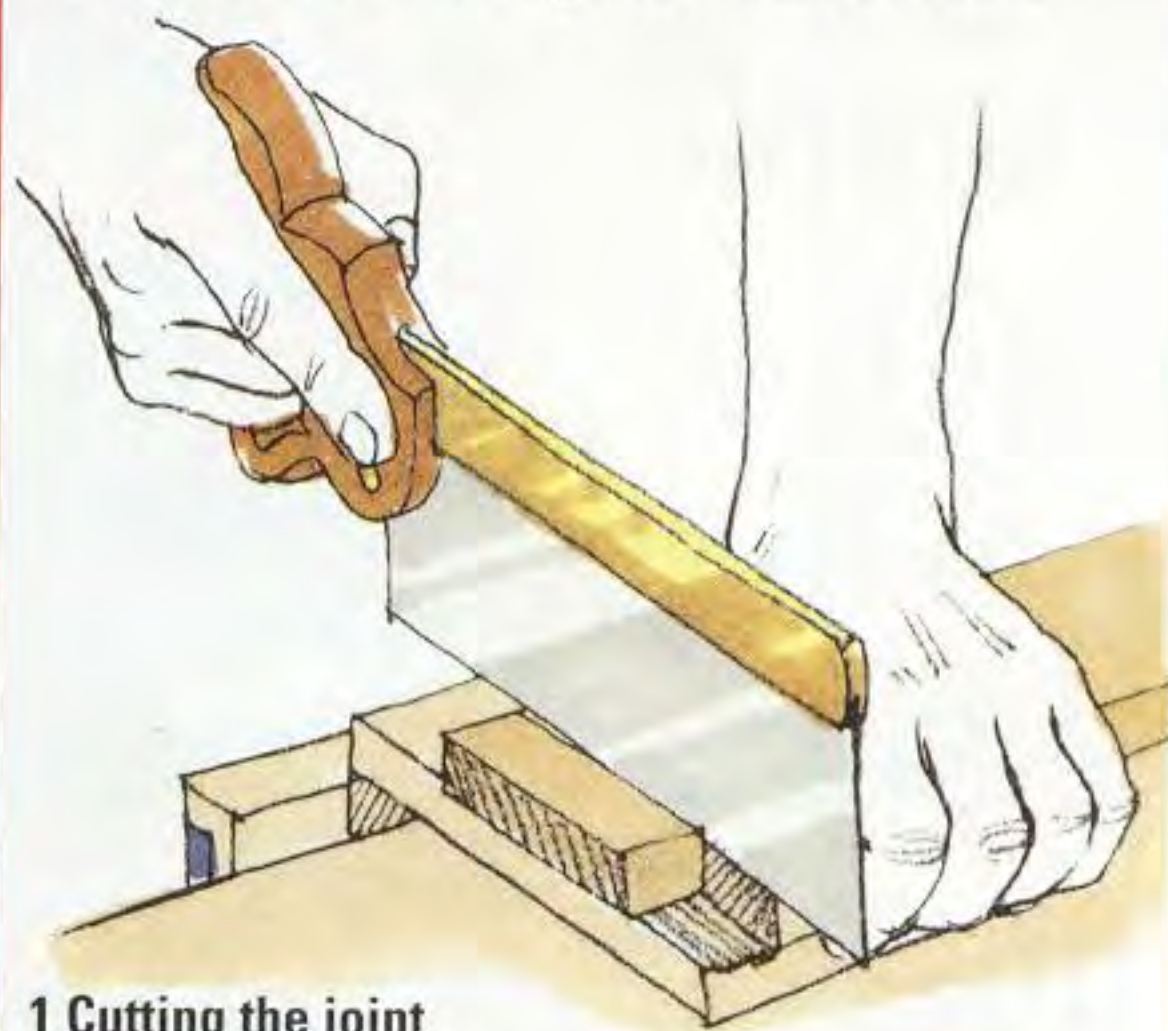
- Don't clutter your bench with tools and pieces of wood. Keep the workshop tidy, and don't let sawdust and shavings build up on the floor – this is a fire hazard and makes the floor slippery.
- Never store materials or equipment above a machine in such a way that they could fall onto it.
- Don't carry a power tool by its cable or use the cable to pull the plug out of a socket. Check the cable and plug regularly for wear or damage.
- Don't throw used batteries from cordless tools into water or a fire, as they are likely to explode.
- After work, disconnect machines and lock your workshop. Keep unsupervised children away from power tools and machinery, even when not in use.

CHAPTER 2 Once you have mastered the skills of cutting and planing wood accurately, assembling butt joints is a simple option for anything from stud partitioning to fine picture framing. Some mitred butt joints will probably be strong enough using glue alone, but it is usually necessary to reinforce square-cut joints in some way.

SQUARE-ENDED BUTT JOINT

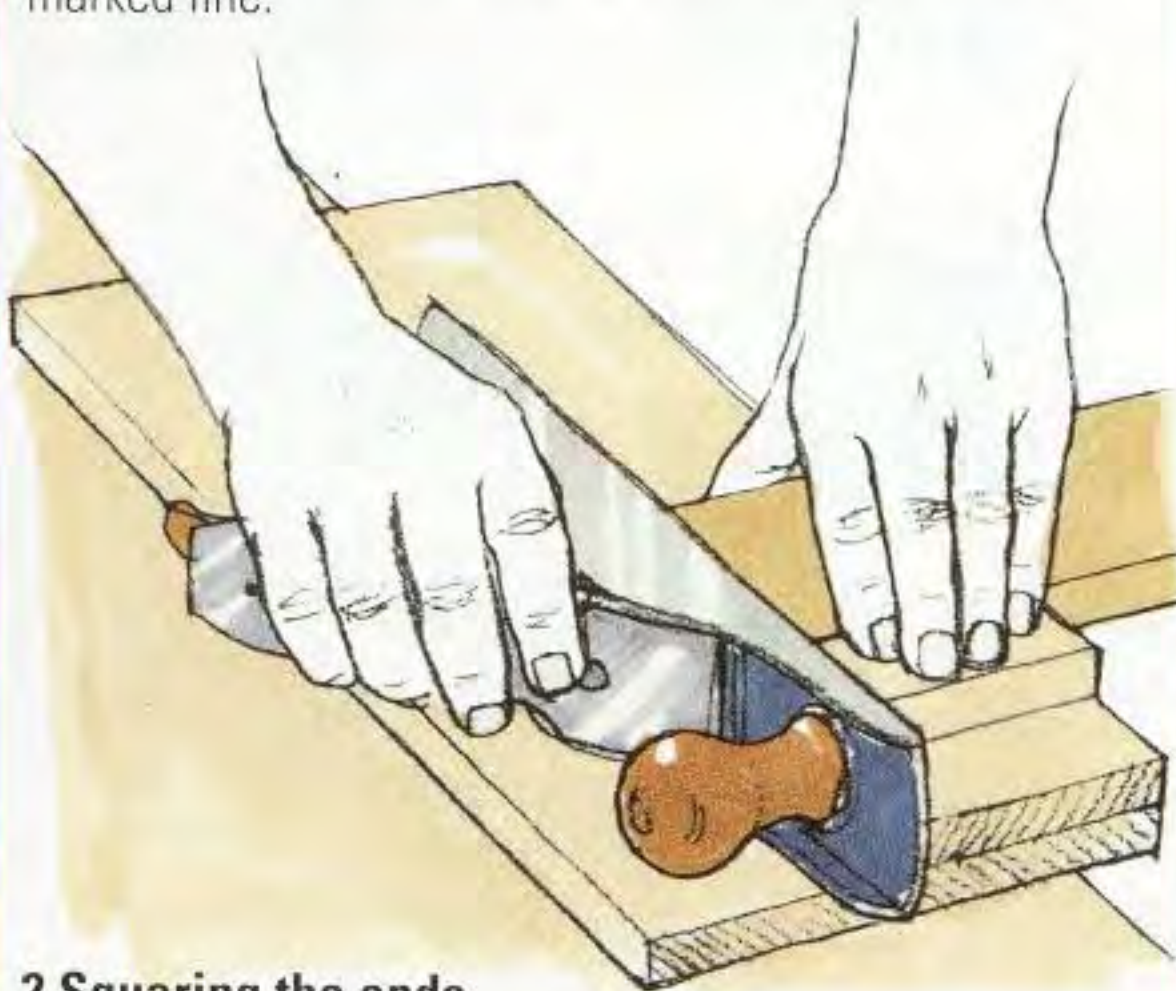
HAND CUT

It is possible to make flat frames and simple box structures utilizing square-cut corner joints. Use sawn timber for rough joinery, but plane the wood square beforehand for good-quality cabinet work. Since glue alone is rarely sufficient to make a sturdy butt joint, hold the parts together with fine finish nails or glued blocks of wood.



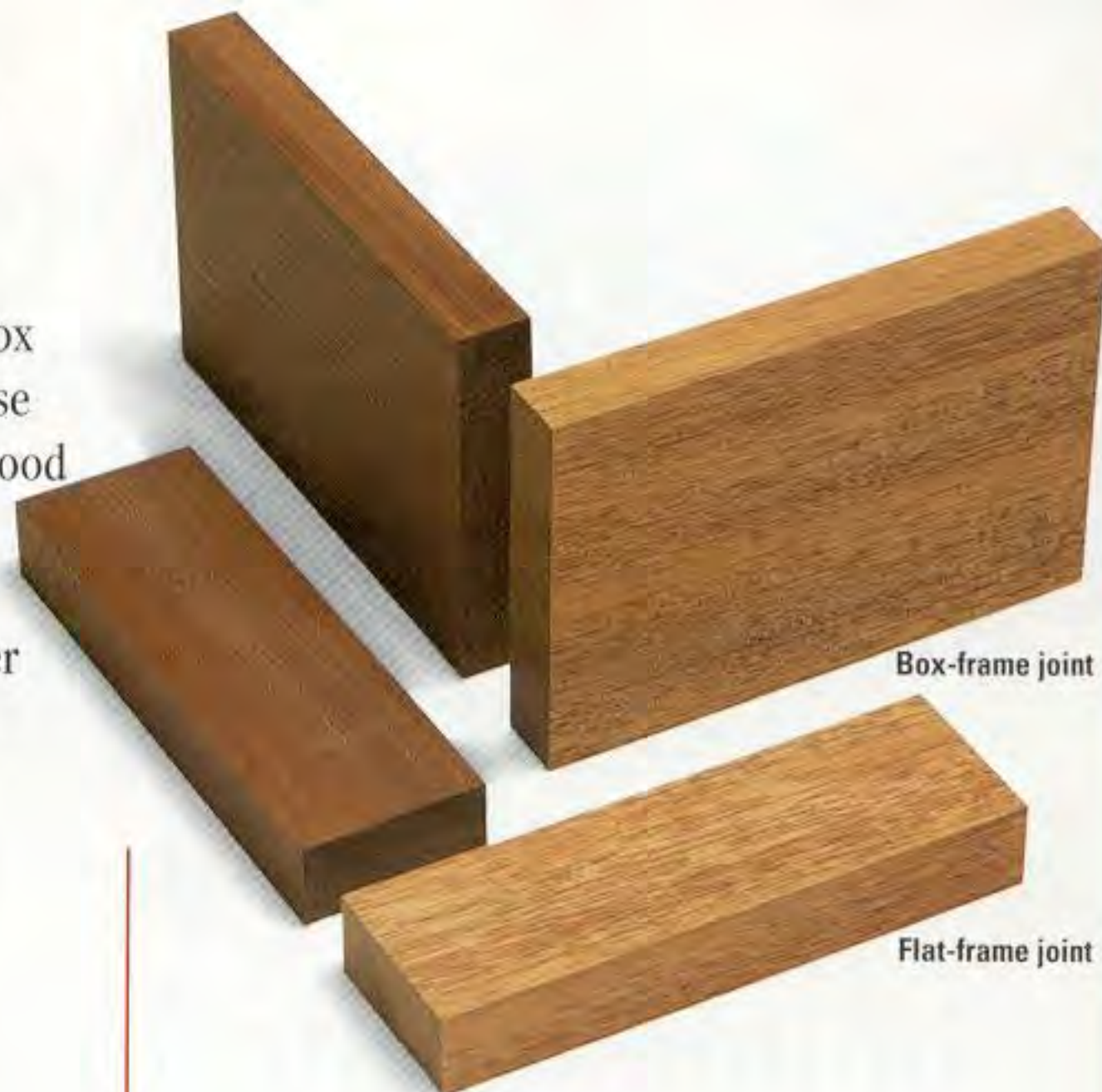
1 Cutting the joint

Mark out each piece of wood to length, using a knife and try square to mark the shoulders of the joint on all faces. Hold the work against a bench hook, and saw down each shoulder, keeping to the waste side of the marked line.



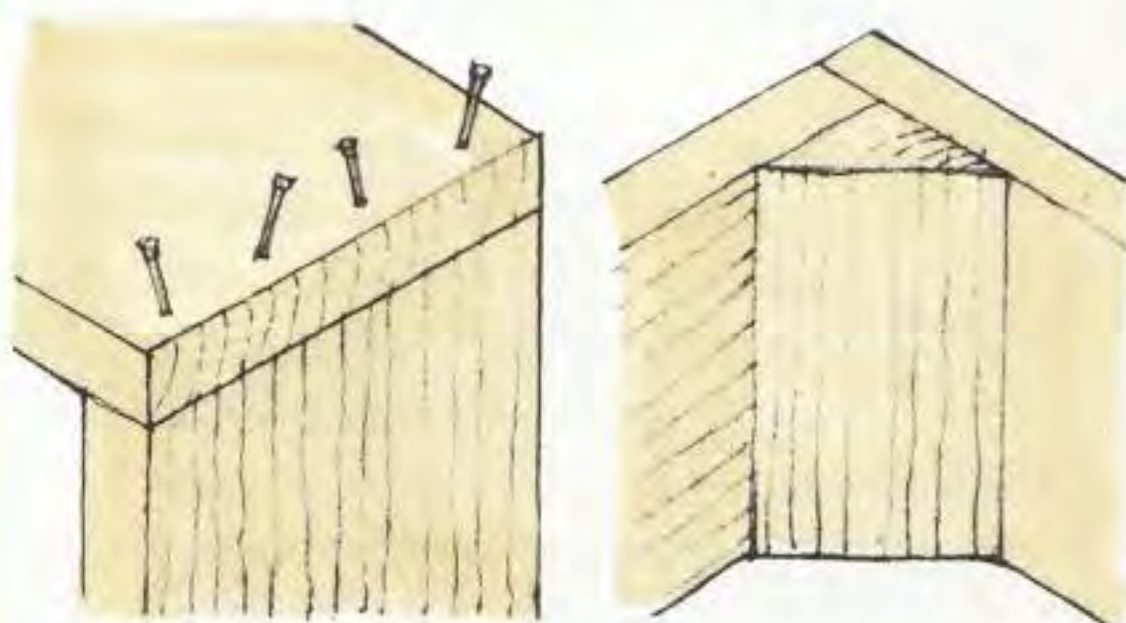
2 Squaring the ends

For all but the most basic work, trim the ends square to form a neat butt joint, using a bench plane and shooting board. Set the plane for a fine cut, and lubricate the running surfaces of the shooting board with a white candle or wax polish.



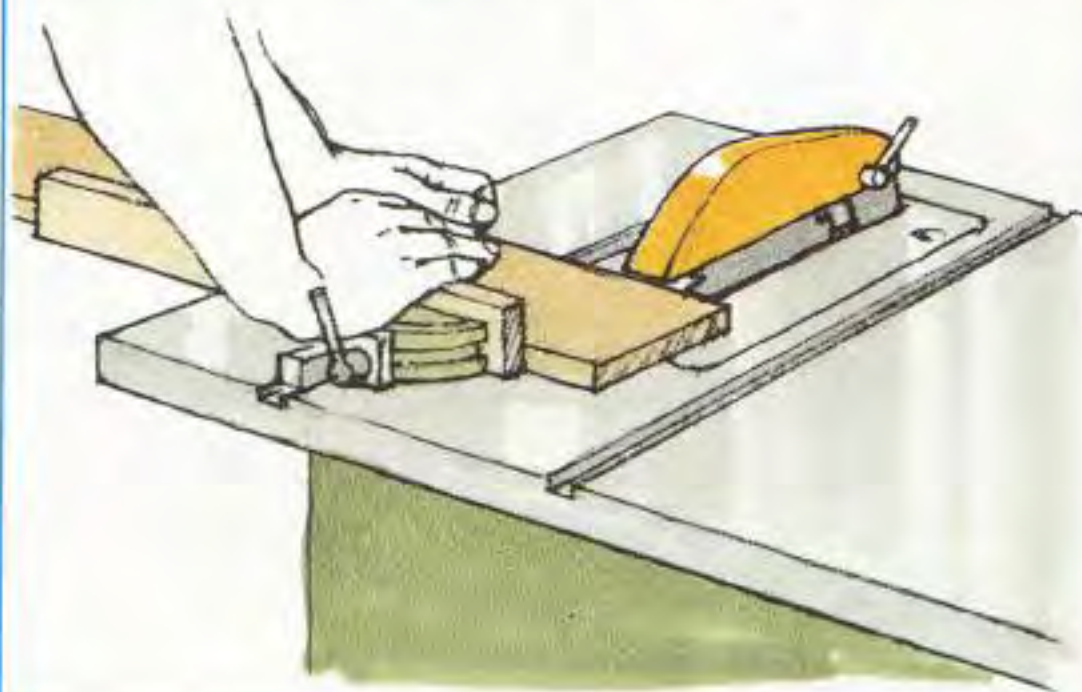
Reinforcing a butt joint

For additional strength, drive nails at an angle into the wood as shown. If you don't want the method of fixing to show on the outside of the joint, glue a corner block on the inside.



CUTTING BUTT JOINTS ON A TABLE SAW

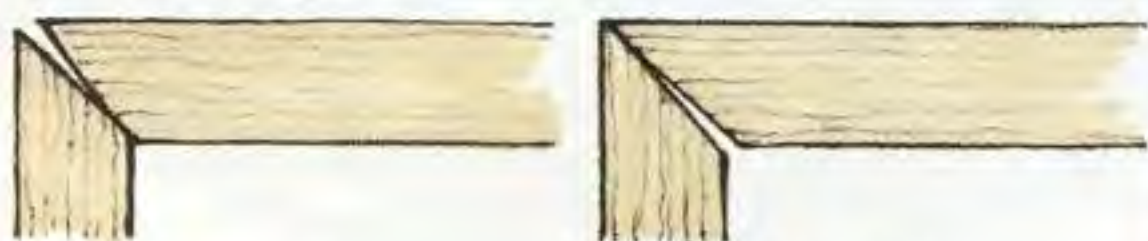
A sharp table-saw blade cuts end grain so cleanly that it requires no further finishing. Use a sliding crosscut table or a mitre fence to keep the work square to the blade. Set up the machine so that the work can just pass beneath the blade guard.



MITRED BUTT JOINT

HAND CUT

The classic joint for picture frames, the mitred butt joint makes a neat right-angle corner without visible end grain. Cutting wood at 45 degrees produces a relatively large surface area of tangentially cut grain that glues well. For light-weight frames, just add glue and set the joint in a mitre cramp.



Open joint caused by inaccurate cutting

Inside gap as a result of wood shrinking

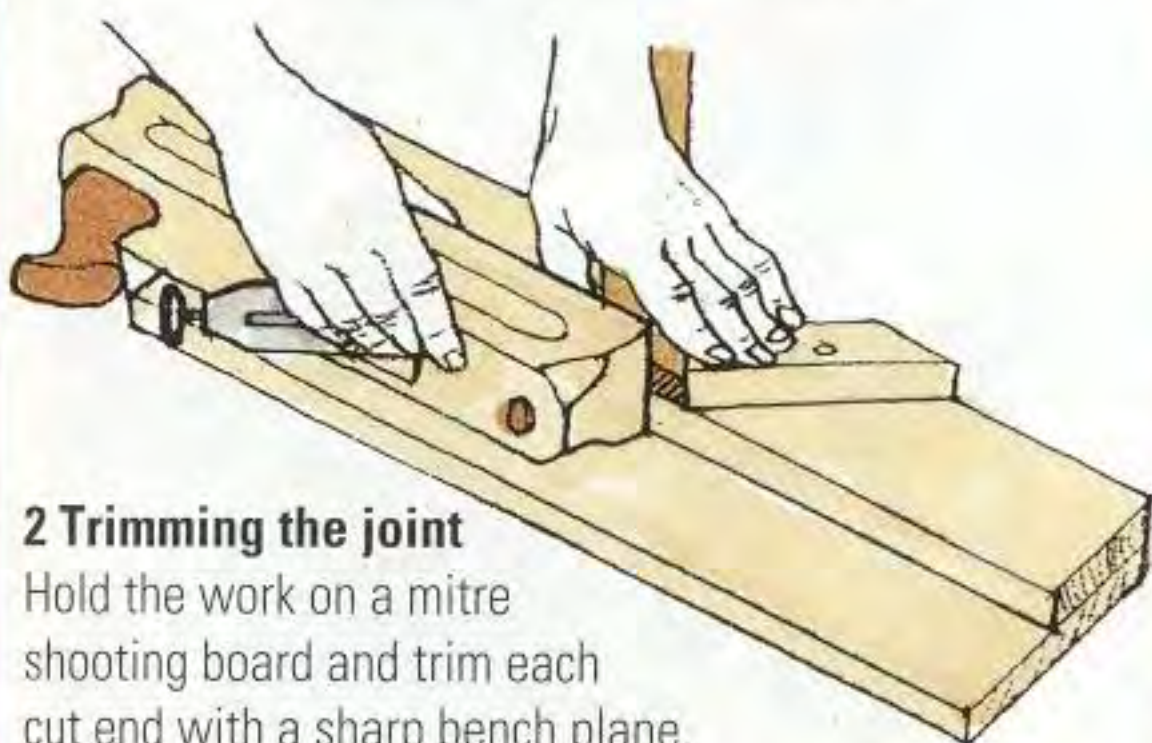
Accurate mitre cutting

Before you pick up a saw, always ensure that the mitre is exactly half the joint angle, or the joint will be gappy. In addition, use well-seasoned timber or a gap may open up on the inside of the joint as the wood shrinks.



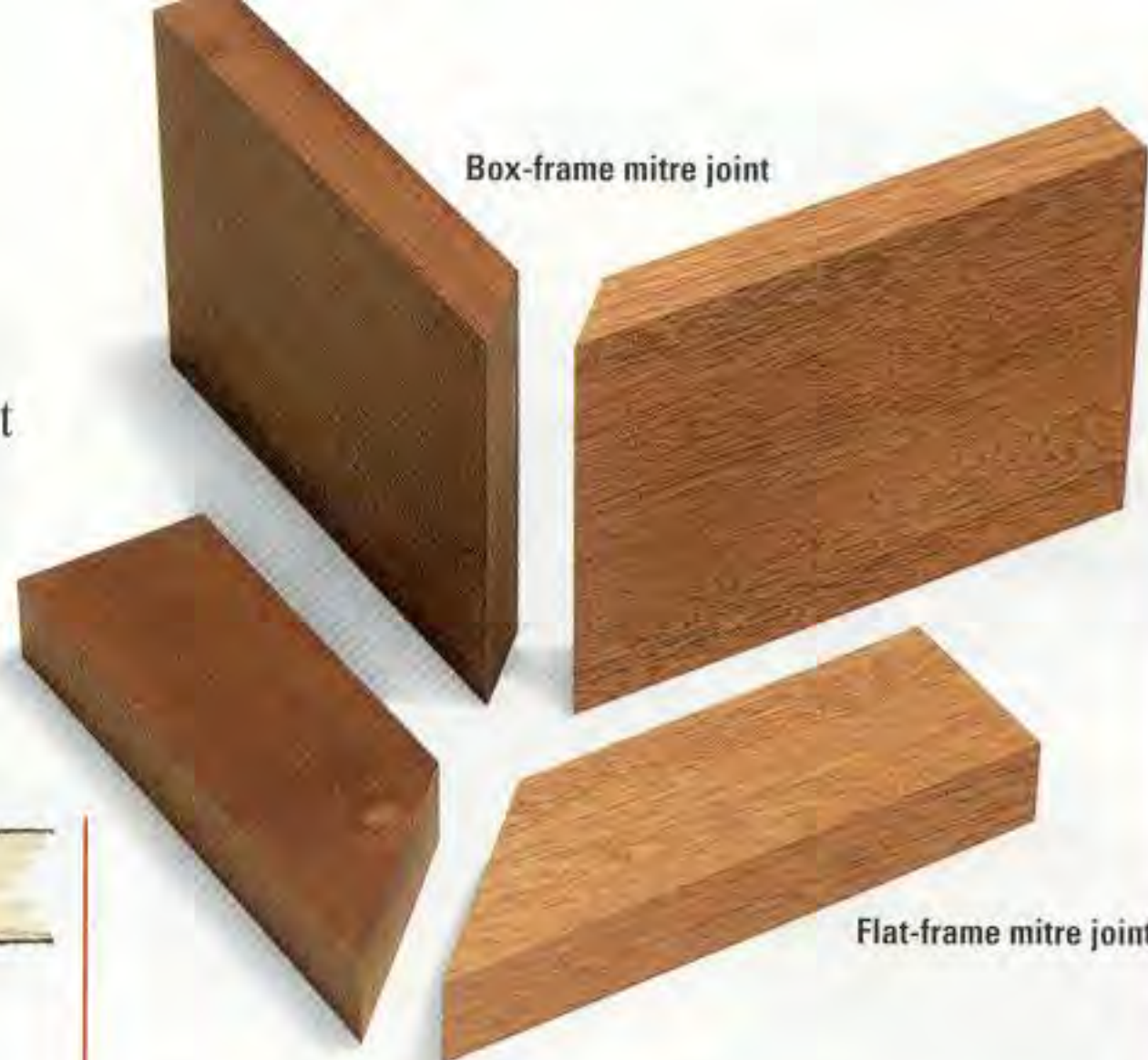
1 Cutting the joint

On each piece of wood, mark the sloping shoulder of the joint, using a knife and mitre square. Extend the marked line across the adjacent faces with a try square. To remove the waste, either follow the marked lines by eye or use a mitre box to guide the saw blade.



2 Trimming the joint

Hold the work on a mitre shooting board and trim each cut end with a sharp bench plane.

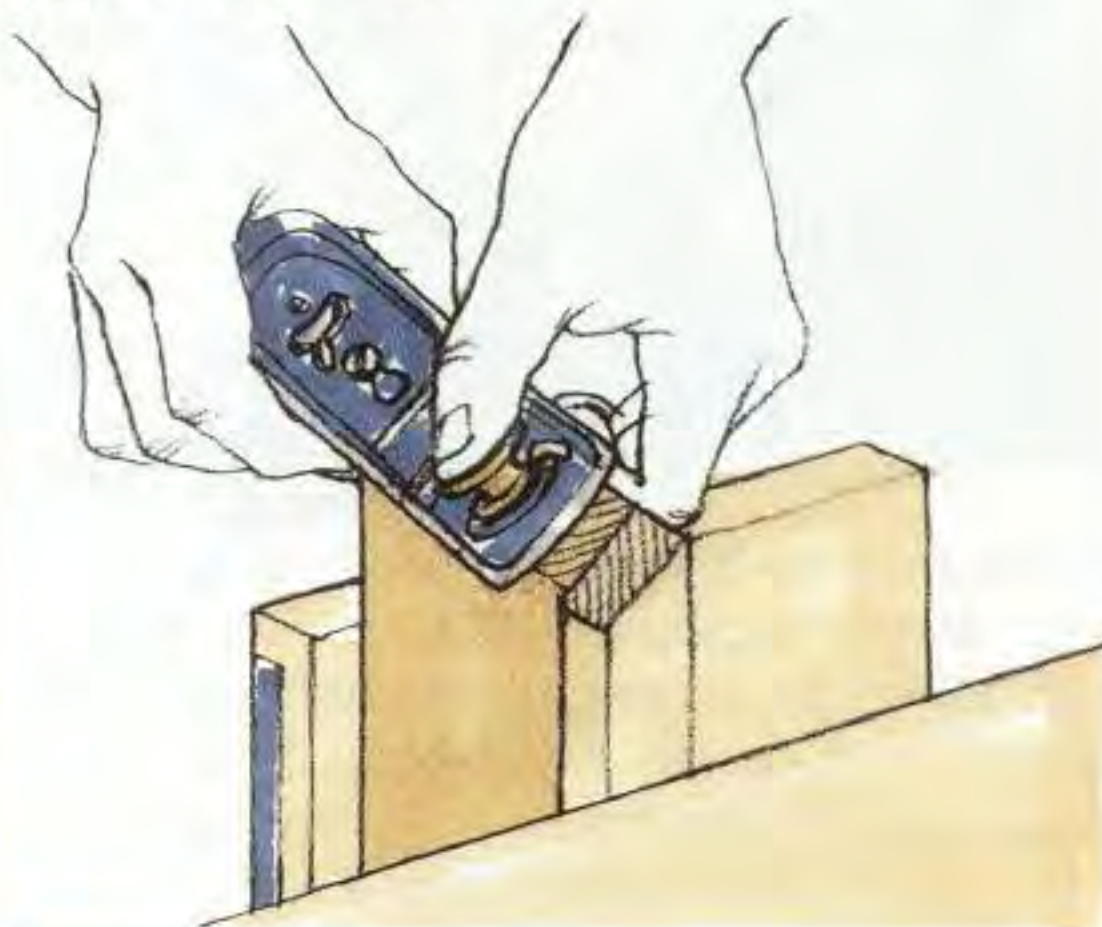


Box-frame mitre joint

Flat-frame mitre joint

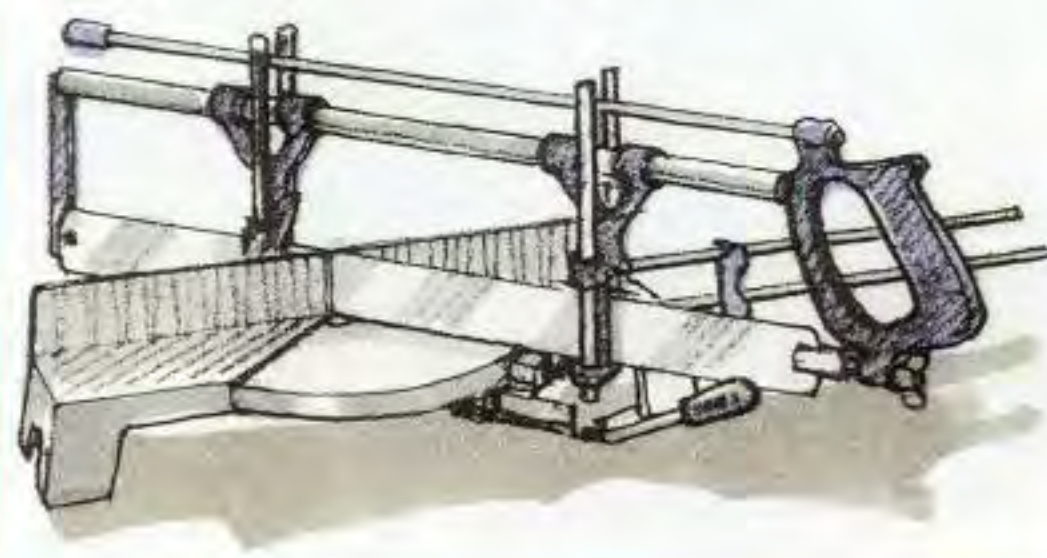
Trimming a wide board

Since it is impossible to mitre a wide piece of wood on a shooting board, clamp the work upright in a bench vice and trim the end grain with a finely set block plane. To prevent splitting, back up the work with a piece of scrap timber.



USING A MITRE SAW

It pays to use a special jig called a mitre saw to cut larger pieces of wood or moulded sections of framing. The workpiece can be held on edge or flat on the bed of the tool. The saw guide, which can be set to any angle, guarantees accurate joints.



MITRED BUTT JOINT

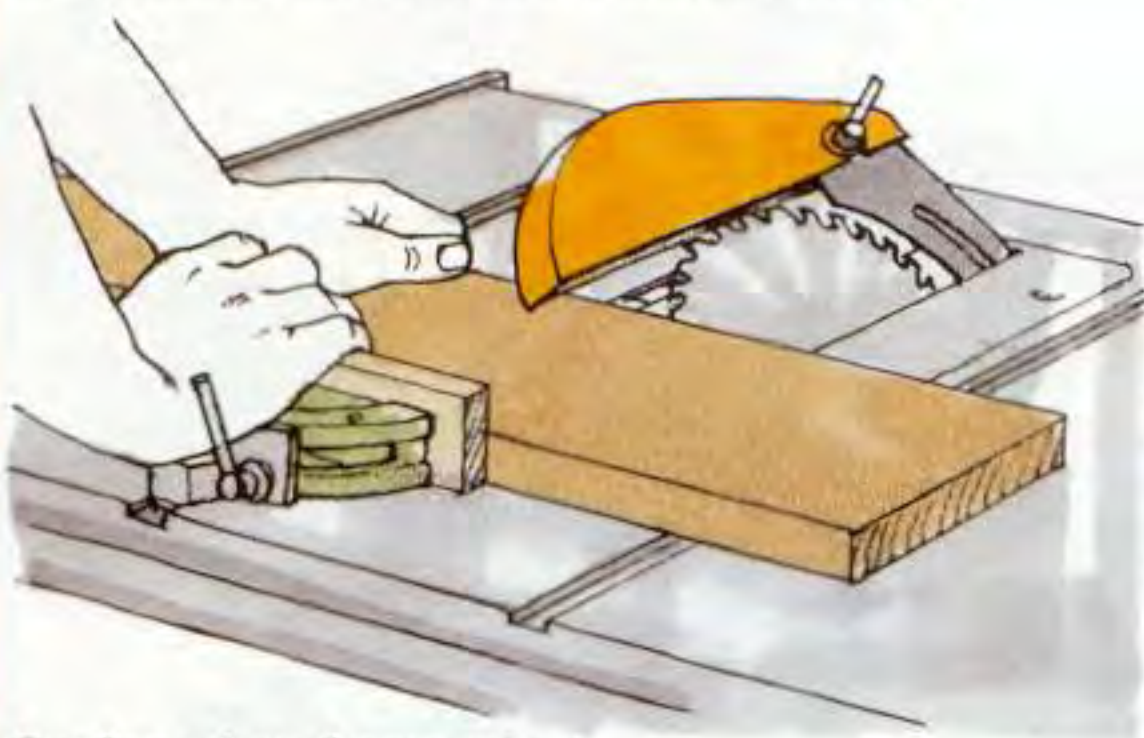
MACHINE CUT

Table saws or radial-arm saws make mitring simple, even for compound mitres where the angle is in two planes. Reinforcing mitre joints with solid wood or plywood tongues is also straightforward on a machine; cut the tongue slots before gluing machine-made joints. Centre the groove in a flat-frame mitre, but for a box-frame or cabinet, position the tongue towards the inside of the angle to prevent weak short grain.



Cutting a flat-frame mitre

Adjust the mitre fence on the table saw to the required angle, usually 45 degrees. Holding the workpiece firmly against the fence, so that it does not get drawn backwards by the saw, feed it towards the blade.



Cutting a box-frame mitre

Tilt the saw blade to 45 degrees to cut a bevel across the board. Set the mitre fence at 90 degrees, and feed the work past the blade.

Box-frame mitre joint

TONGUE



Flat-frame mitre joint

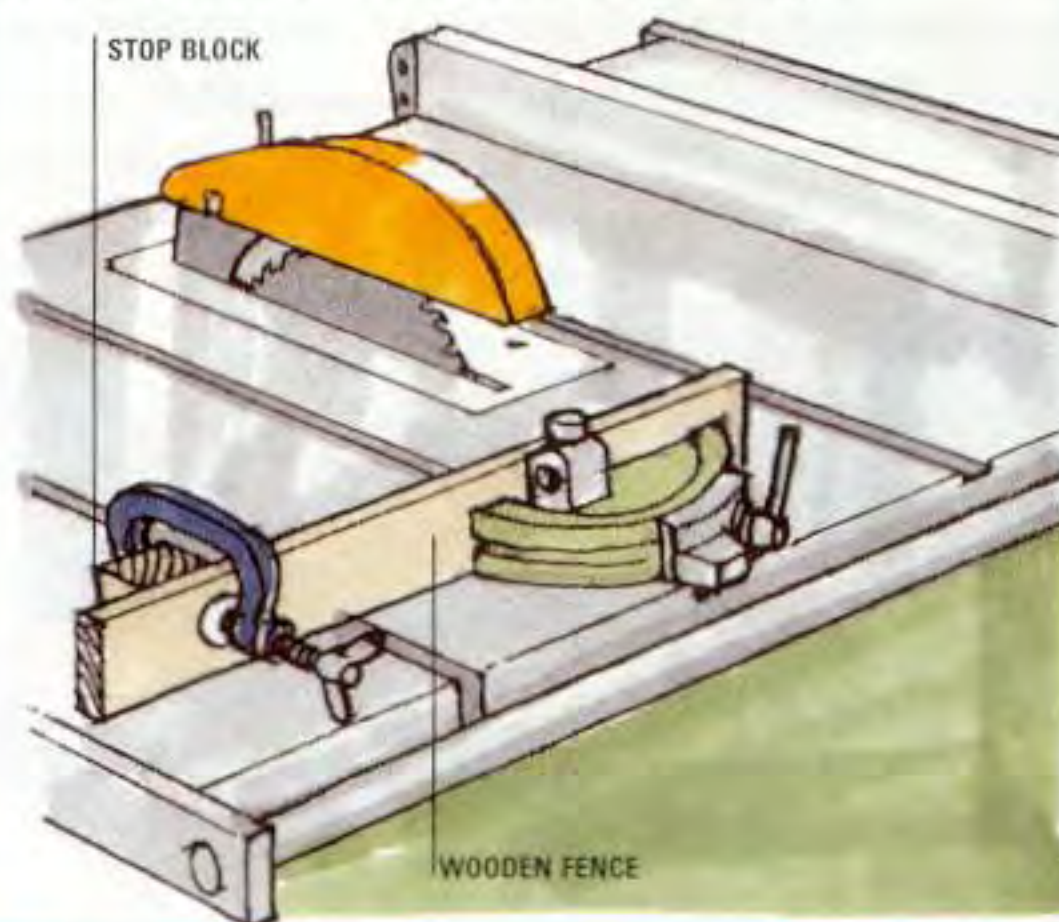
TONGUE

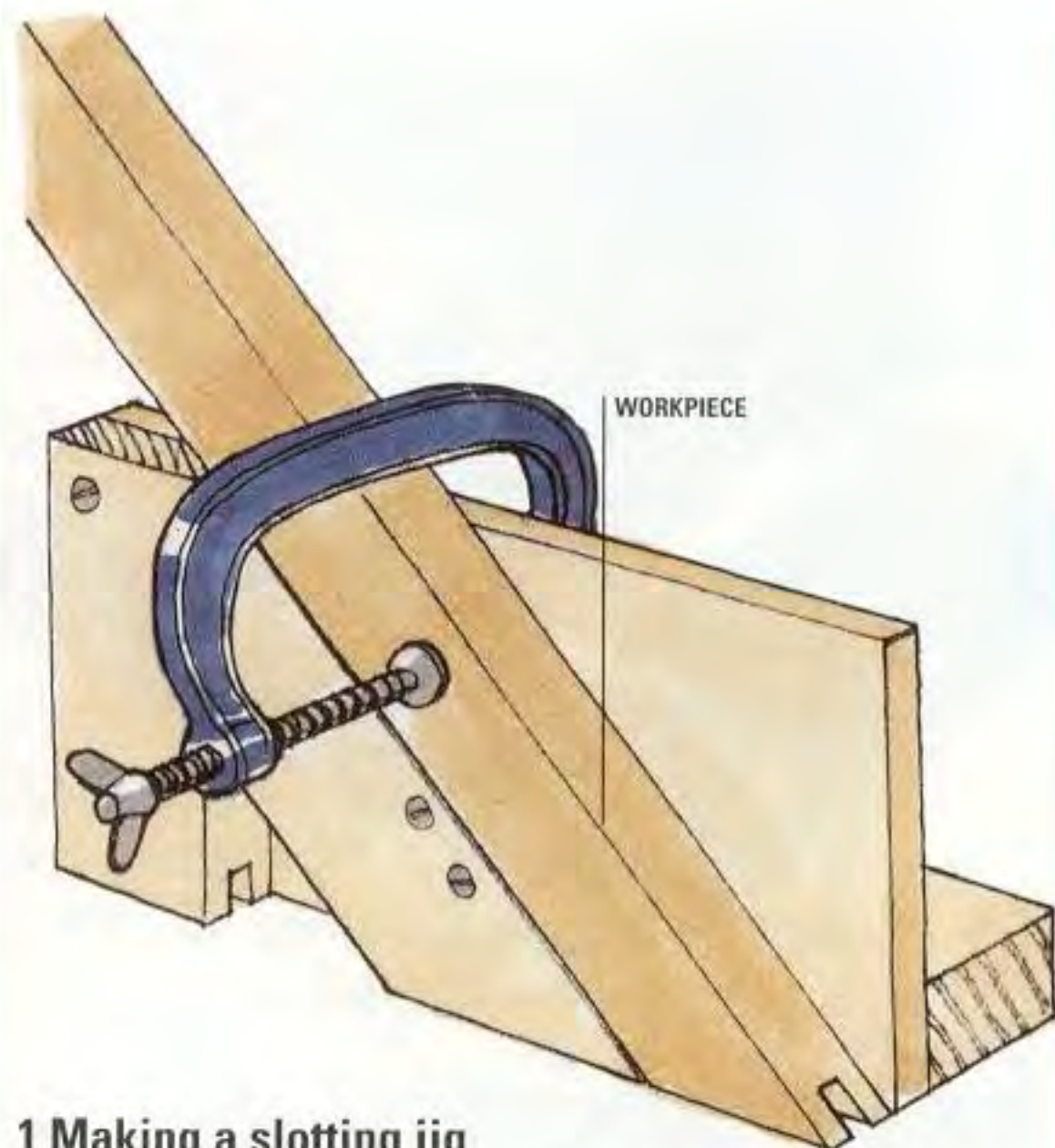
EXTENDING A TABLE-SAW FENCE

The mitre fence on most table saws is comparatively short, but some are pre-drilled so that you can screw on a longer hardwood face to extend the fence. Feeding this wooden fence into the saw blade for the first time cuts it perfectly to length. An extended fence not only provides better control, but stops the grain of a workpiece splitting at the back as it is sawn. If you can't fit a permanent extension, sandwich a piece of scrap wood between the fence and the workpiece.

With either method, use both hands to hold the workpiece against the fence, and feed the work quite slowly into the blade. Clamp to the fence any pieces too small to be held with two hands.

A block of wood clamped to the extension serves as a stop for one end of the workpiece when cutting several pieces of wood to the same length.





1 Making a slotting jig

To slot a flat-frame mitre make a cutting jig that will hold the work securely and keep your hands away from the saw blade. Cut an MDF backing panel about 400 x 250mm (16 x 10in). Glue and screw offcuts of the framing wood to the panel as shown, setting one to the mitre angle. Ensure all screws are clear of the blade. Fix a steadying block to the opposite face of the panel, flush with the bottom edge.



2 Cutting the slot

Clamp the work in the jig, with the mitred end flush with the base. Set the saw fence to centre the cut on the ends. Hold the jig firmly against the fence while making the cut.



Slotting a box-frame mitre

Set the blade to 45 degrees and adjust it to the correct height. To position the mitre accurately over the blade, butt the other end of the workpiece against a wooden block clamped to the extended mitre fence.

CUTTING MITRES ON A RADIAL-ARM SAW

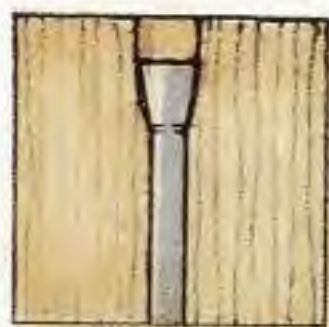
Having sawn bevels for a box-frame mitre, adjust the blade depth to saw slots for reinforcing tongues across each cut face. Butt the other end of the workpiece against a stop clamped to the fence.



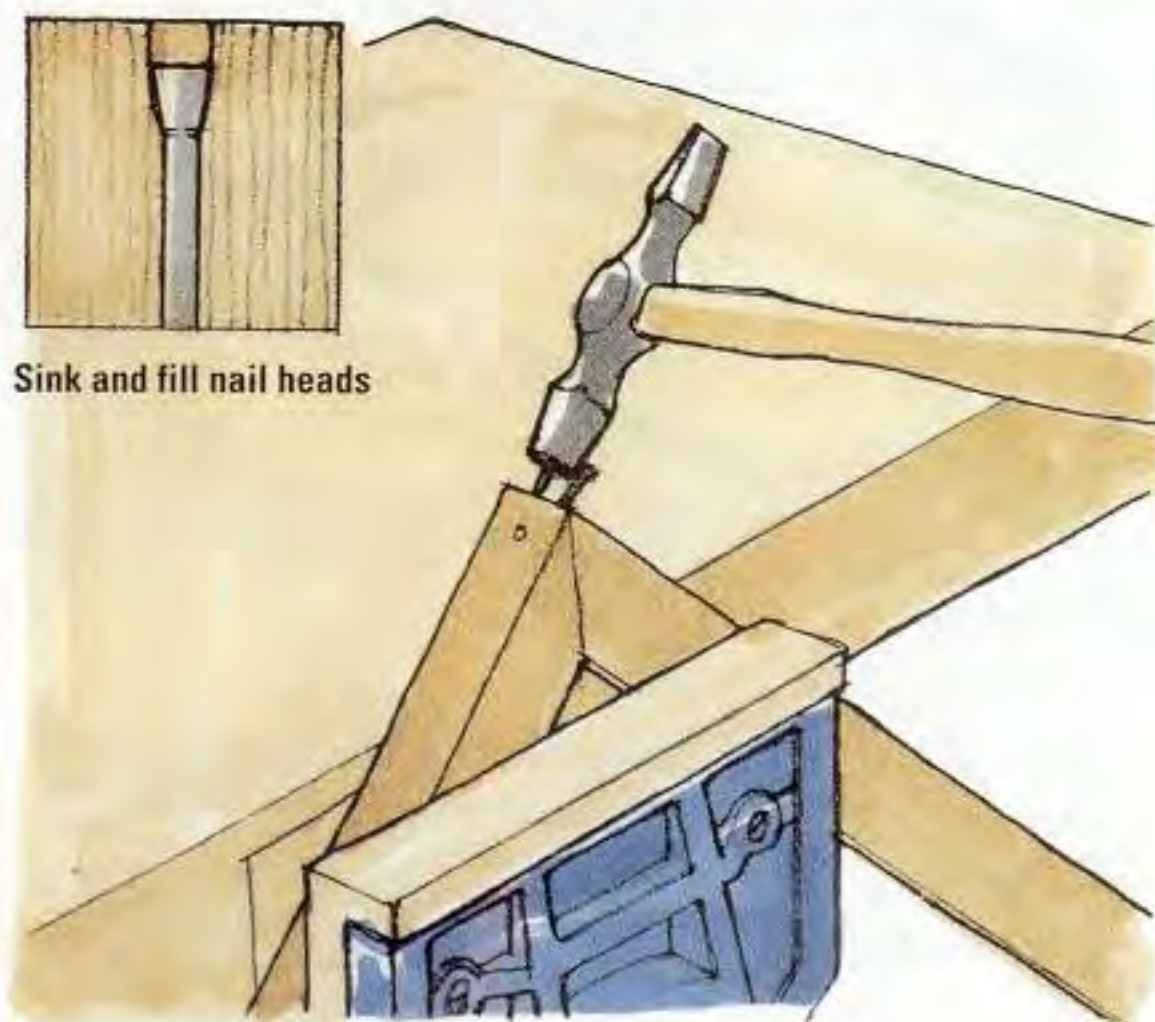
REINFORCED MITRE JOINT

HAND CUT

Once you've glued up even a lightweight frame, you can drive a small pin or two into the side of the mitre joints to make sure they won't come apart. Larger mitre joints should be glued and allowed to set, then reinforced with veneer splines or a separate tongue of solid wood or plywood.



Sink and fill nail heads



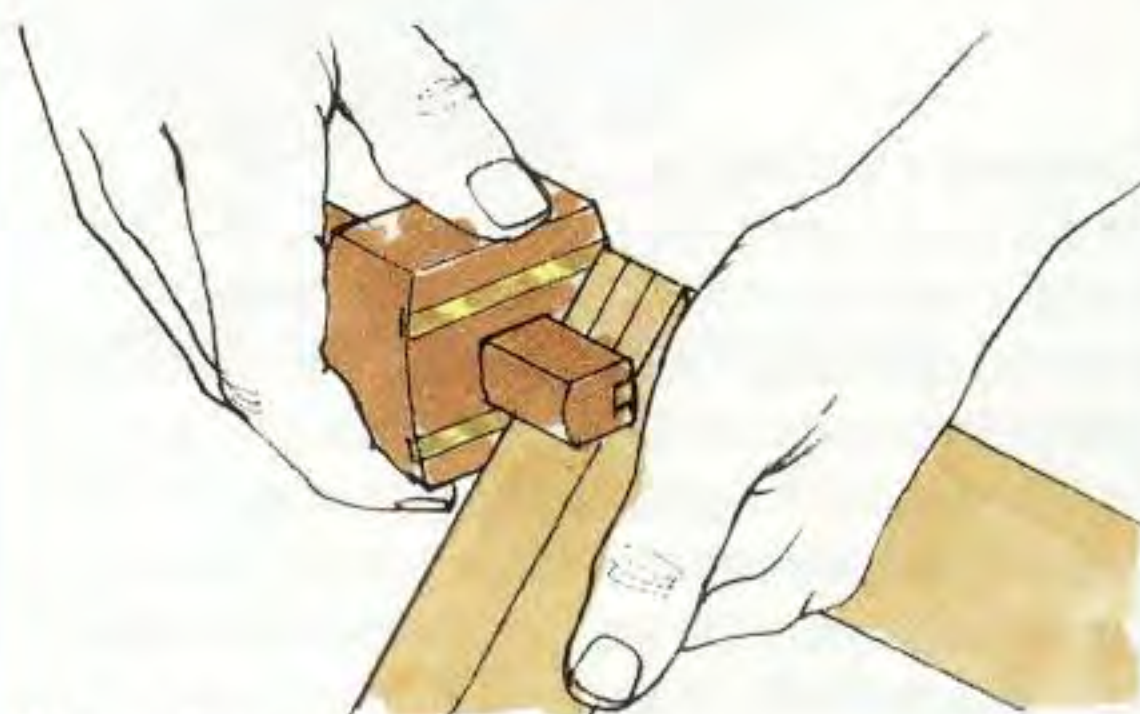
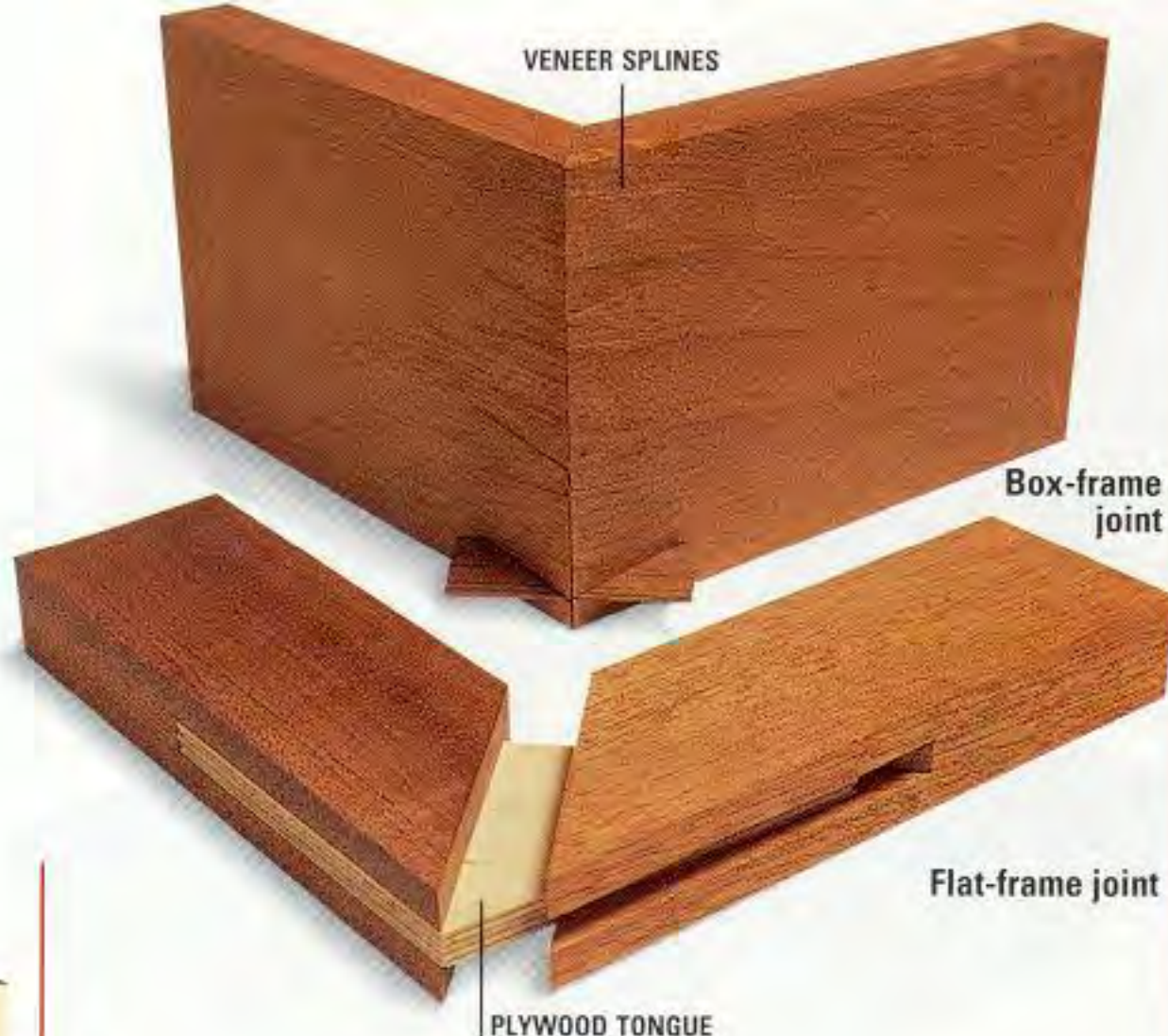
Disguising a nailed joint

Sink the nail heads below the wood surface, then use matching wood filler to disguise the holes.



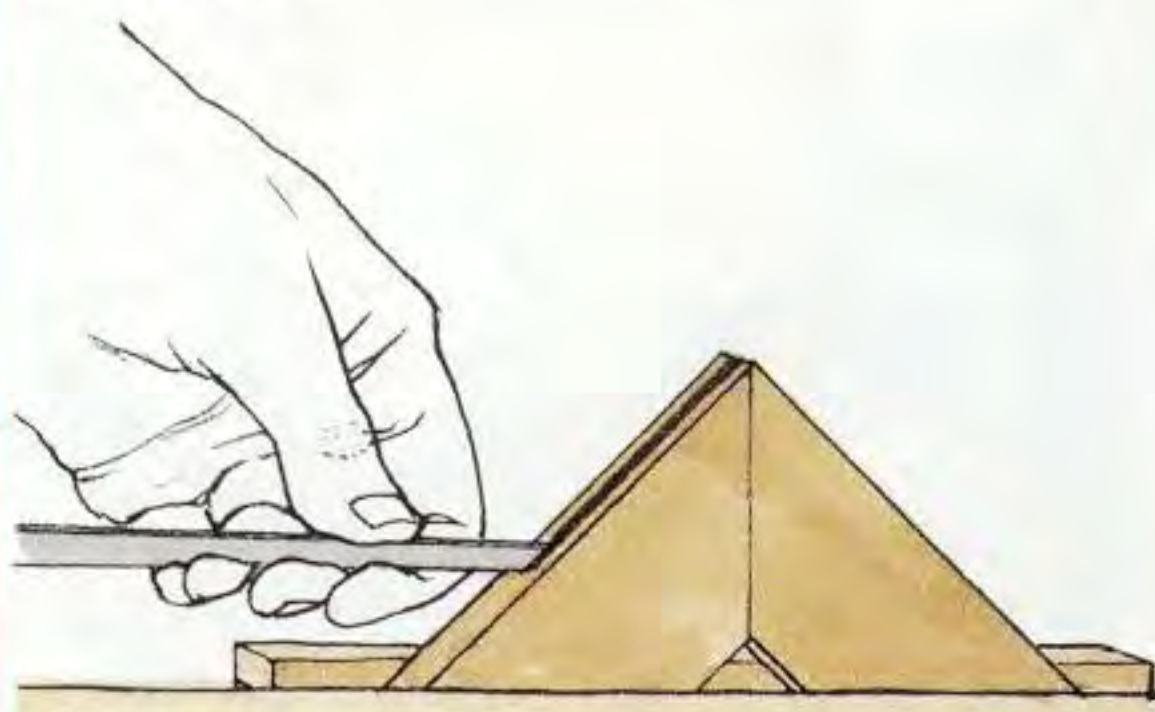
Reinforcing with veneer

Make perpendicular or angled saw cuts across the corner of a wide mitre joint; angled splines provide greater strength. Glue veneer or thin plywood splines into the saw cuts and, when set, trim them flush.



1 Inserting a tongue

Insert a tongue in a larger mitred frame. To mark a slot for the tongue, set a mortise gauge to one-third the thickness of the wood, then scribe parallel lines, centred on the edges of each workpiece. Mark each end of the slot between the gauged lines, using a knife and try square.



2 Fitting the tongue

Set the joint vertically in a vice and saw down the waste side of the lines. Using a chisel and working from each side towards the middle, chop out the waste wood. Glue a snugly fitting tongue in the slot, and trim flush when set.

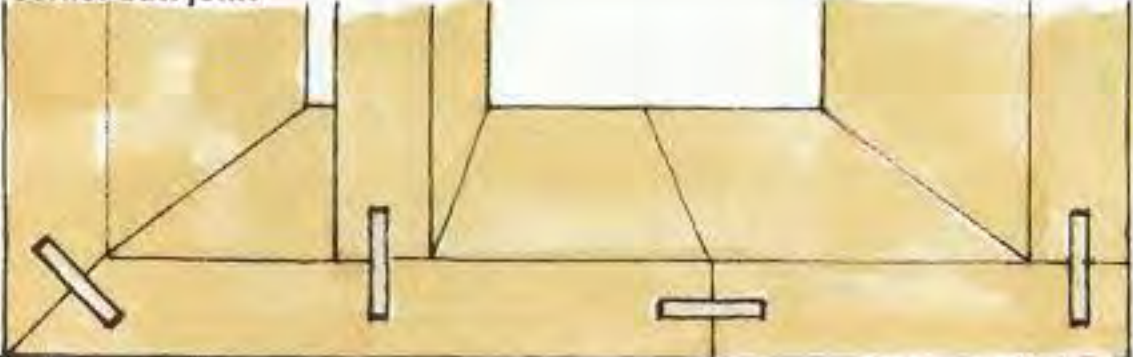
BISCUIT JOINT

MACHINE CUT

A biscuit joint is a reinforced butt or mitre joint. In principle, it is similar to a dowel joint, but instead of a round peg or dowel fitting in a hole, in biscuit jointing a flat oval plate (the biscuit) made of compressed beech is fitted into a matching slot. With the addition of water-based PVA glue, the biscuit expands to fill the slot, forming a very strong joint. The biscuit jointer itself is a small-scale plunge saw with a circular-saw blade, specifically developed for trimming panels or cutting grooves for drawer panels.



Corner butt joint



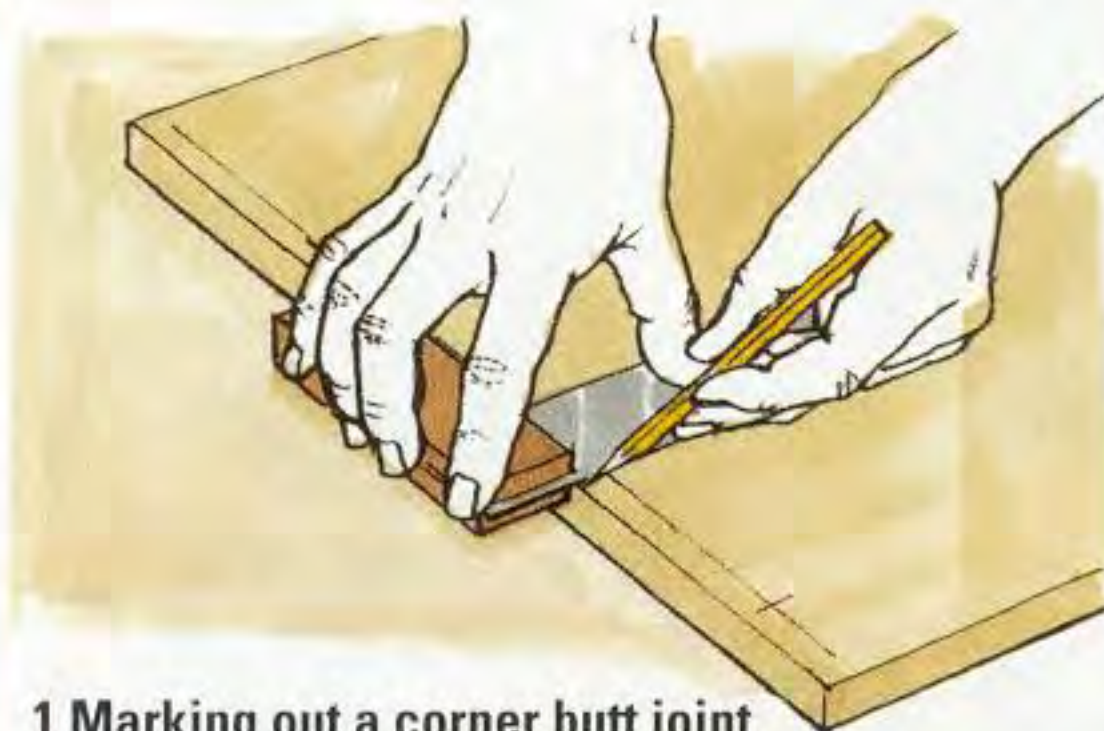
MITRE JOINT T-BUTT JOINT EDGE-TO-EDGE JOINT CORNER BUTT JOINT

Types of biscuit joints

You can make corner- and T-butt joints, mitred and edge-to-edge joints, in both solid wood and man-made boards. Biscuit joints are mostly used for framing or in cabinetmaking.

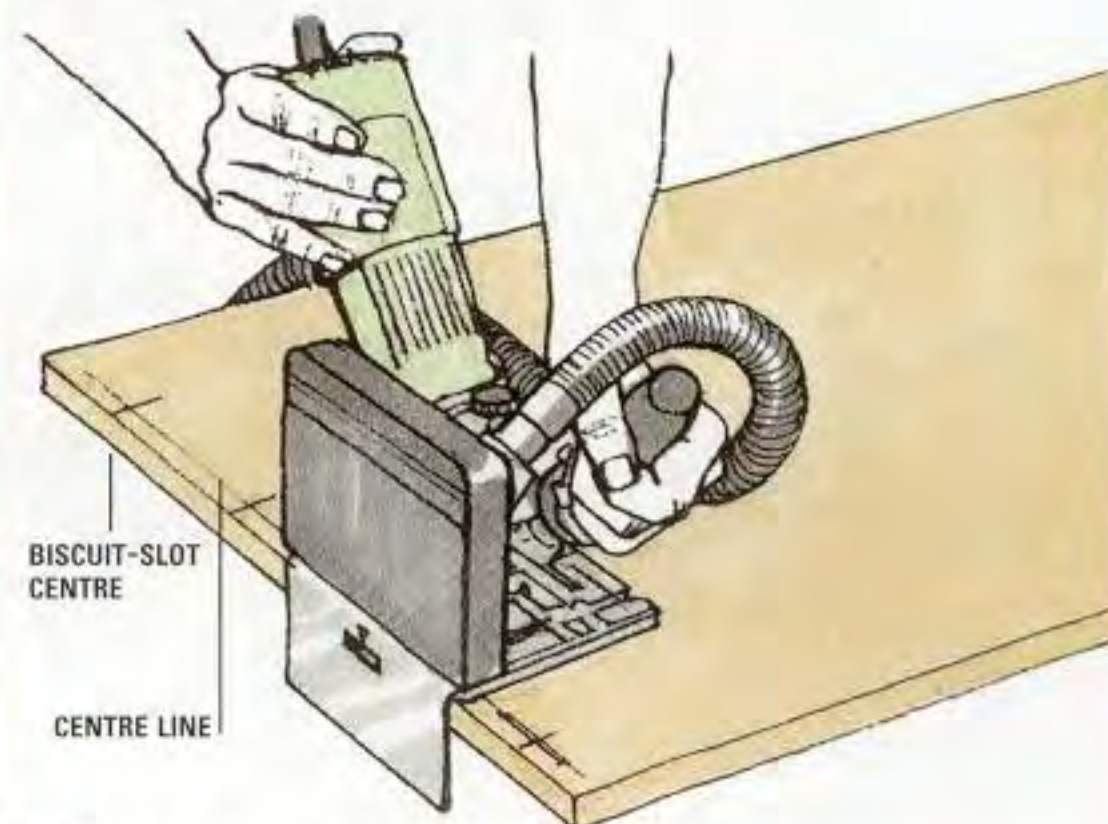


Mitred corner joint



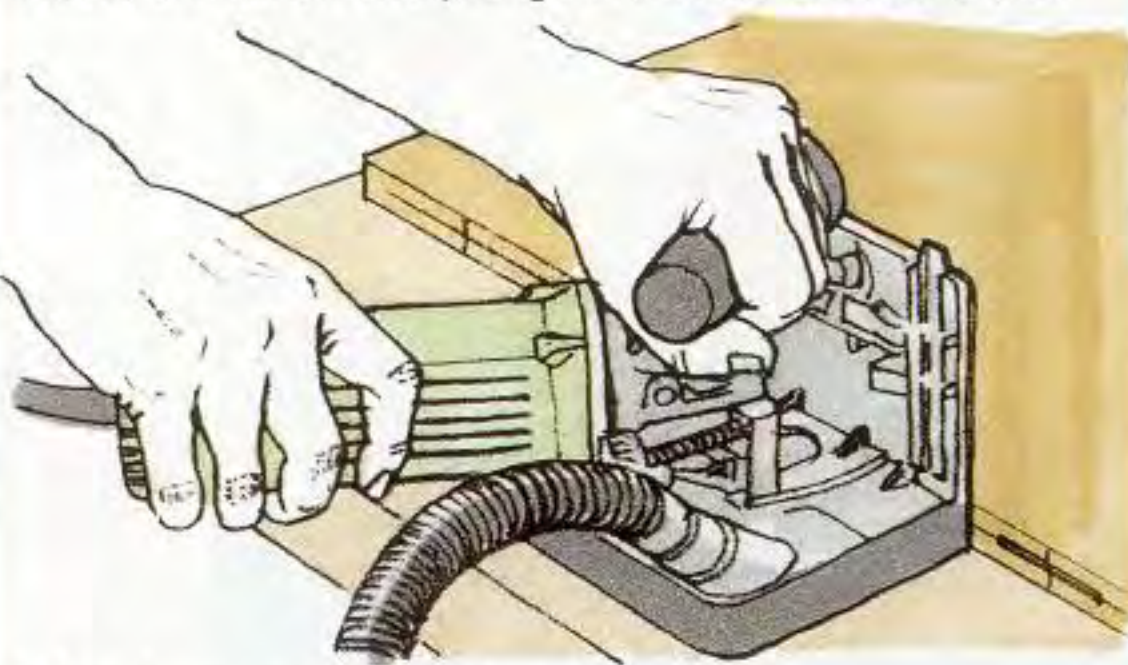
1 Marking out a corner butt joint

Draw the centre line of the joint on the work, then mark along it the central point of each biscuit slot, spaced about 100mm (4in) apart. Set the cutting depth of the blade to match half the width of the biscuits being used, and adjust the tool's fence to align the blade with the marked centre line.



2 Cutting corner-joint slots

Before making the cut, align the cutting guide (marked on the side of the fence) with the central point of each slot. Keeping the fence pressed against the edge of the wood, switch on and plunge the blade to cut the slot.



3 Cutting matching slots

To cut the other half of the joint, mark the matching biscuit-slot centres on the end of the second workpiece, and clamp it on a flat surface. Turn the guide fence over and lay the jointer on its side, then adjust the fence to centre the blade on the edge of the workpiece.



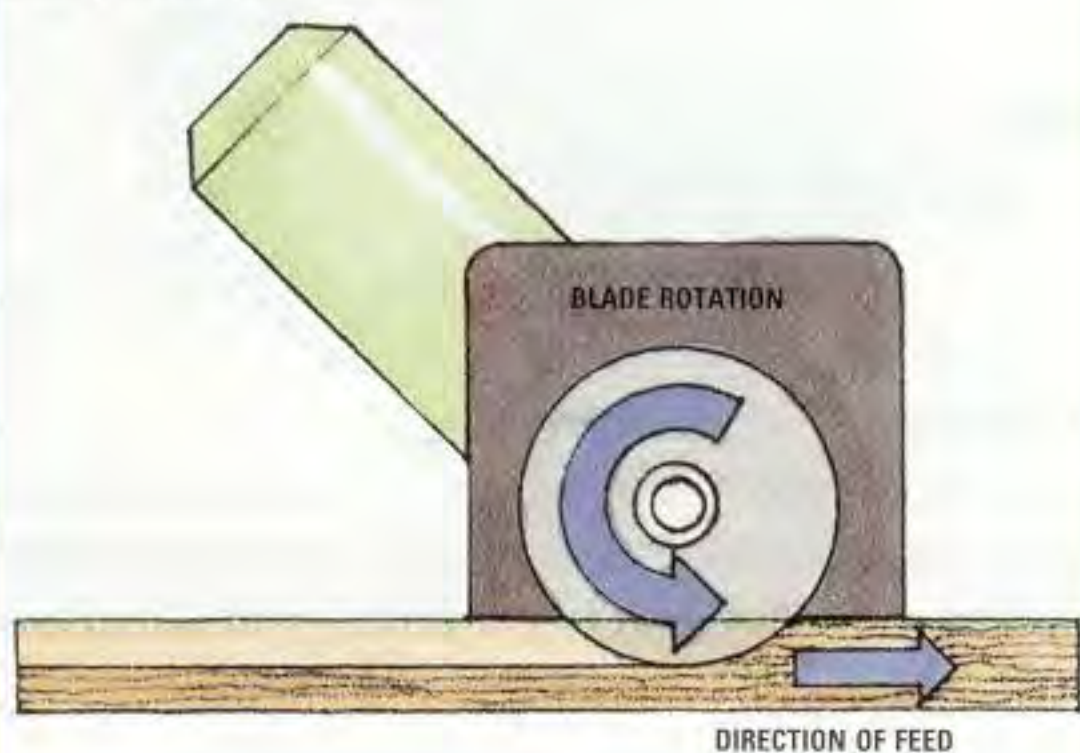
Making a T-joint

Mark the centre line of the joint across one board. Use the end of the second board, clamped on its side, as a fence to align the jointer's blade with the marked line. Plunge each slot in turn. Without moving the second board, cut matching slots in its end (see page 23).

BISCUIT-JOINTER SAFETY

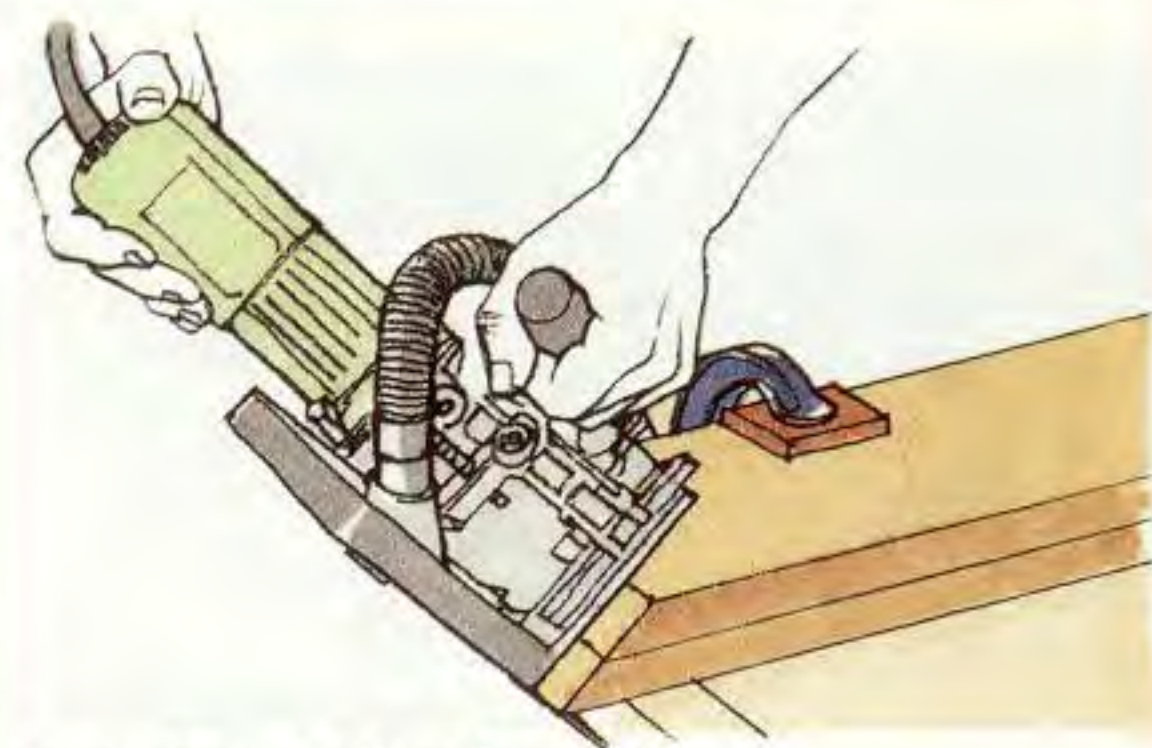
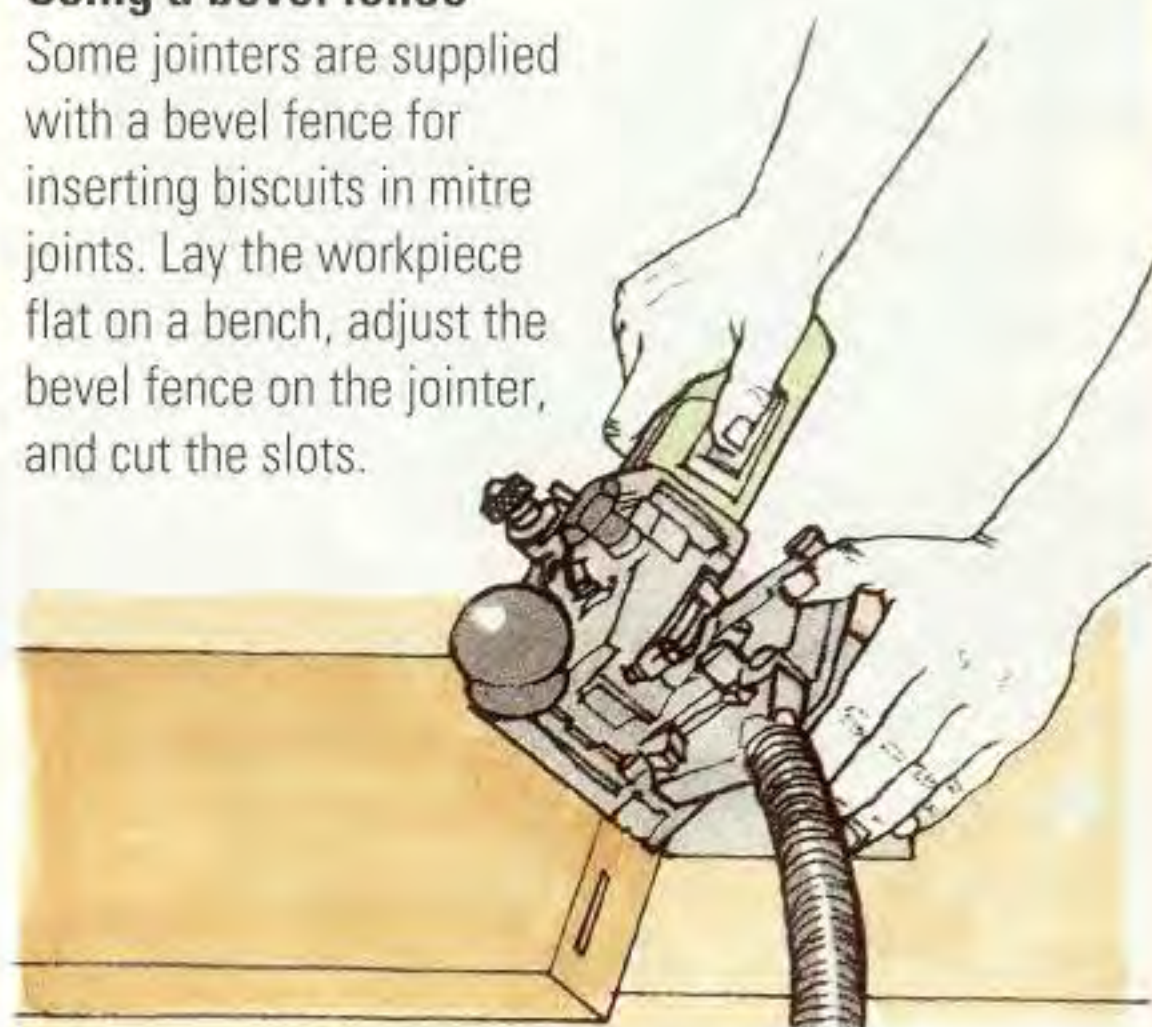
As well as observing the standard working methods for power tools (see page 16), note the following points with specific reference to biscuit jointers.

- Remove and throw away cracked or bent blades, and replace with sharp ones.
- The motor must be running before you plunge the blade into wood.
- Do not attempt to slow down or stop a spinning blade by applying pressure from the side.
- The blade guard must always be in place when the jointer is running.
- When cutting a groove, always feed the jointer away from you.



Using a bevel fence

Some jointers are supplied with a bevel fence for inserting biscuits in mitre joints. Lay the workpiece flat on a bench, adjust the bevel fence on the jointer, and cut the slots.



Improvising with a standard fence

Clamp the work overhanging the bench, and run the right-angle fence along the outer edge of the bevel. To help support the jointer, increase the width of the bevel by clamping one component on top of the other.



Cutting a groove

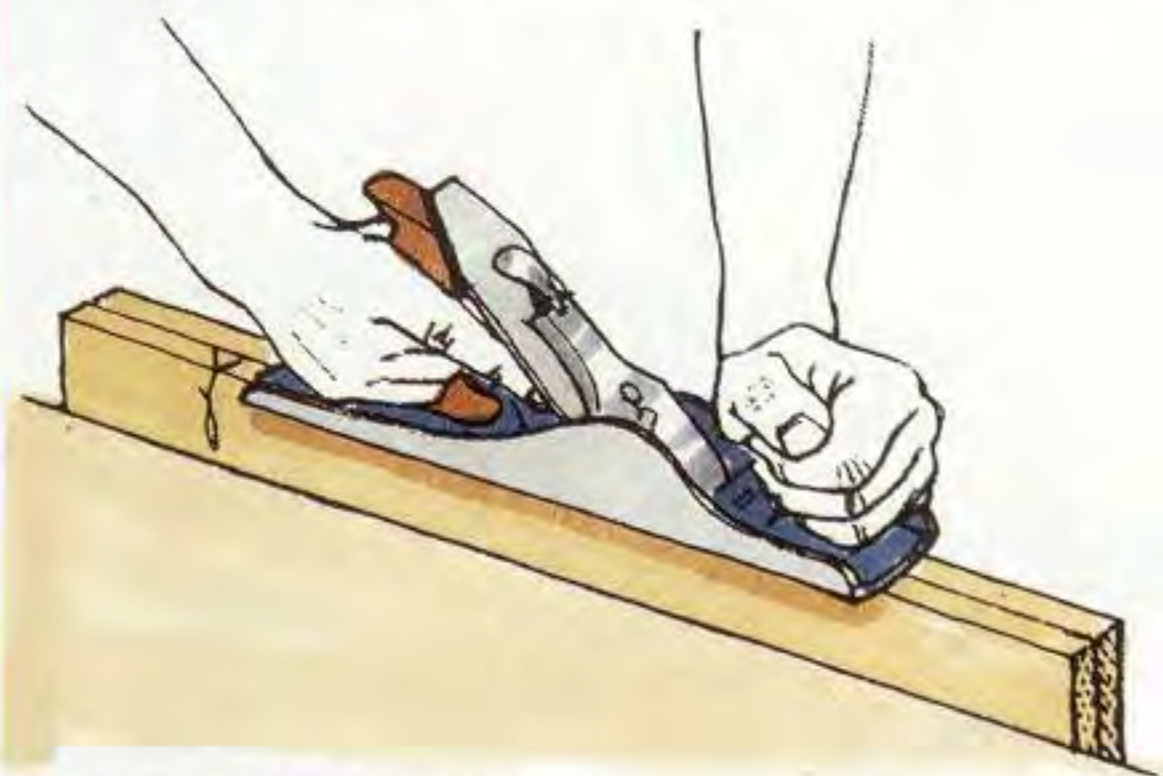
Set up the workpiece and adjust the jointer as described for making a corner-butt joint (see page 23). Rest the front end of the jointer on the panel, switch on and plunge the saw. Feed the tool across the work, then raise the blade before switching off.

CHAPTER 3 Edge joints are used to join narrow boards together to make up a large panel, such as a table top or part of a cabinet. Using modern glues, even a plain butt joint is adequate, but including a tongue and groove in the joint makes it easier to assemble accurately and adds considerably to its strength.

EDGE-TO-EDGE BUTT JOINT

HAND CUT

Timber selection is as important as good edge-to-edge joints when making a wide panel from solid wood. To ensure that the panel will remain flat, try to use quarter-sawn wood – that is, with the end-grain growth rings running perpendicular to the face side of each board. If that is not possible, arrange them so that the direction of ring growth alternates from one board to the next. Also try to ensure that the surface grain on all boards runs in the same direction, to facilitate final cleaning up of the panel with a plane. Before you get to work, number each board and mark the face side.



Planing edges square

With the face sides on the outside, set both boards back-to-back and level in a vice. Plane the edges straight and square, using the longest bench plane you can find, preferably a try plane.



Checking for straight edges

It is vital that the edges are straight if you intend to use a rubbed joint; check them using a metal straightedge. If the boards are to be clamped together, a very slight hollow is acceptable.

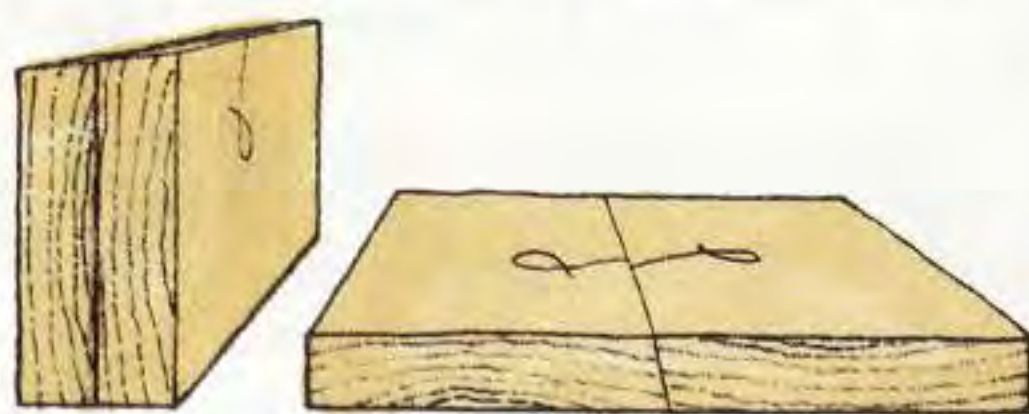


Butt joint

Tongue-and-groove joint

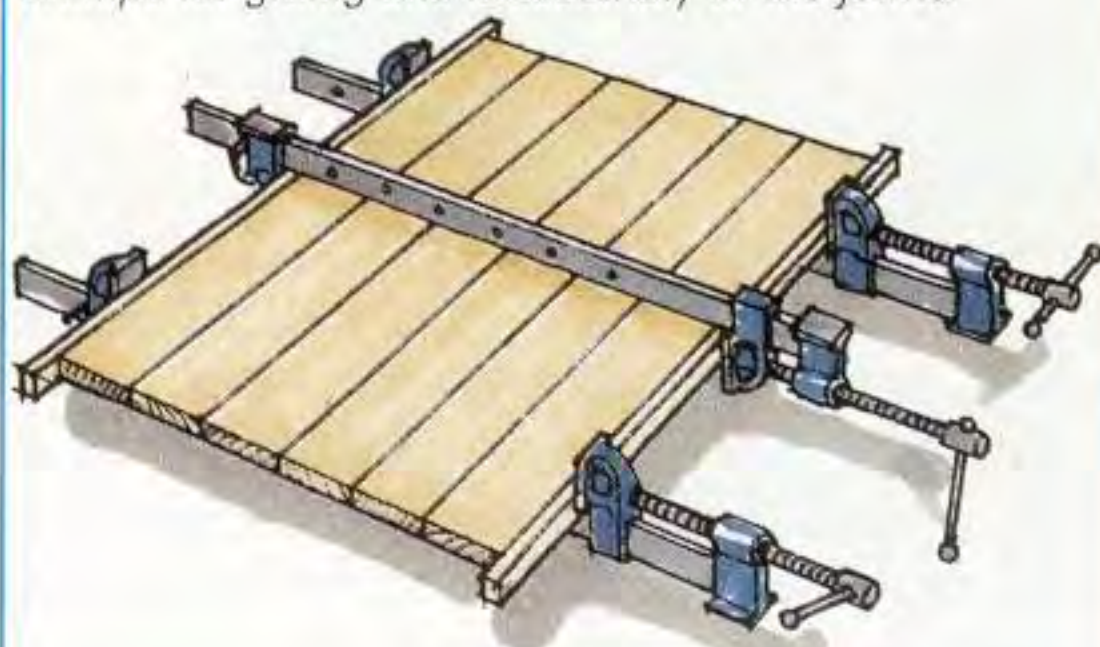
Matching edges

It is good practice to keep the edges as square as possible. However, provided boards have been planed as a pair, they will fit together and produce a flat surface, even when the edges are not exactly square.



CLAMPING JOINTS

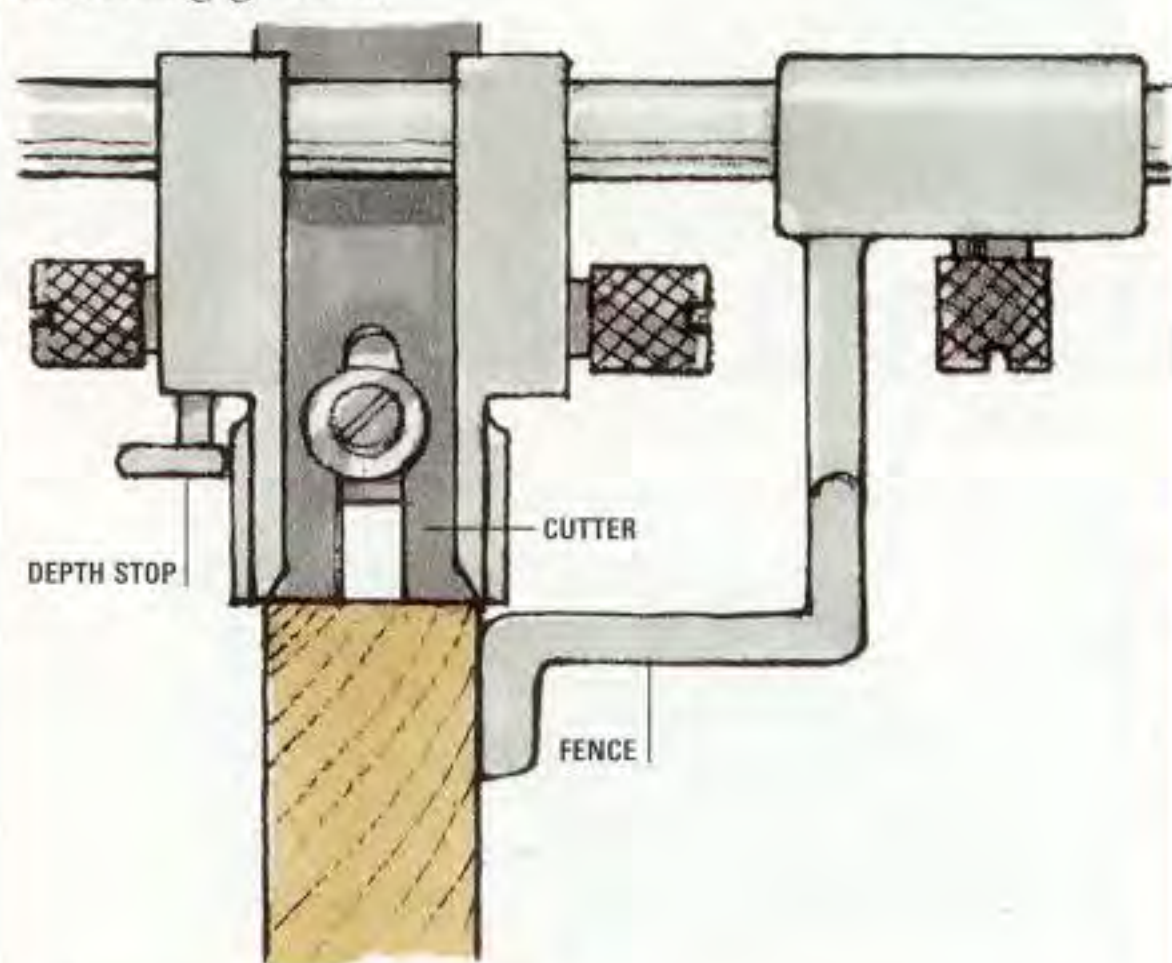
Before adding glue, set prepared boards in sash cramps to check that the joints fit snugly. Use at least three cramps, alternated as shown, to counter any tendency for the panel to bow under pressure. Use scraps of softwood to protect the edges from bruising. When you have everything to hand, remove the cramps for gluing and reassembly of the joints.



TONGUE-AND-GROOVE JOINT

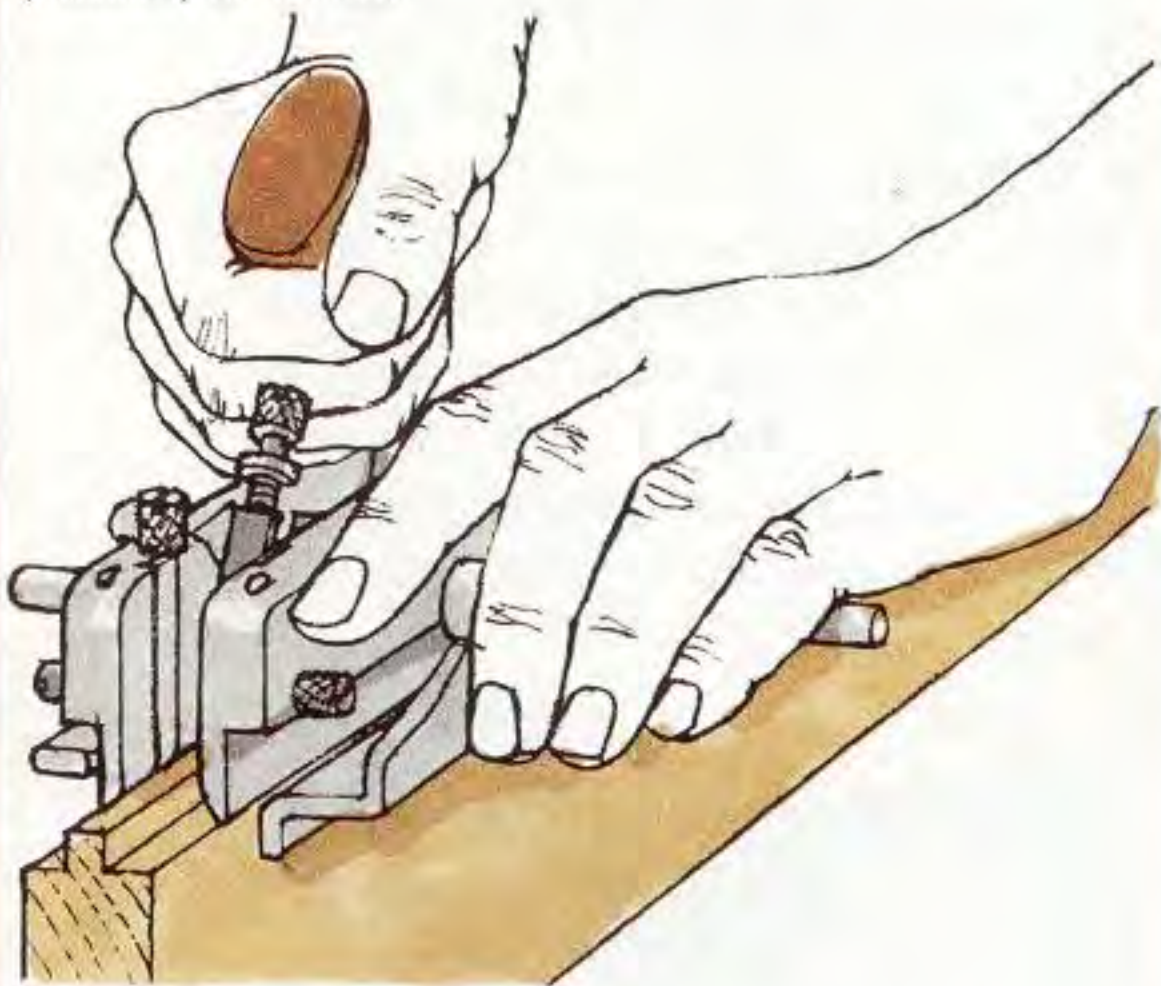
HAND CUT

Use a combination plane to cut a tongue-and-groove joint by hand. This kind of plane is similar to a standard plough plane, but comes with a wider range of cutters, including one designed to shape a tongue on the edge of a workpiece. Cut the tongue first, then change the cutter and plane a matching groove.



1 Adjusting the cutter

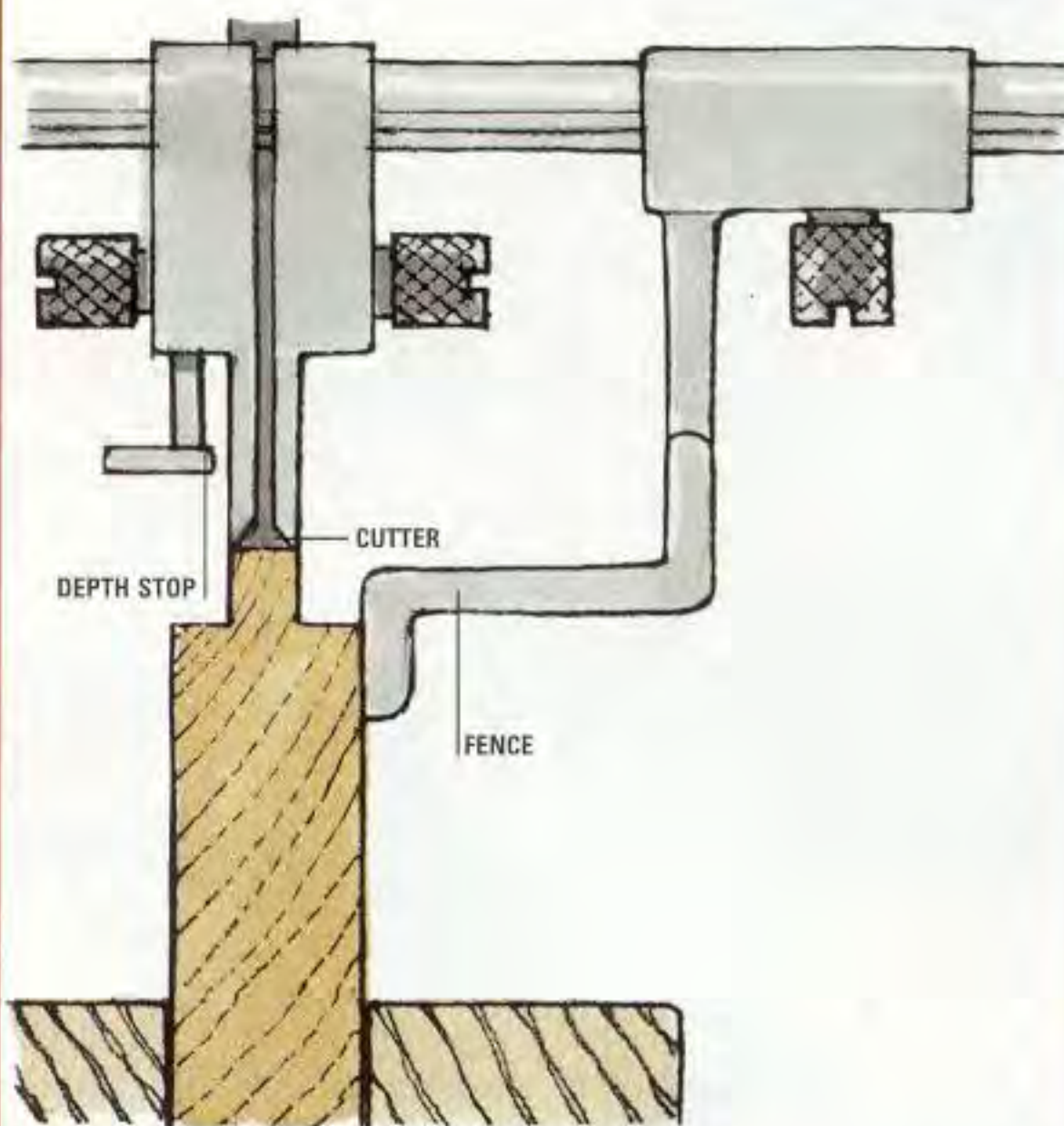
Clamp the work in a bench vice, face-side towards you. Adjust the fence until the cutter is centred on the edge of the work. Provided the matching groove is also cut from the face side, it is not essential that the tongue is precisely on-centre.



2 Cutting the tongue

Adjust the plane's depth stop to cut a tongue of the required size, then begin planing at the far end of the workpiece, gradually working backwards as the tongue is formed.

EDGE-TO-EDGE JOINTS

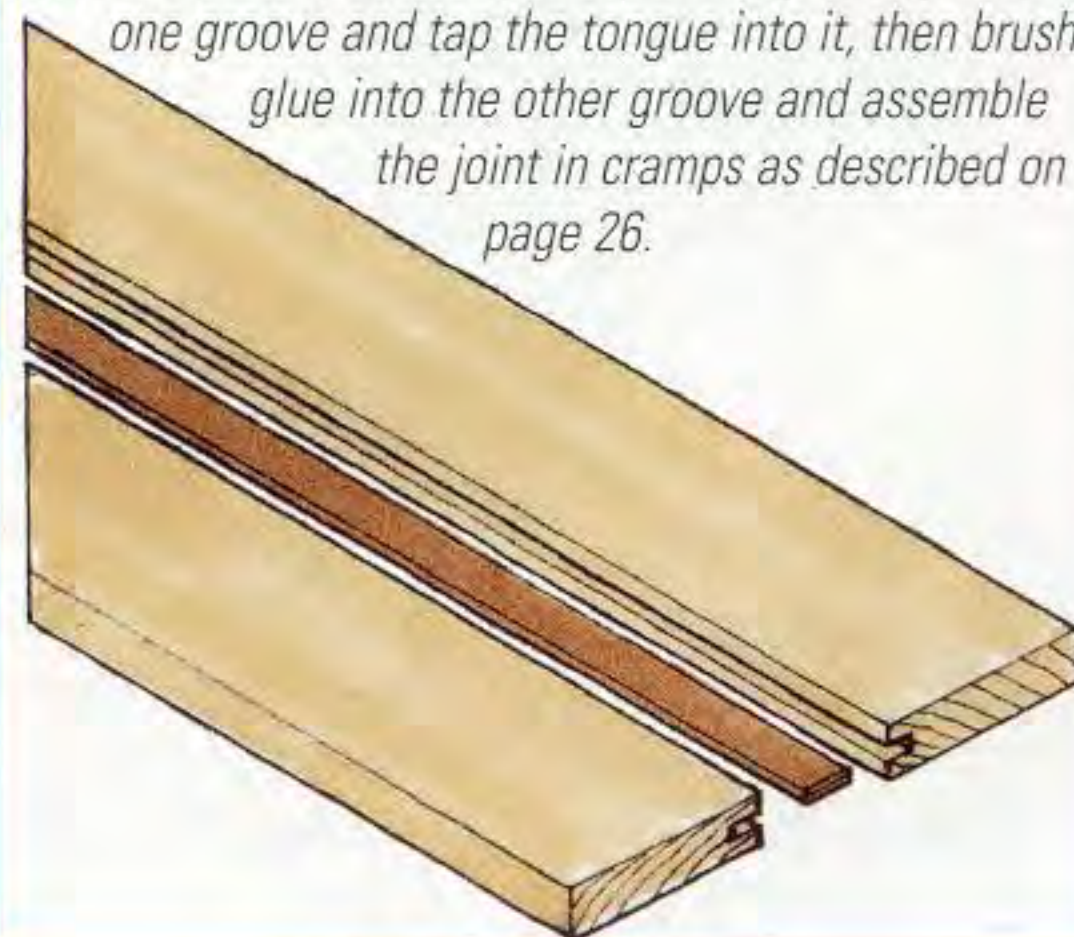


3 Cutting the groove

Select a ploughing cutter that matches the width of the tongue, and fit it into the plane. Adjust the fence while sitting the cutter on top of the tongue; set the depth stop, making sure it will cut a groove slightly deeper than the tongue. Clamp the uncut board in the vice and cut the groove.

INCLUDING A TONGUE

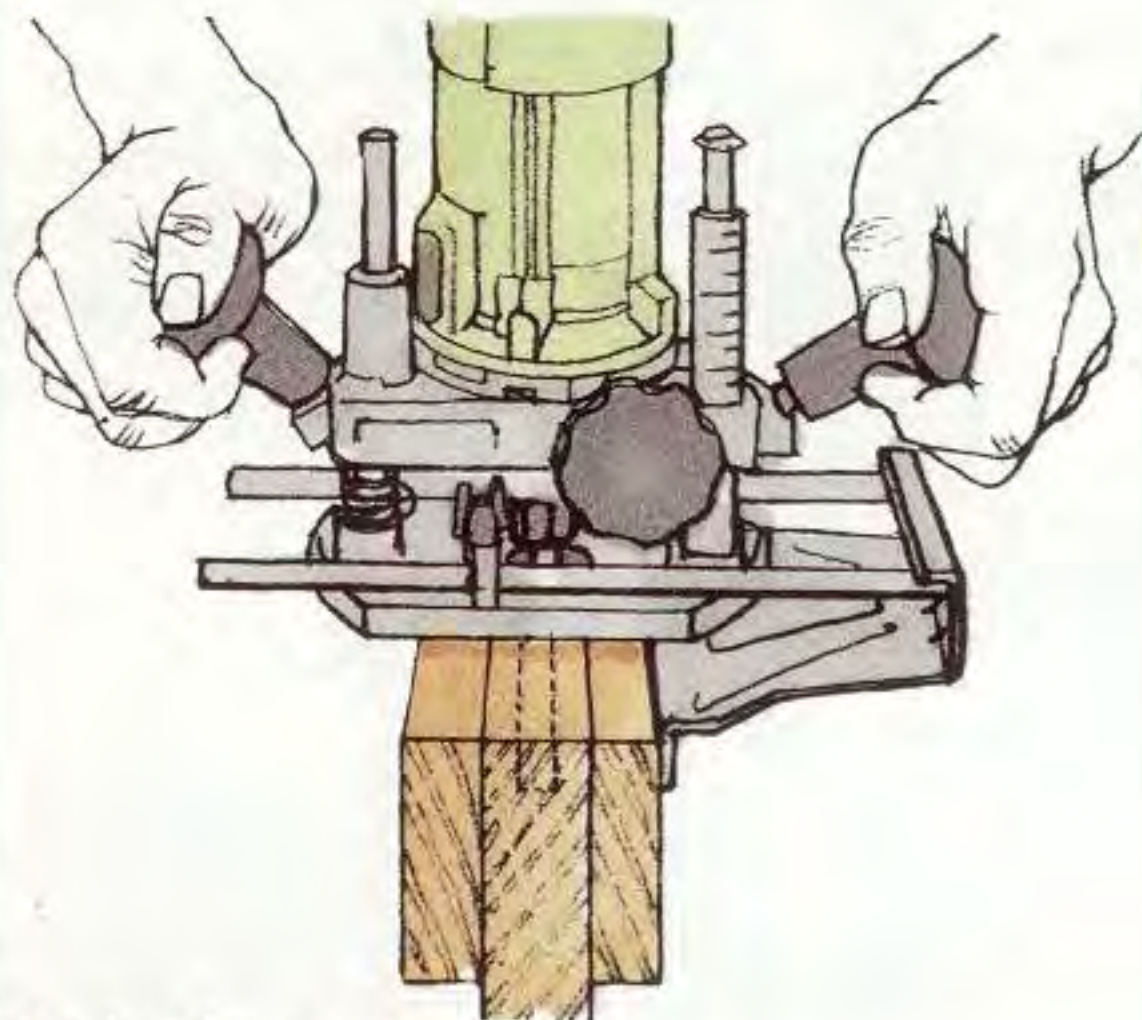
A loose tongue has three advantages over using an integral one; it avoids decreasing the width of the boards; it gives the joint marginally greater strength; and a simple plough plane can be used to cut the grooves. Plane a groove down the centre of each board and insert a separate tongue made from plywood or solid timber (ideally cross-grained). Glue one groove and tap the tongue into it, then brush glue into the other groove and assemble the joint in cramps as described on page 26.



TONGUE-AND-GROOVE JOINT

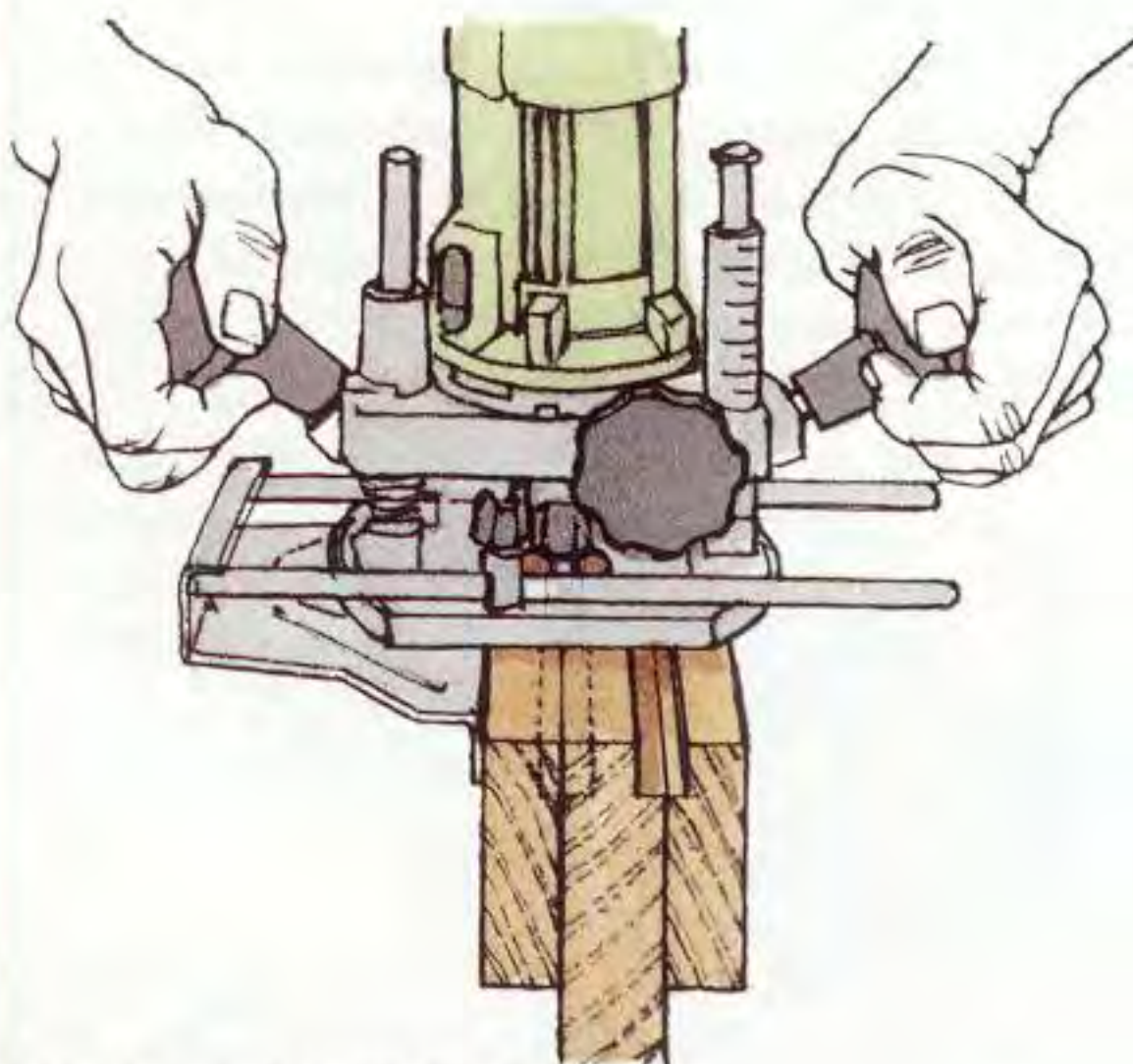
MACHINE CUT

A power router is not only the perfect tool for grooving a joint to take a separate tongue, it can also be adapted to machine an integral tongue on one half of a joint. For jointing larger sections of timber, consider setting up a table saw to cut tongues and grooves.



Routing the groove

A wooden strip clamped along each side of the workpiece provides a wide, flush surface to support the base of the router.



Routing an integral tongue

Clamp the matching component between two similar strips of wood, then adjust the router's fence to guide the cutter along one side of the tongue. Remove the waste from the other side.



1 Cutting a tongue with a table saw

With the wide face of the wood against the fence, saw along one side of the tongue. Turn the wood end-for-end, and saw the other side.



2 Removing waste

Adjust the fence, lay the work on its side, and cut away the waste on one side of the tongue. Turn the work over and repeat the procedure.

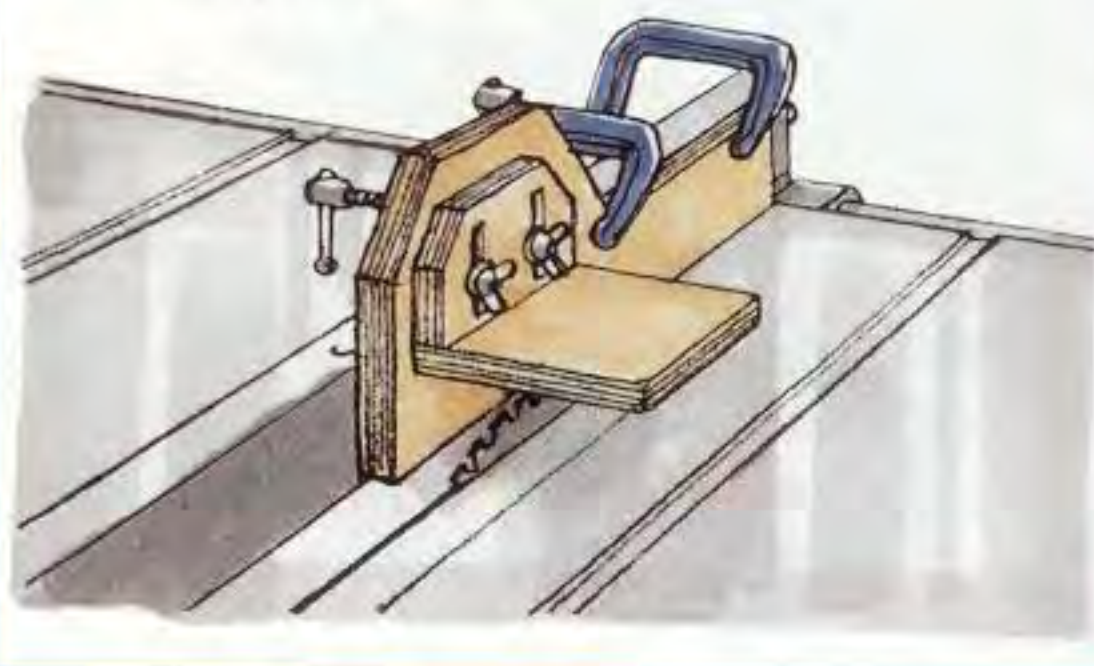


3 Sawing a matching groove

Adjust the fence to saw just on the inside of the groove. Turn the work end-for-end and saw down the other side of the groove before removing the waste, one saw cut at a time.

TABLE-SAW SAFETY

With some table saws, you have to remove the riving knife and blade guard before you can cut a groove or rabbet; this makes operating the machine more hazardous, so work with great caution and attention. If your table saw cannot be fitted with a vertical and horizontal 'hold-down' guard, which surrounds the area of the work near the blade, make an auxiliary fence from wood, with a guard that covers the blade, to line the rip fence.



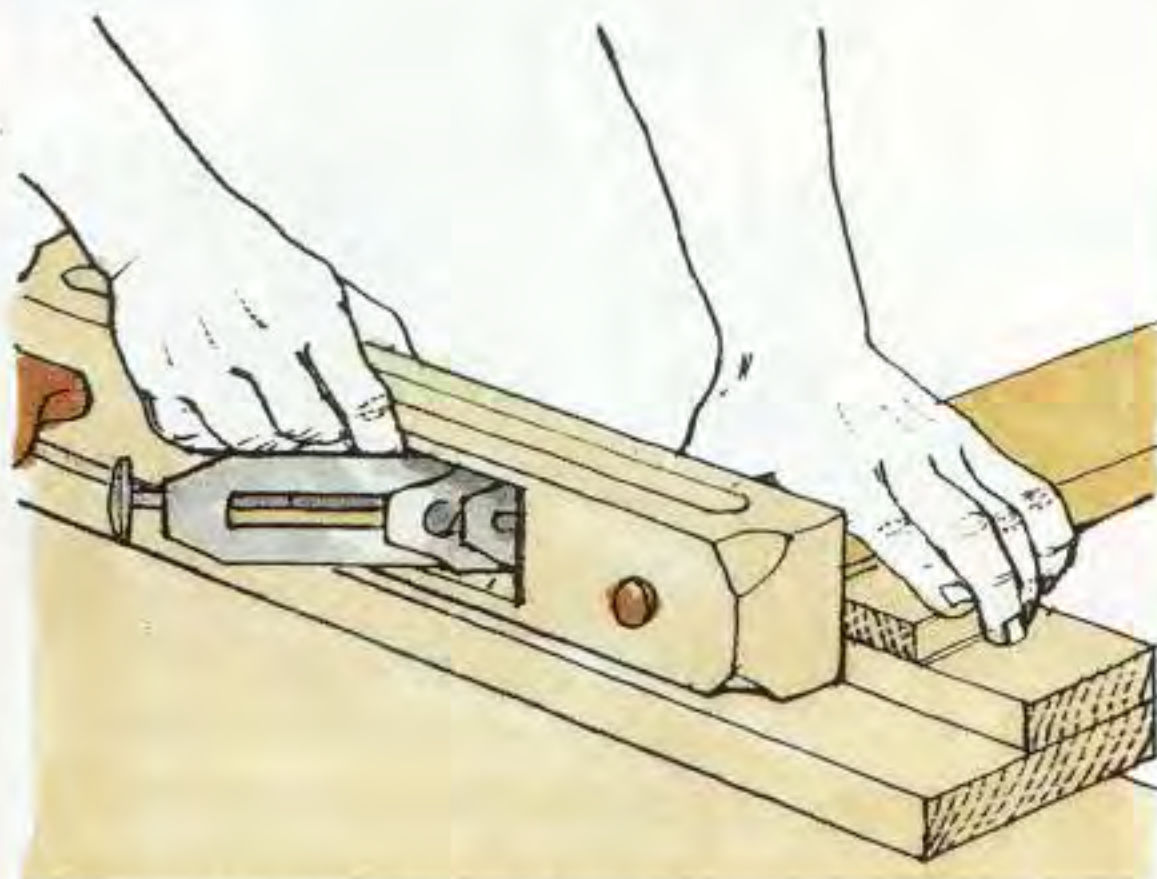
CHAPTER 4 Dowelling is just one of the methods used to reinforce butt joints. However, since a well-made dowel joint rivals the mortise and tenon in strength and versatility, it is legitimately considered to be a separate category of joint, and one which is relatively easy to make.

DOWEL JOINTS

FRAME JOINTS

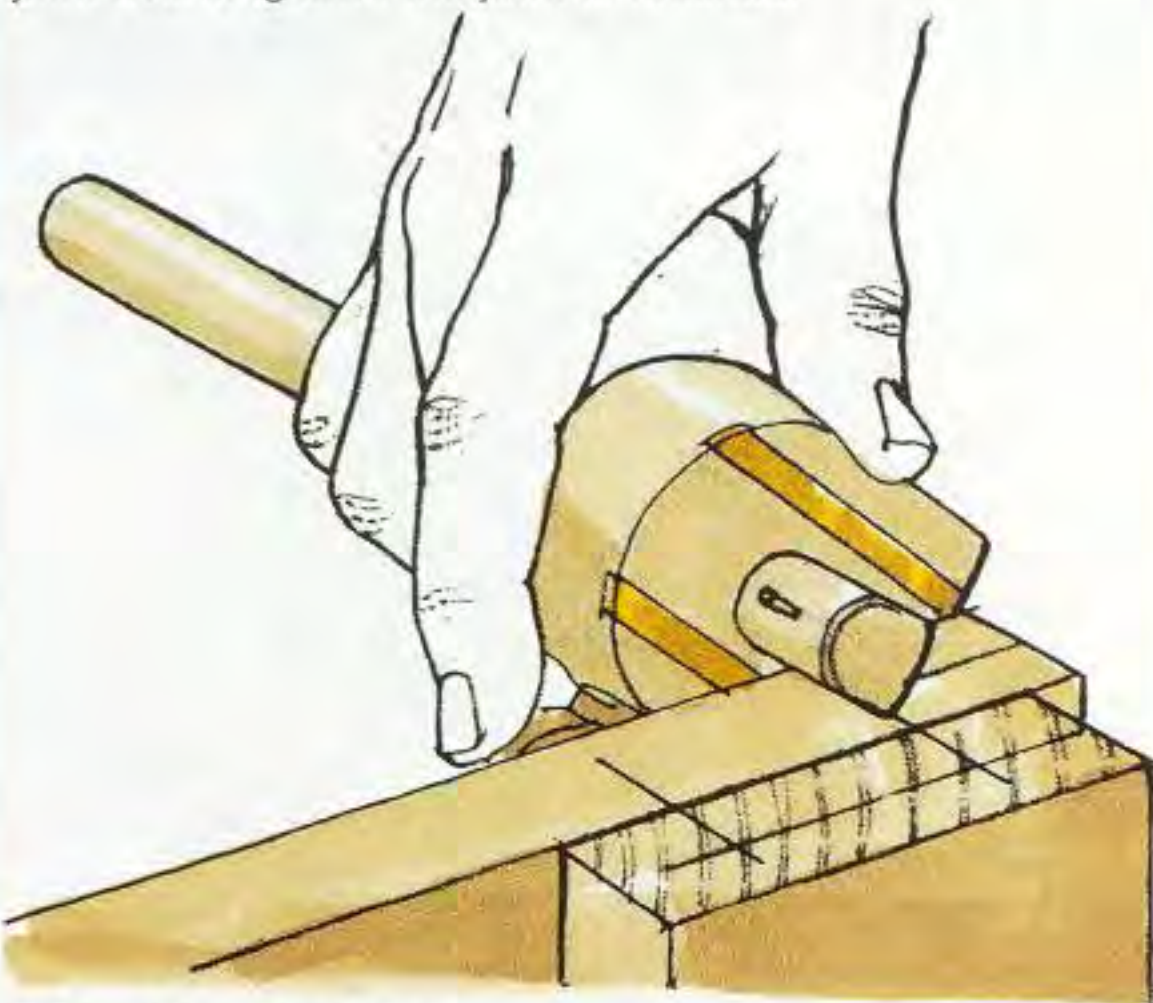
HAND CUT

Frames made with dowelled butt joints are surprisingly strong. Nowadays, most factory-made furniture incorporates dowel joints, even for chair rails which must be capable of resisting prolonged and considerable strain. In most cases, two dowels per joint are sufficient. Place them a minimum of 6mm ($\frac{1}{4}$ in) from both edges of the rail.



1 Cutting components to length

Saw each component to length and trim the ends of the rail square as described for making a square-ended butt joint (see page 18). Leave the stile or leg of a corner joint overlong until the joint is finished.



2 Marking the joint

Clamp the two components in a vice with their joining surfaces flush. Using a try square, draw the centre of each dowel hole across both components, then scribe a line centrally on each one with a marking gauge. Bore the dowel holes where the lines cross.

RAIL

LEG OR STILE

3 Boring dowel holes

Place the point of a dowel bit on the marked centre and bore each hole in turn. Unless you are using a dowelling jig (see opposite) or a bench stand (see page 34), it pays to have someone standing to one side who can tell you when the drill bit is vertical.

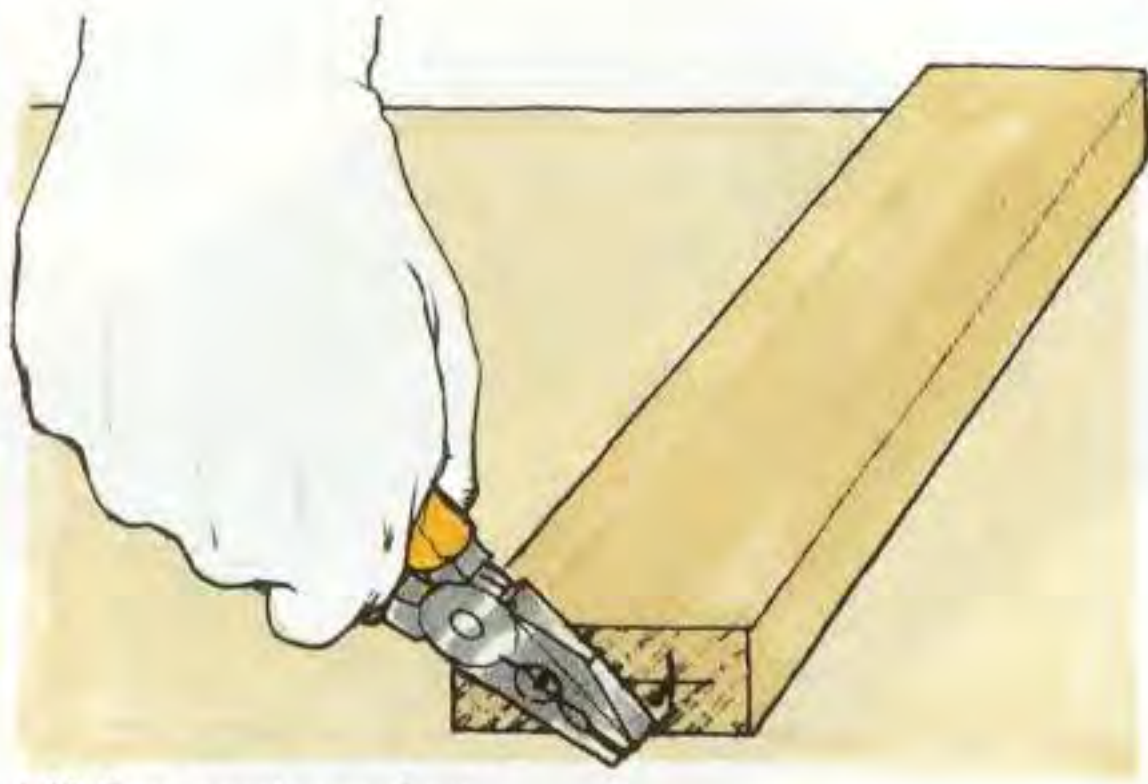


DOWELS

Ready-made dowels are manufactured from tough short-grain woods, such as ramin, birch, beech or maple. They are chamfered at each end to make them easier to insert in the holes, and are fluted lengthways to allow excess glue to escape. Choose dowels that are about half the thickness of the workpieces; the length of each dowel should be approximately five times its diameter.

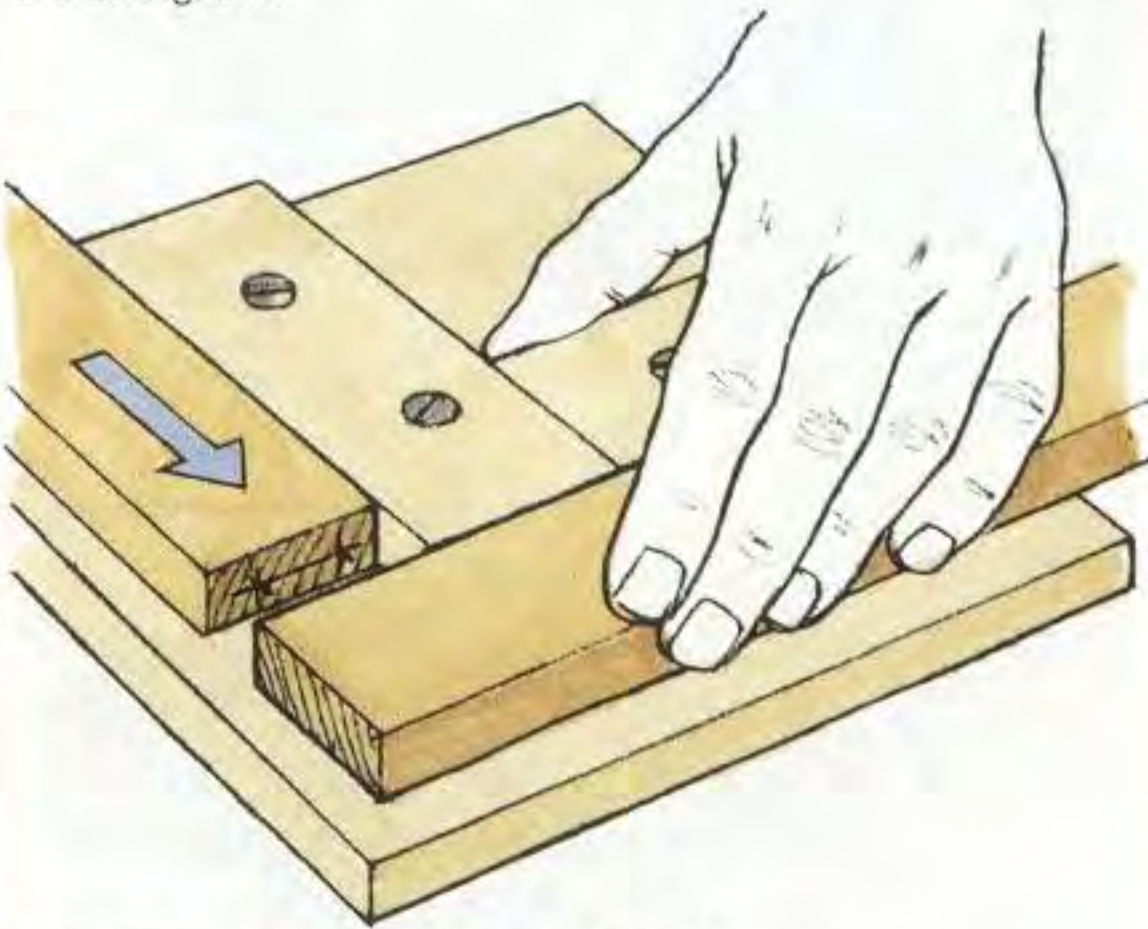
If you need a few dowels only, cut them from a length of dowel rod. Steady the rod on a bench hook and cut off short sections with a fine-tooth saw. Chamfer each dowel with a file, and saw a single glue slot.





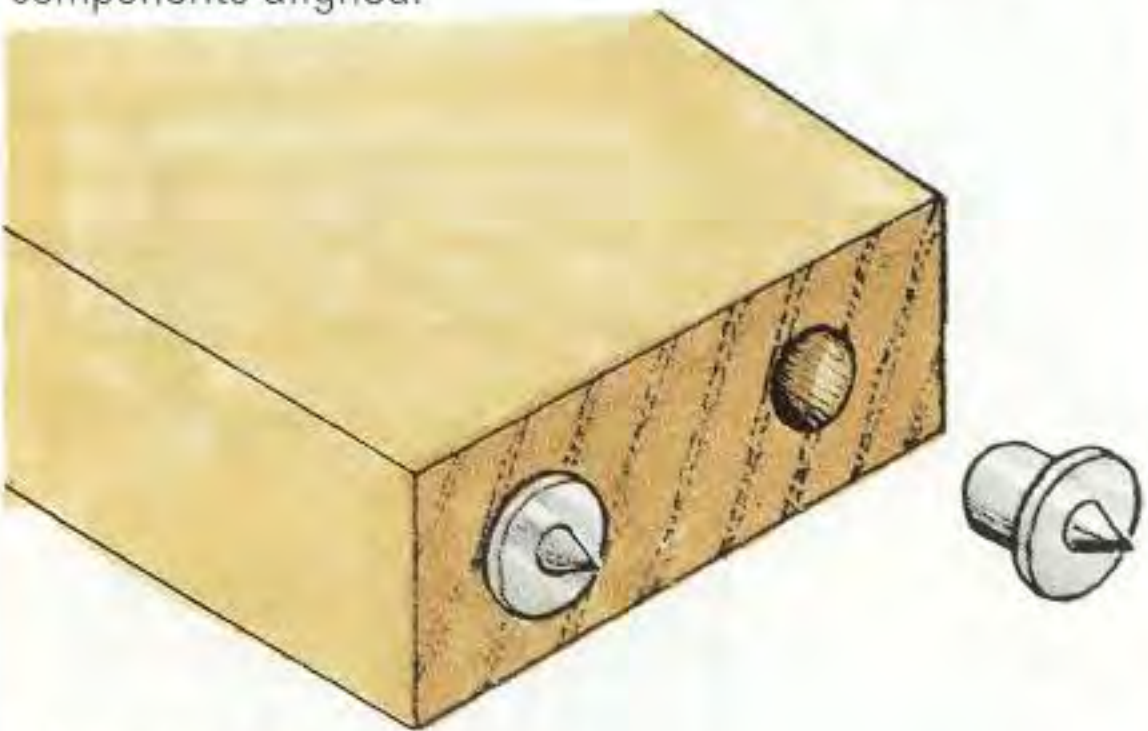
1 Using centre points

For greater accuracy in marking out dowel joints, draw the centre points on the end of the rail only, then drive in panel pins where the lines cross. Cut off the pin heads with pliers, leaving short 'spikes' projecting from the end grain.



2 Marking the other component

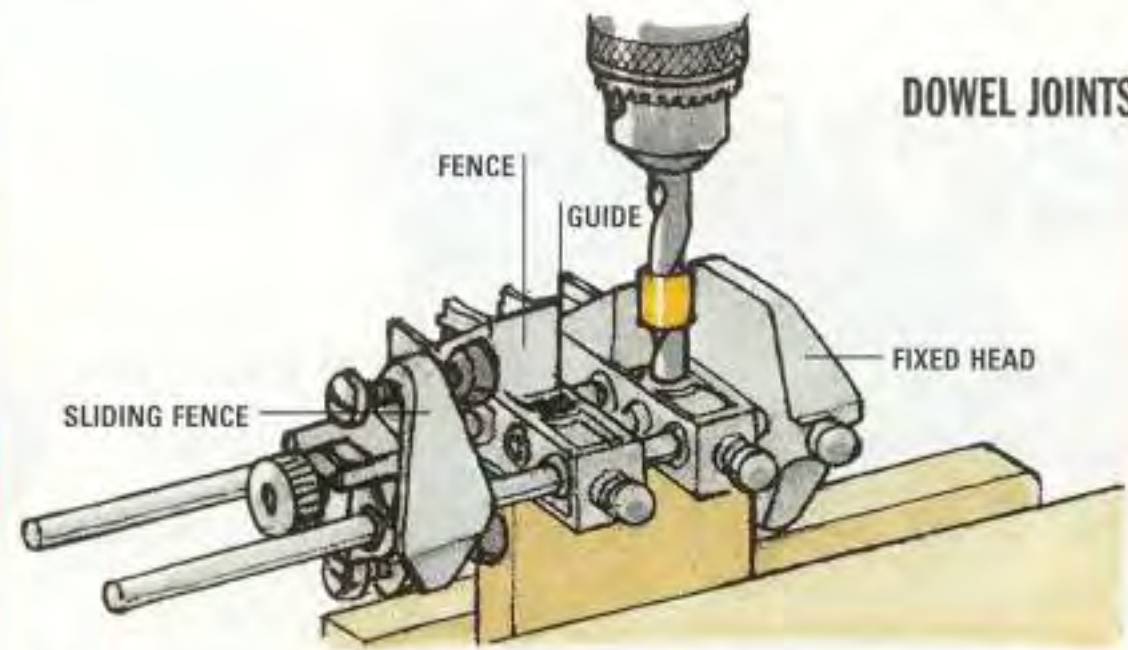
Lay the leg or stile on its side and press the end of the rail against it, leaving two pinholes that mark the hole centres exactly. A simple right-angle jig keeps the components aligned.



Ready-made centre points

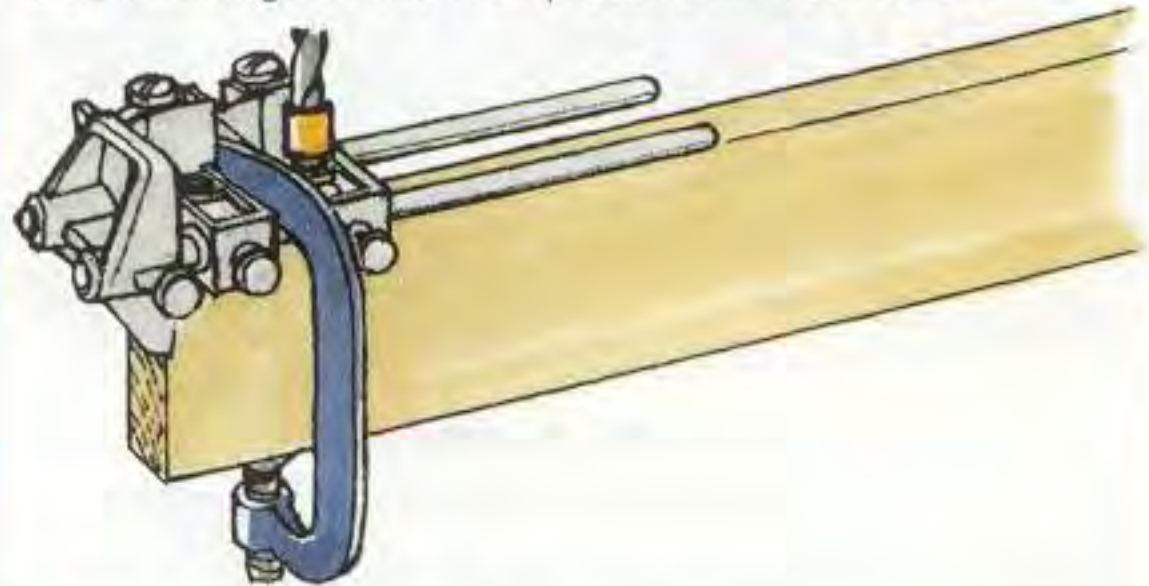
As an alternative to using panel pins, bore dowel holes into the end of the rail, then slip into them store-bought dowel points that will mark the side grain of the matching component.

DOWEL JOINTS



1 Dowelling rails with a jig

Clamp the jig on the end of the rail, ensuring that the fixed head and side fences are located against the face side and edge of the workpiece. Drill both holes.



2 Dowelling the stiles

Once you have drilled all the rails, remove the sliding fence and, without altering the other settings, turn the jig over and clamp it to the stile with a G-cramp. Bore dowel holes in the side grain.

DOWELLING JIGS

It's worth acquiring a dowelling jig for a project that requires a number of identical dowel joints. The jig not only guides the bit to bore perfectly vertical holes, it also dispenses with the need to mark out each and every joint separately. With one of the better jigs, you can mark out wide boards for cabinet work as well as rails and stiles. The type of jig shown here has a fixed head or fence from which measurements are taken, and a sliding fence that clamps the jig to the work-piece. Adjustable drill-bit guides and side fences position the dowel holes.



EDGE-TO-EDGE DOWEL JOINT

HAND CUT

When constructing a wide solid-wood panel, you can make a particularly strong joint between boards by inserting a dowel every 225 to 300mm (9 to 12in).



1 Marking an edge-to-edge joint

Clamp adjacent boards back-to-back in a vice and mark the dowel centres, using a try square and pencil. Scribe a line down the centre of each board with a marking gauge.

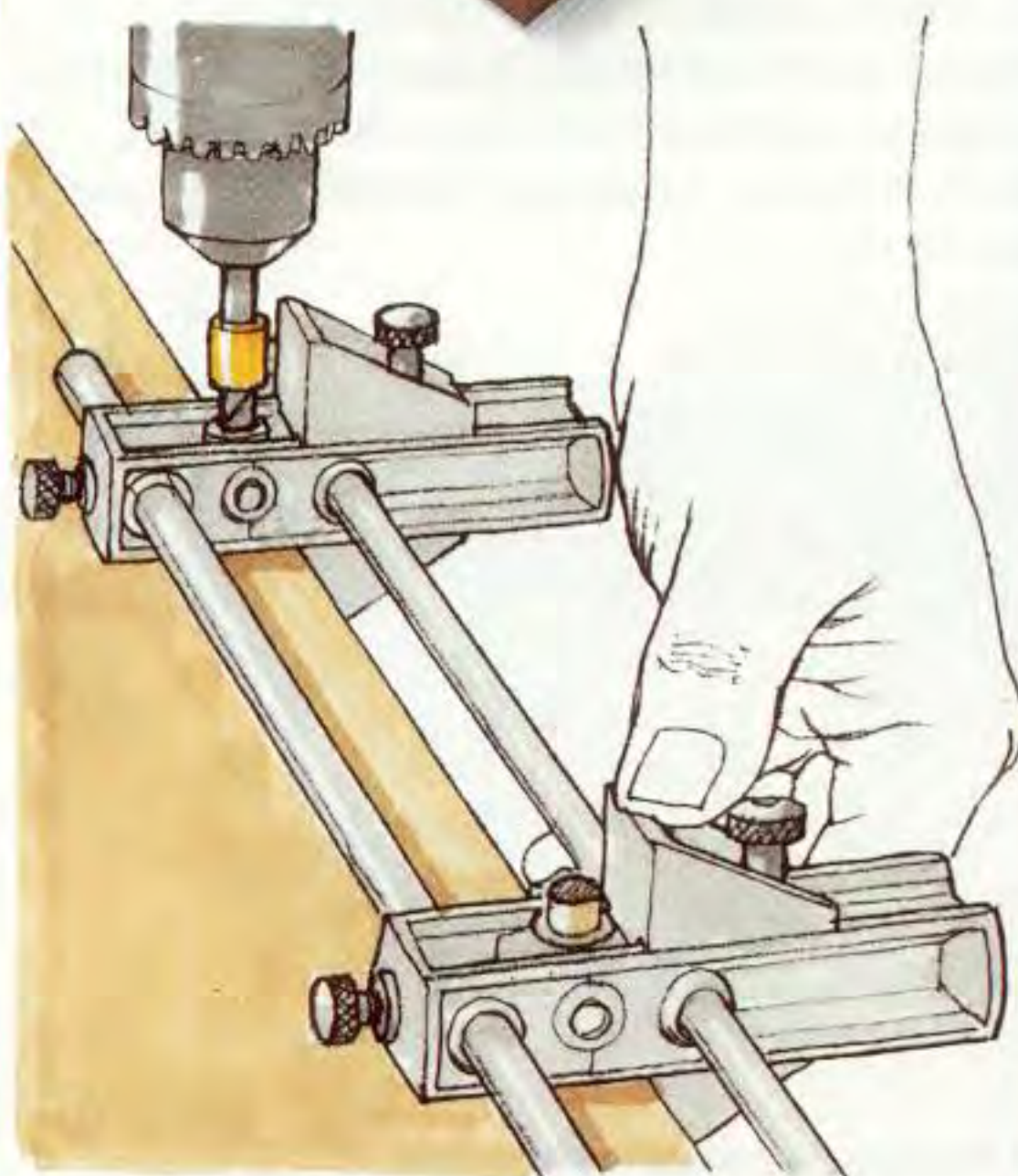


2 Boring the holes

If possible, have a helper stand at one end of the workpiece, to tell you when the drill is upright as you bore each hole where the marked lines cross.

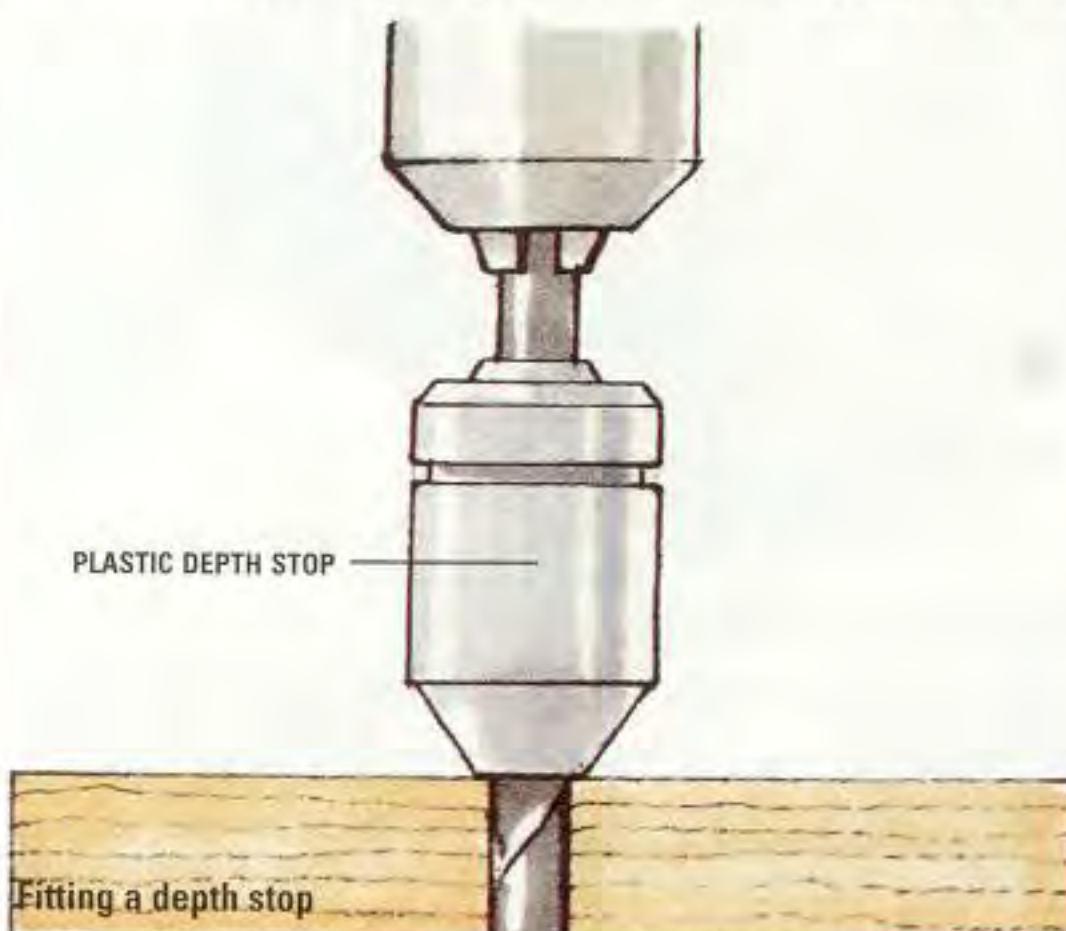
USING A DEPTH STOP

Each hole should be slightly deeper than half the length of the dowel. To enable you to drill consistently deep holes, fit a plastic guide onto the drill bit (see right). Depth stops cost very little, but if you prefer, bind a strip of adhesive tape around the drill bit to mark the appropriate level.



Dowelling with a jig

Remove both end fences of a dowelling jig when boring holes in the edge of a wide board. Holding the side fences against the face side of the work, drill two holes. To drill subsequent holes, drop one drill-bit guide over a short dowel rod pushed into the last hole drilled.

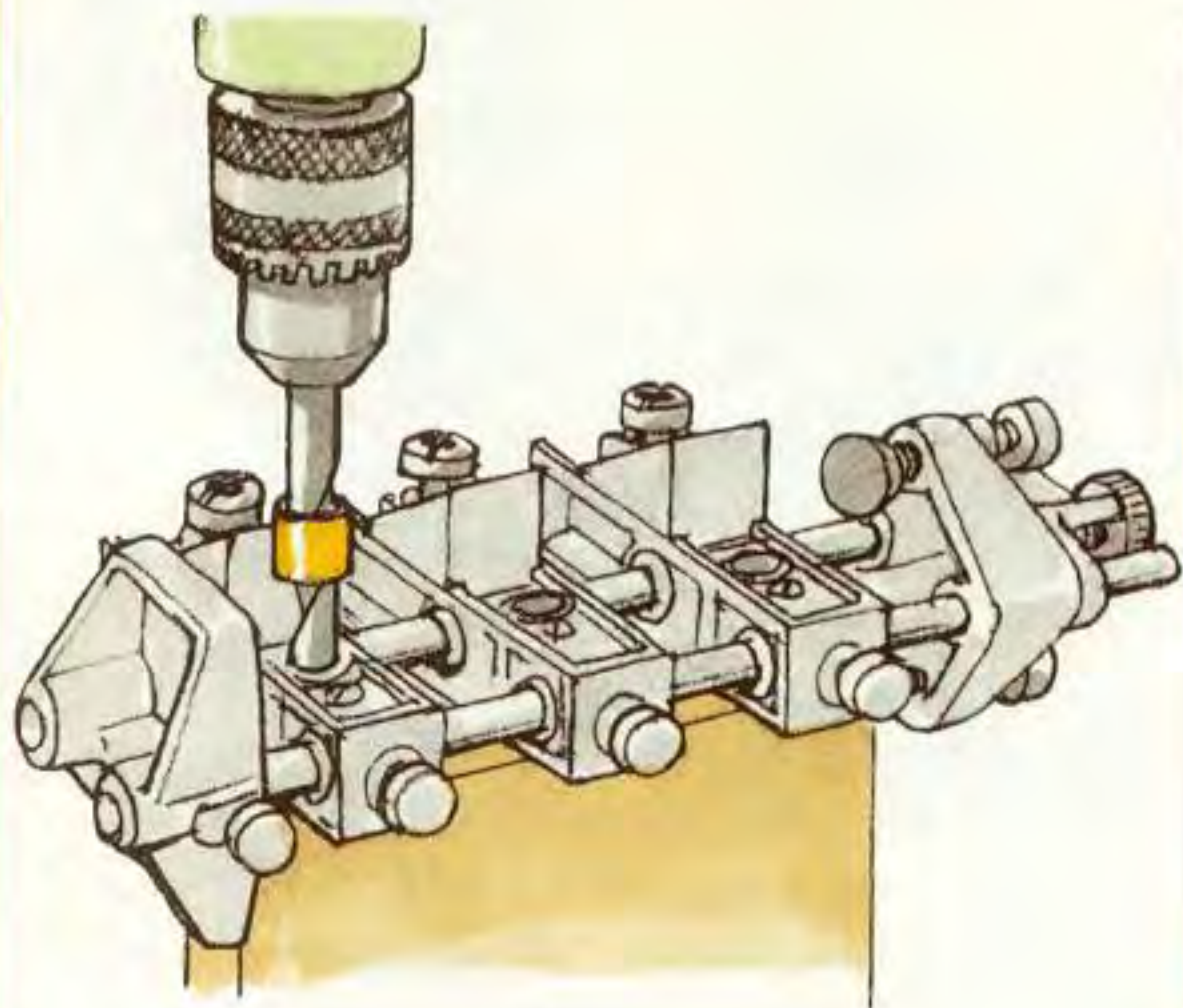


Fitting a depth stop

CARCASS BUTT JOINTS

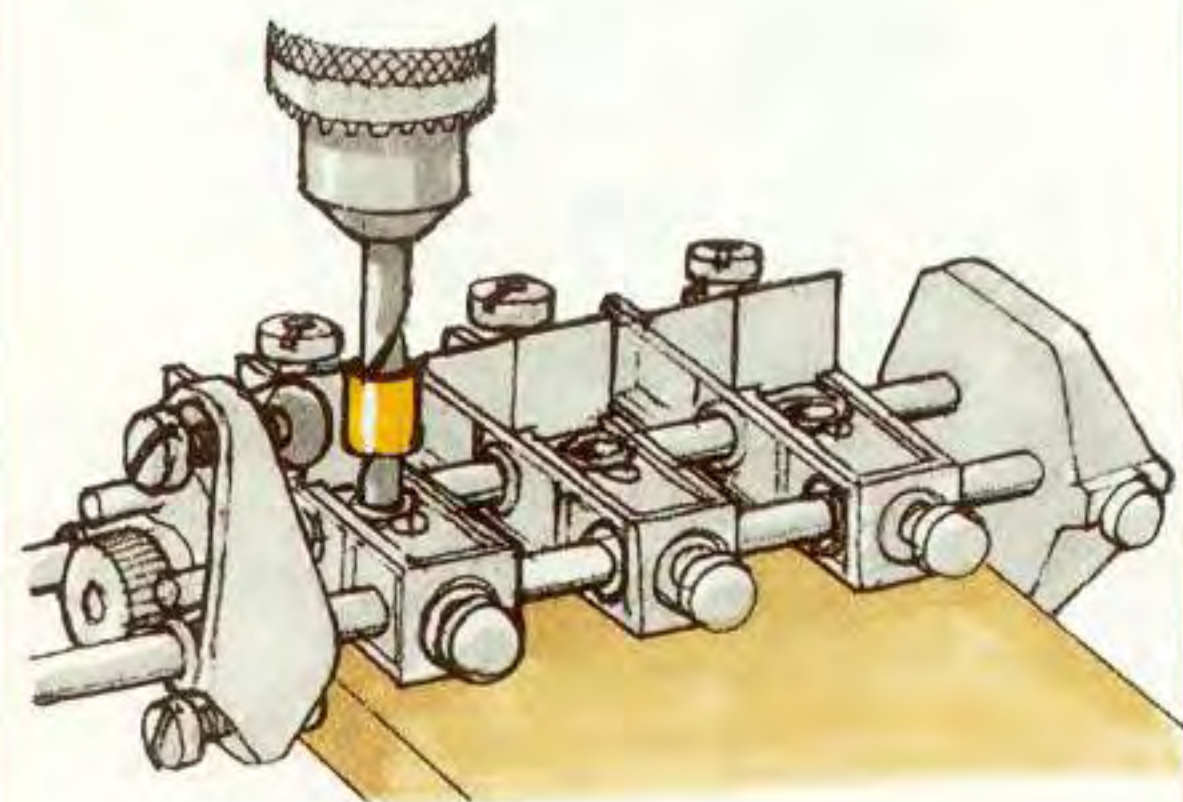
HAND CUT

When constructing a carcass with butt joints that are reinforced with multiple dowels, it pays to buy extra-long slide rods and additional drill-bit guides for a dowelling jig.



1 Dowelling a corner joint

For a right-angle butt joint, drill the end grain first. Set the jig's side fences to position the dowel holes centrally on the thickness of the workpiece, and adjust the drill-bit guides to space the dowels 50 to 75mm (2 to 3in) apart. Make sure the fixed head is clamped against the face edge.



2 Drilling matching holes

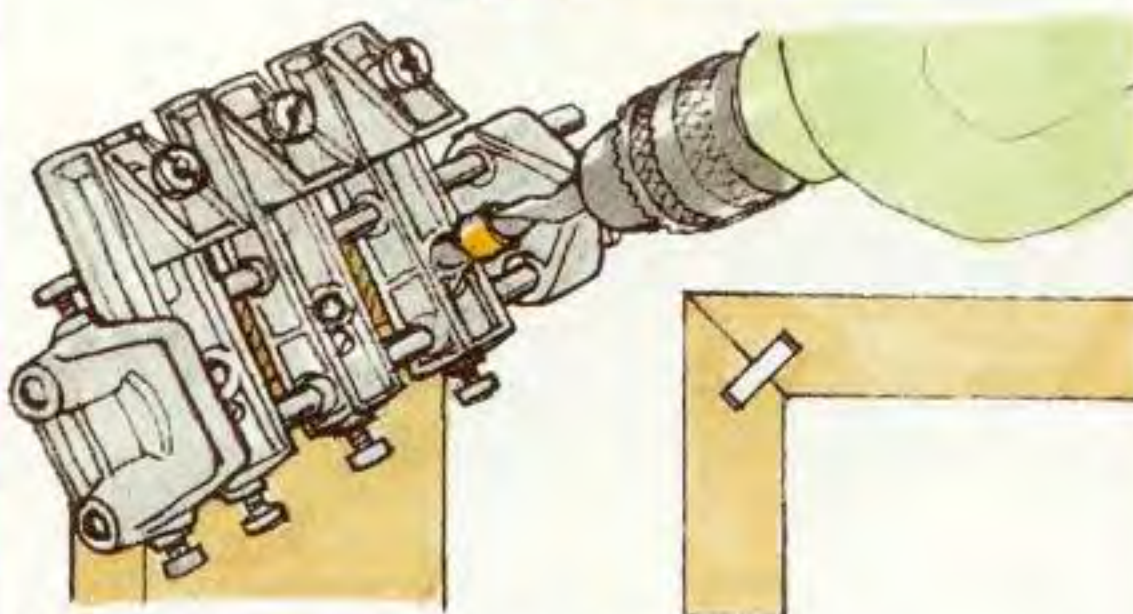
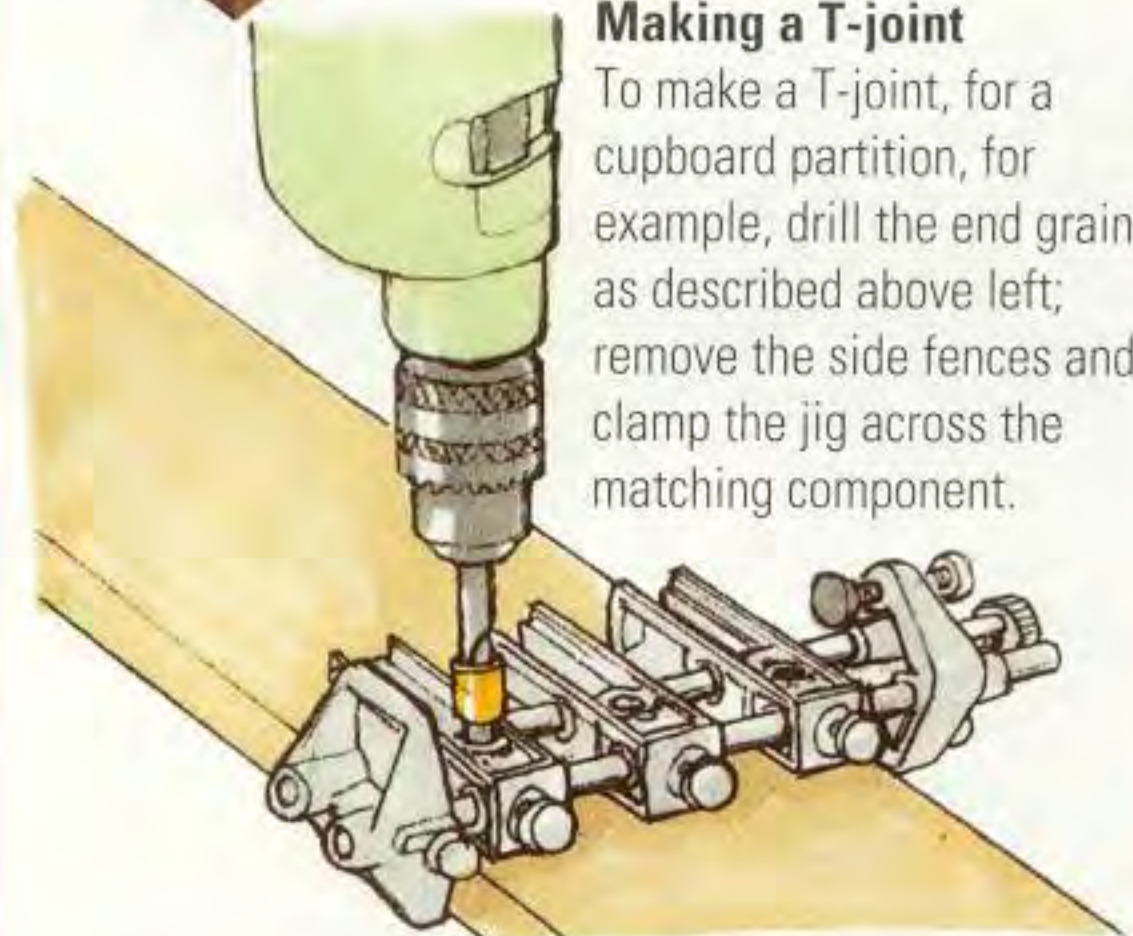
Without changing any settings, invert the jig and clamp it to the inside of the other component, with the side fences butted against the end grain and the fixed head against the face edge. Attach a depth stop (see opposite) to the bit to ensure you don't drill right through the wood.

DOWEL JOINTS



Making a T-joint

To make a T-joint, for a cupboard partition, for example, drill the end grain as described above left; remove the side fences and clamp the jig across the matching component.



Dowelling a mitred carcass joint

To make a dowel-reinforced mitre joint, assemble a jig similar to that used for a right-angle butt joint (see left), and clamp it to the bevelled end of the workpiece. Adjust the drill-bit guides to position the dowels towards the lower edge of the bevel. Having drilled the dowel holes, transfer the jig to the other mitred board and drill matching holes.

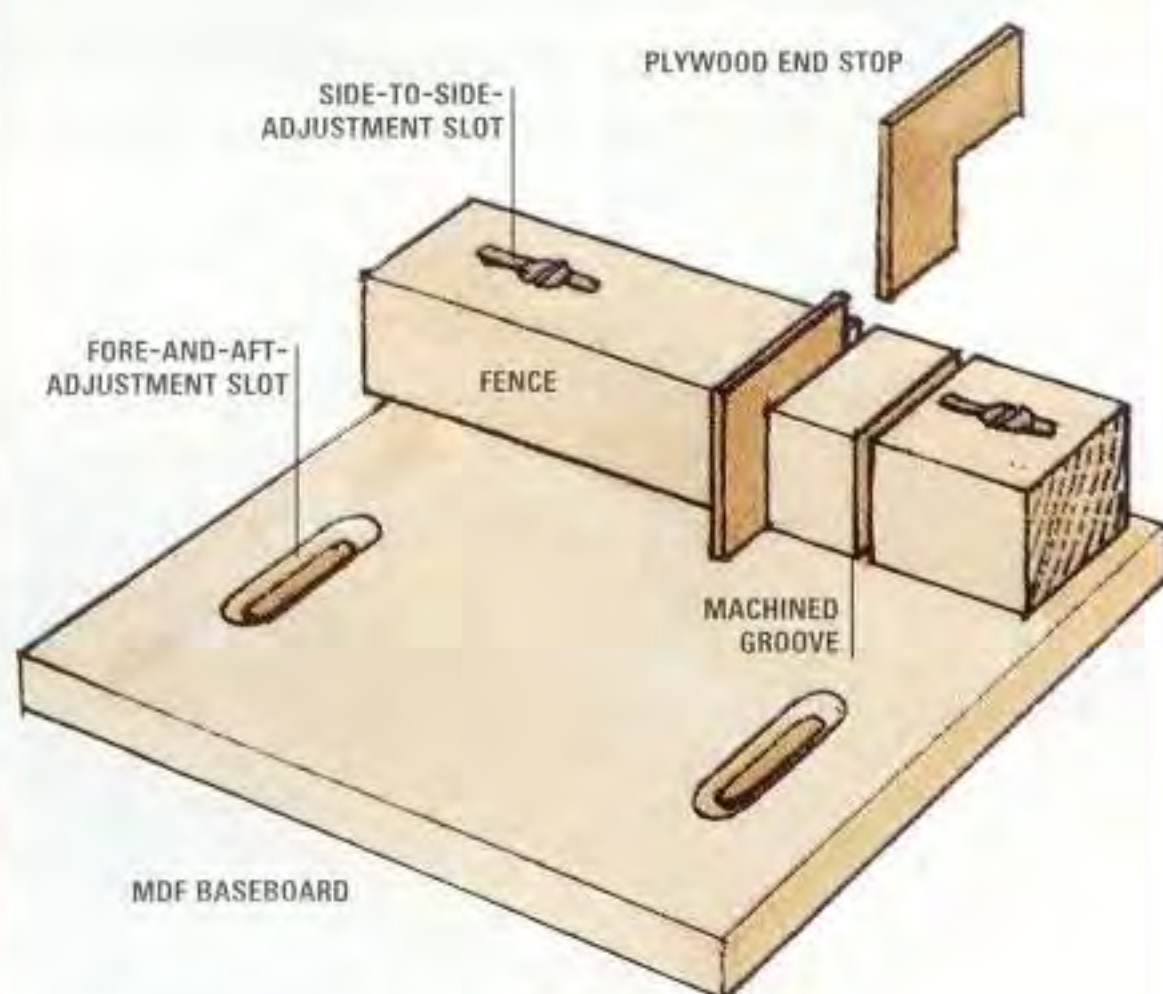
DOWEL JOINTS

MACHINE CUT

A drill press, or even a power drill mounted in a sturdy drill stand, solves the problem of drilling dowel holes vertically. All you have to do is ensure that the work is positioned accurately before you pull down on the lever.

For an edge-to-edge joint, for example, bolt a simple fence to the base so that you can slide the work along it until each marked hole centre is directly below the tip of the dowel bit. The depth gauge on the stand will prevent the drill boring too deeply into the work. Chamfering the holes makes final assembly easier.

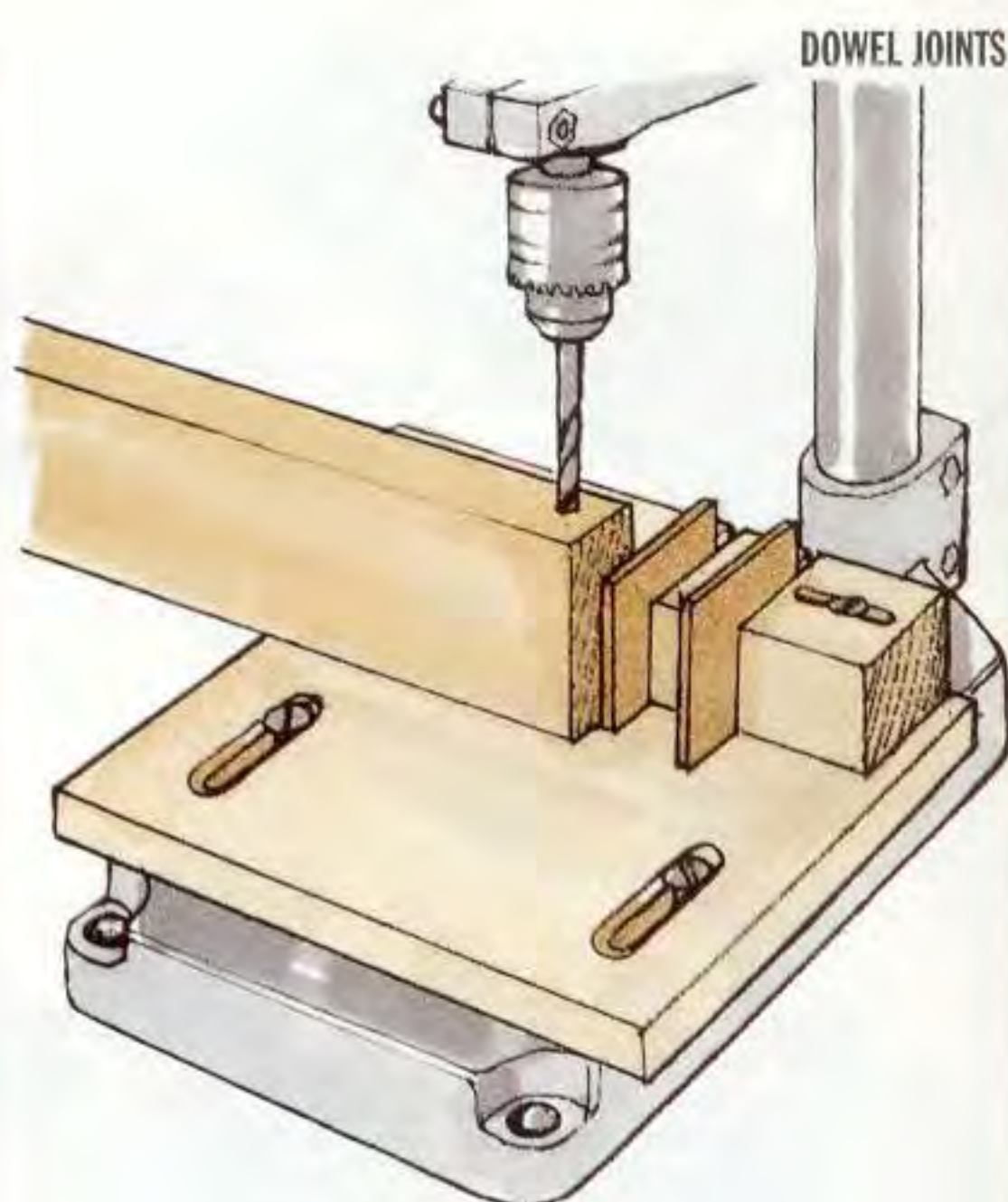
Make a special jig for the drill stand when you want to make several dowelled frame joints.



Making a corner-joint jig

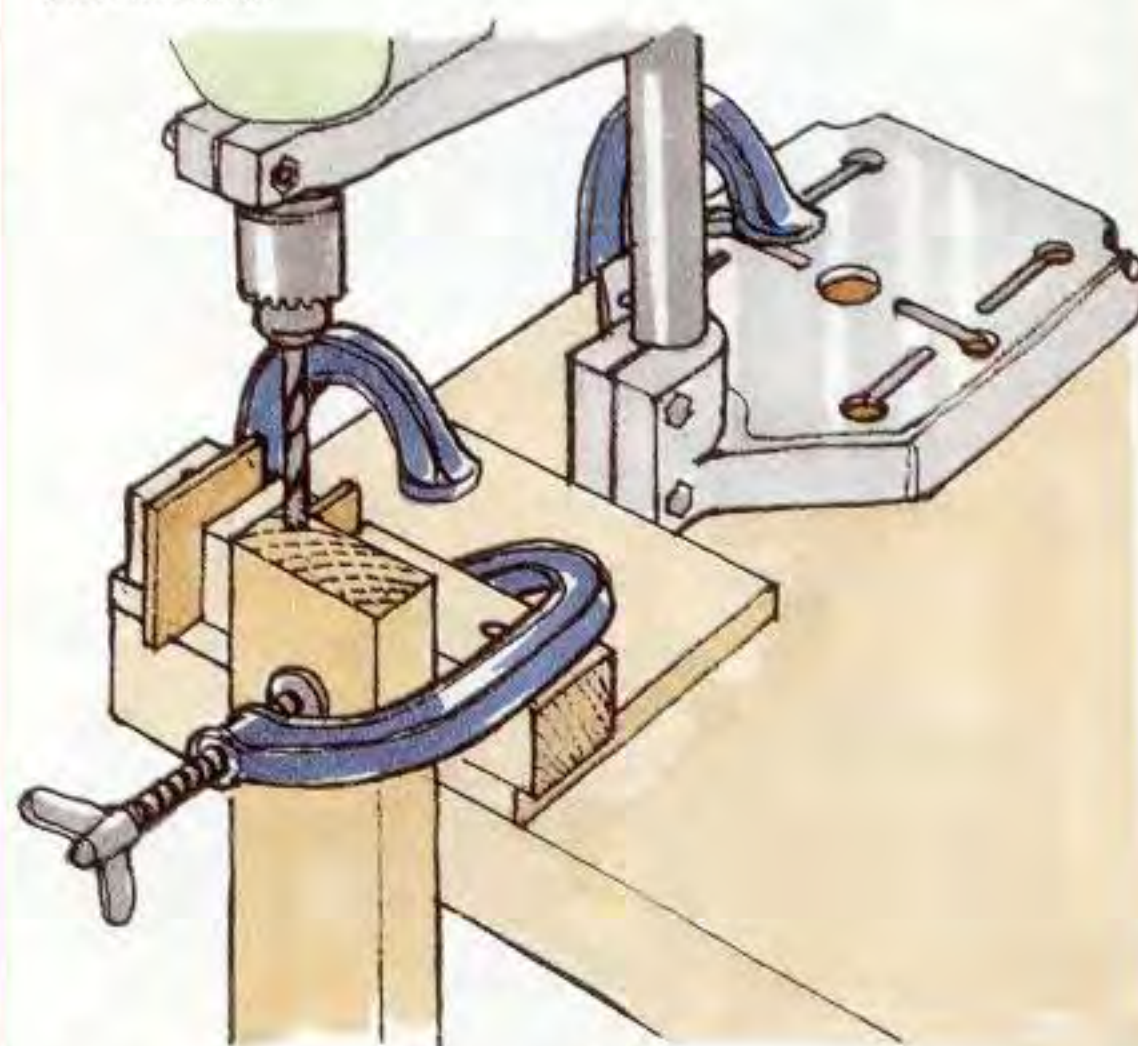
To join a rail and stile at right angles, make a simple jig comprising a 12mm ($\frac{1}{2}$ in) MDF baseboard and a hardwood fence with adjustable end stops.

- 1 Cut slots in the baseboard to provide fore-and-aft adjustment when bolted to the drill-stand base.
- 2 Machine 10mm ($\frac{3}{8}$ in) deep grooves in the top and sides of the fence to take 3mm ($\frac{1}{8}$ in) thick plywood end stops. Set them apart to provide the required spacing between dowel holes. Make L-shape plywood stops that fit snugly in the grooves.
- 3 Machine bolt slots in the fence for side-to-side adjustment once the fence is bolted flush with the back edge of the baseboard.



Boring dowel holes in a stile

Adjust the jig to position the centre line of the stile directly below the drill bit. With the end of the workpiece butted against the first plywood stop, bore the hole for the dowel. Remove the stop and slide the work up to the second end stop, then bore another dowel hole.



Boring holes in the end of a rail

To allow you to set the rail vertically, swing the drill stand to overhang the bench, and clamp it down. Clamp the workpiece to the jig, then the jig to the bench, in order to position the end grain below the dowel bit. Drill the first hole, remove the stop, then reposition the work against the second stop and drill another hole.

CHAPTER 5 The bridle joint is similar in appearance to a mortise-and-tenon joint, though in most circumstances it would not be as strong. However, a bridle joint is relatively quick and easy to make, since most of the waste wood is removed with a saw. The 'tenon' of a bridle joint, which is used exclusively for frame construction, usually constitutes one-third the thickness of the wood being joined.

BRIDLE JOINTS

CORNER BRIDLE JOINT

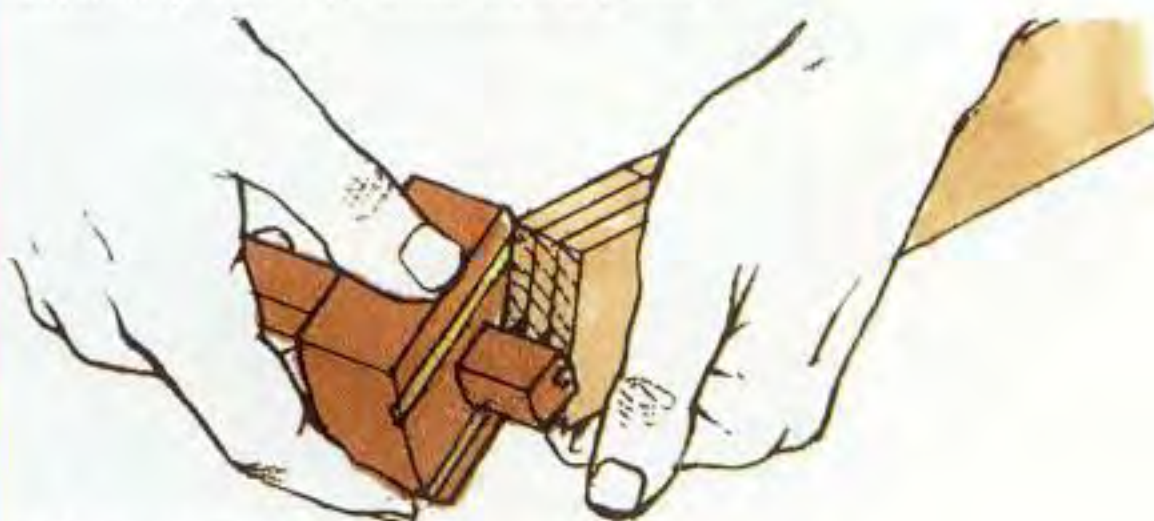
HAND CUT

A corner bridle joint is adequate for relatively lightweight frames, provided they are not subjected to sideways pressure, which tends to force bridle joints out of square. The strength of the bridle is improved considerably if you insert two dowels through the side of the joint after the glue has set.



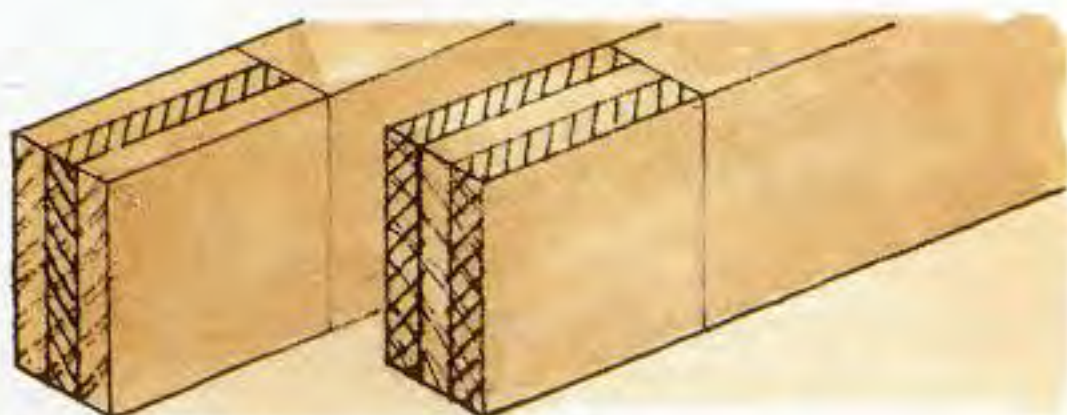
1 Marking out the shoulders

Taking each tenon member in turn, mark square shoulders all round, allowing for a tenon that is slightly overlong so that it can be planed flush after the joint is complete. Use a marking knife, but apply light pressure across both edges. Mark out the mortise member similarly, but this time use a pencil.



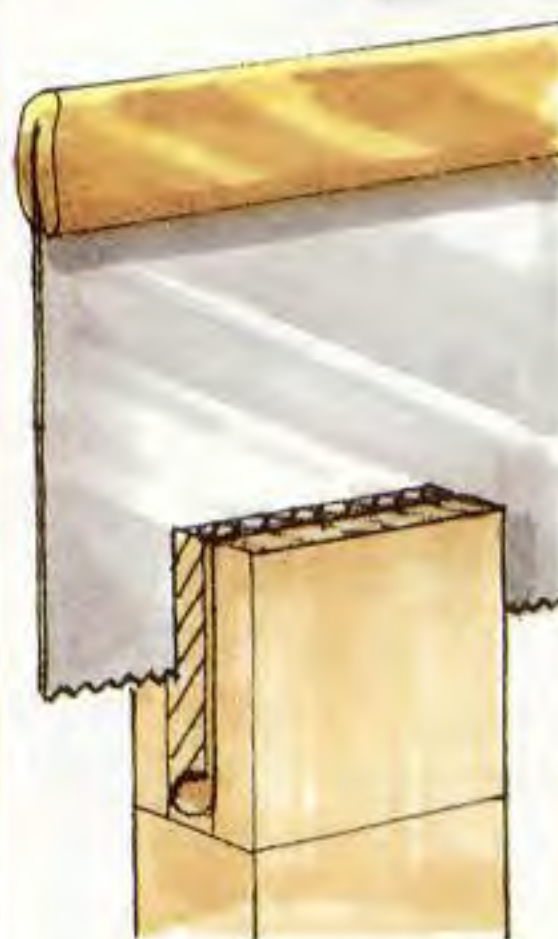
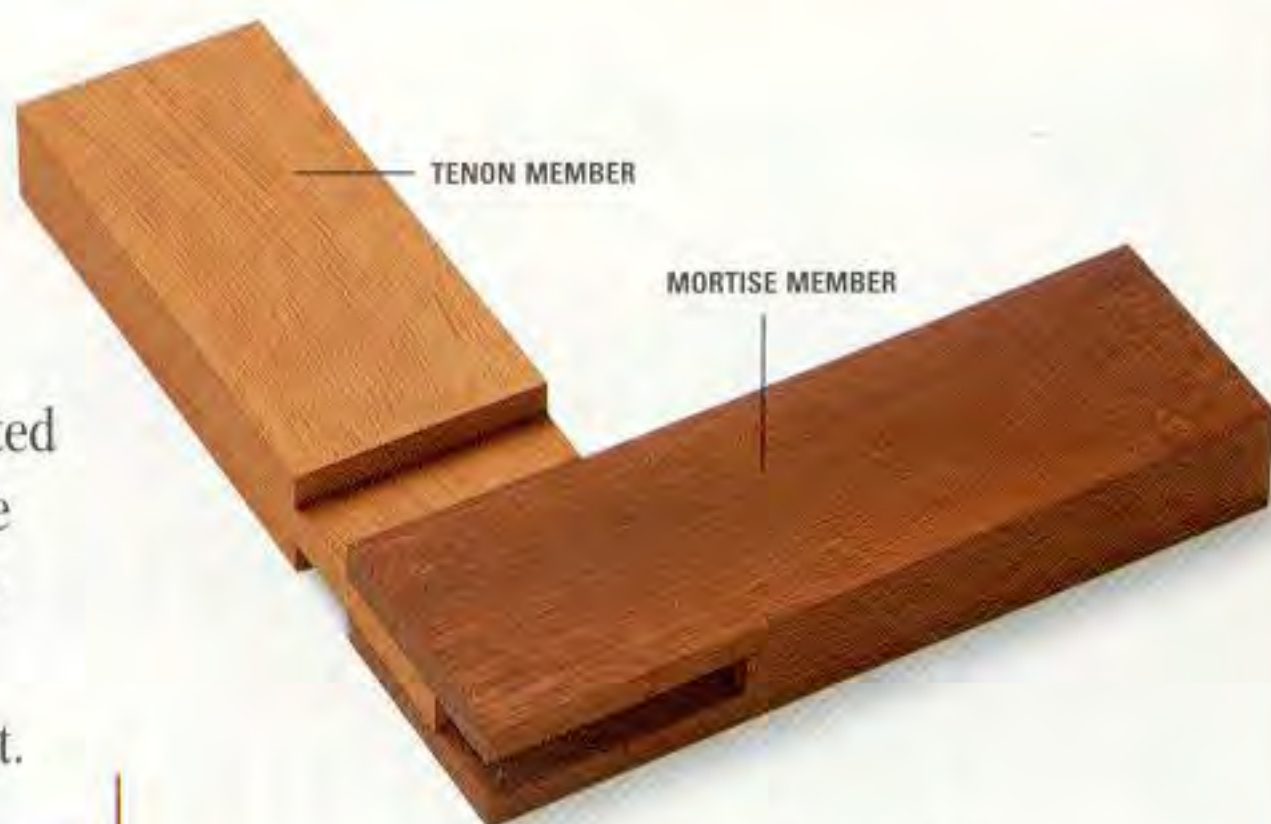
2 Scribing the tenon

Set the points of a mortise gauge to one-third the thickness of the wood, and adjust the tool's stock (fence) to centre the points on the edge of the work. Scribe the width of the tenon on both edges and across the end.



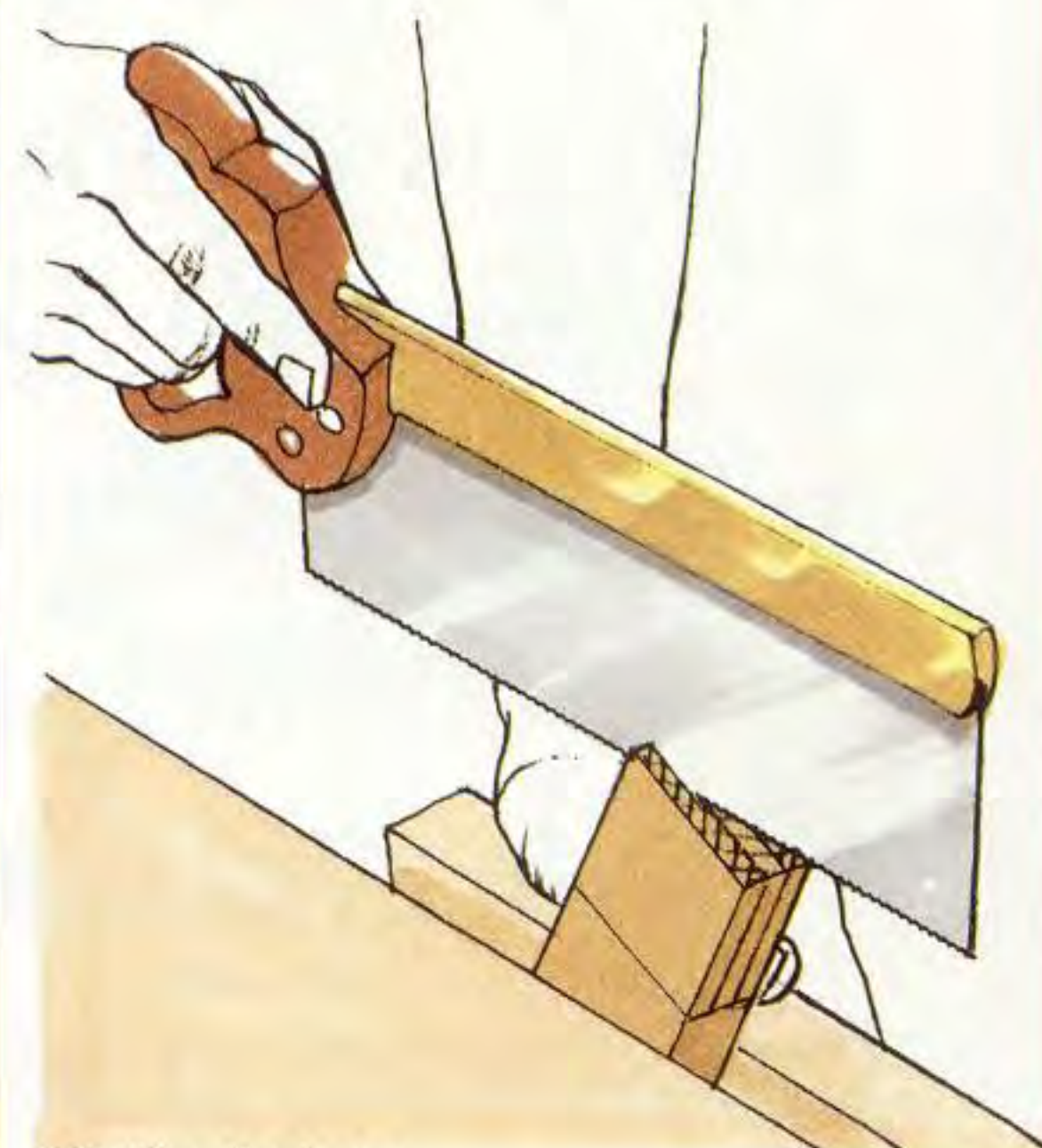
3 Marking out the open mortise

Use the same gauge to mark the sides of the open mortise, then take a marking knife and score the short shoulders at the base of the mortise, between the gauged lines. Mark the waste wood with a pencil on both components so that you don't get confused when cutting the joint.



4 Cutting the open mortise

Select a drill bit that approximates the width of the mortise, and bore a hole into the waste wood just above the shoulder line on opposite sides of the joint. Set the wood in a vice and saw on the waste side of both gauged lines, down to the hole at the base of the mortise. Chisel the shoulder square.



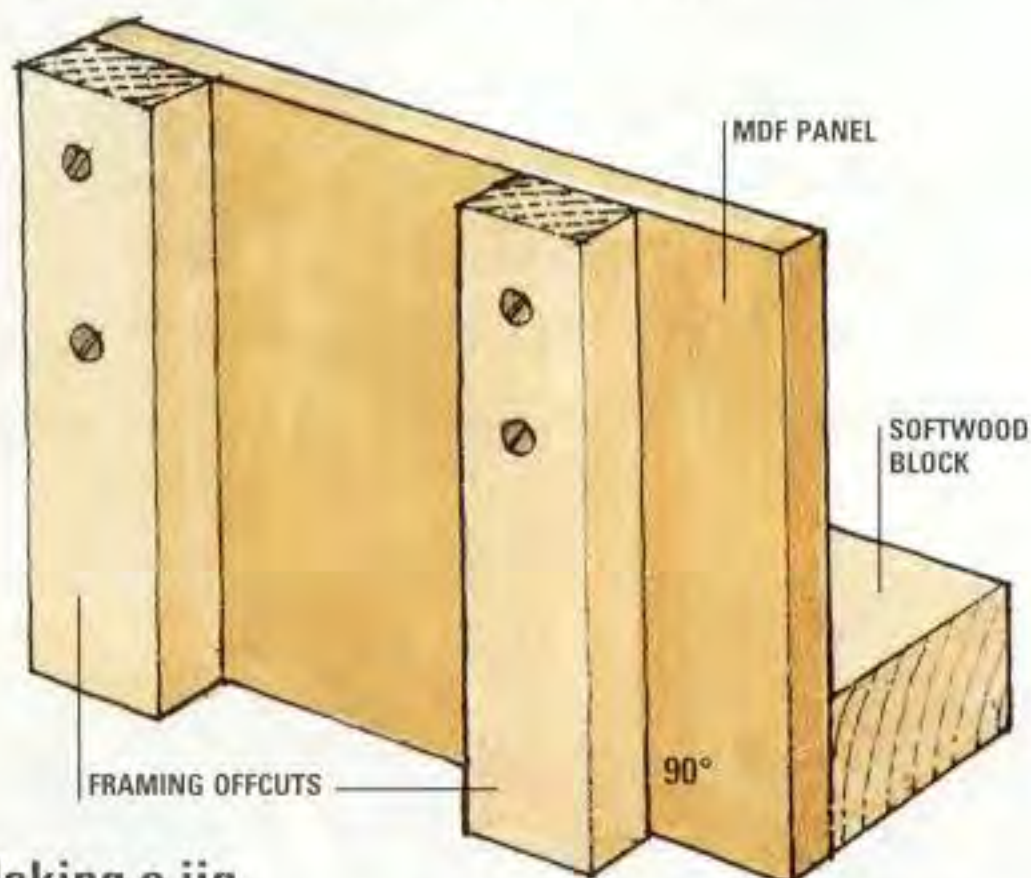
5 Cutting the tenon

With the work clamped in a vice, saw both sides of the tenon down to the shoulder (see mortise and tenon, page 65). Lay the workpiece on its side on a bench hook and saw each shoulder line to remove the waste wood.

CORNER BRIDLE JOINT

MACHINE CUT

A table saw is perhaps the best machine for cutting bridle joints. It is good practice to fit the blade guard whenever possible; however, if a particular operation requires you to remove it, always use a jig that will permit you to perform the task safely, keeping your hands away from the blade.



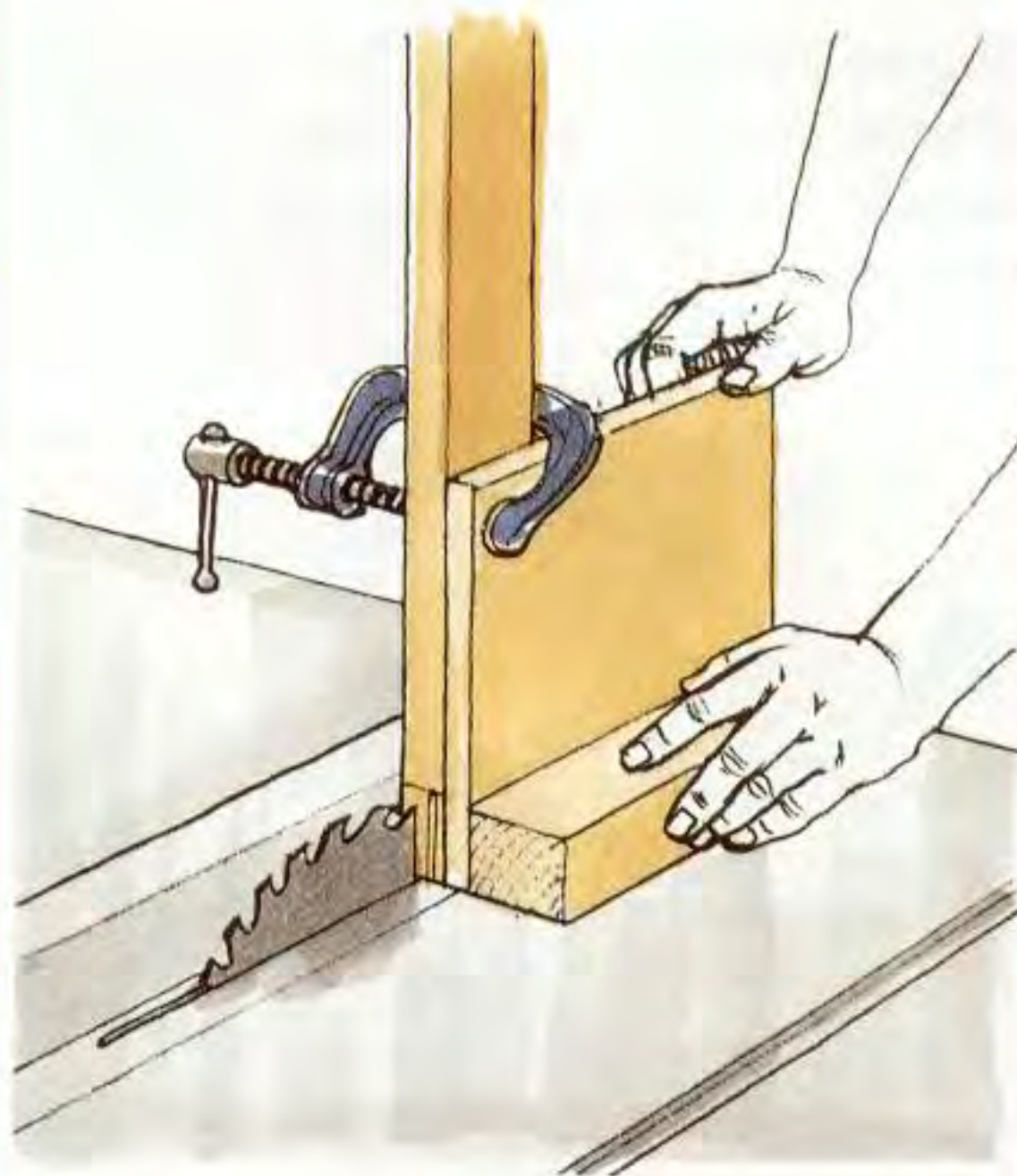
Making a jig

Most relatively sophisticated table saws have tenon-cutting jigs for securing workpieces and guiding them past the blade. In the absence of such equipment, make a jig that will hold the wood upright while it is run along the rip fence.



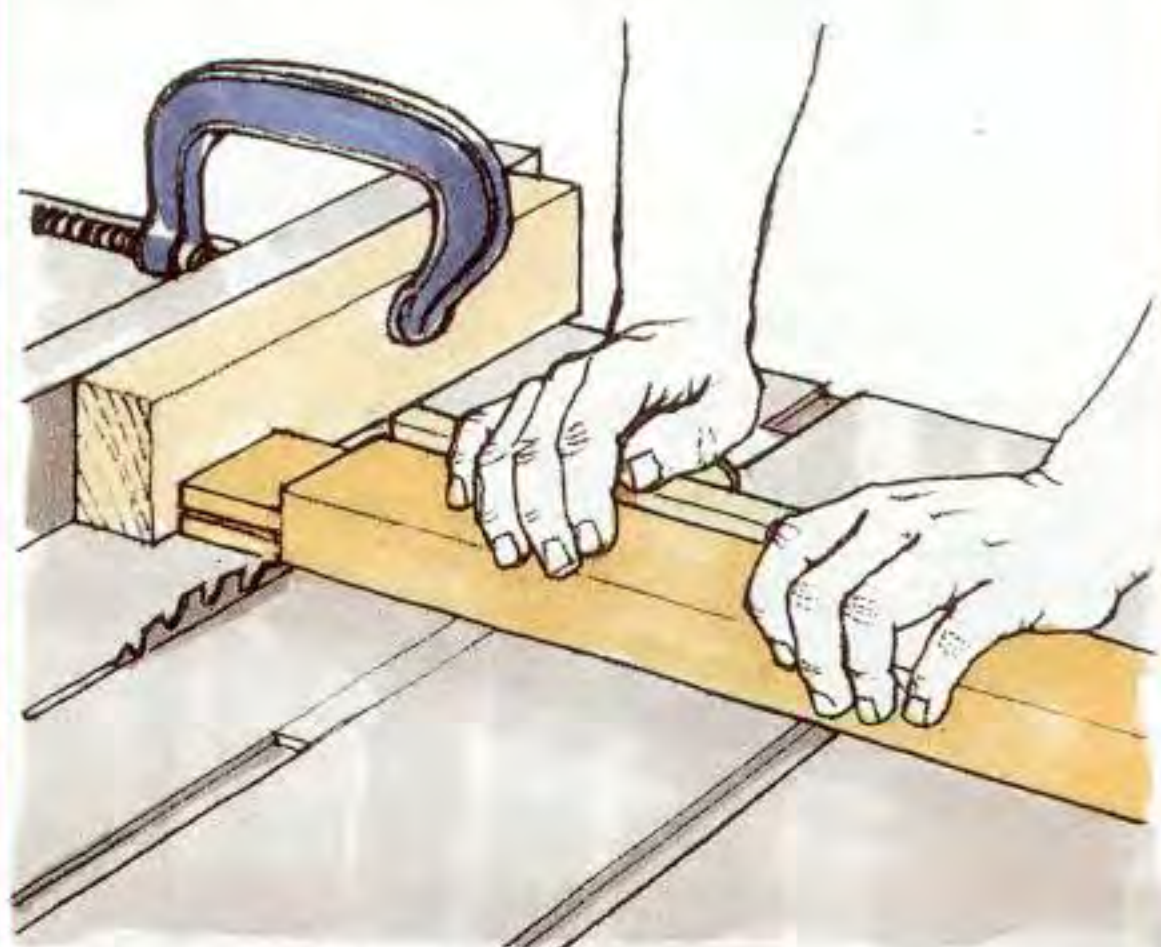
Cutting an open mortise

Having cut the component to length, clamp it vertically in the jig. Adjust the fence to saw just on the inside of the mortise, and raise the blade to make the required depth of cut. Make the first cut, reverse the work in the jig, and pass it across the blade again, to saw down the other side of the mortise. If necessary, reset the saw fence to remove any remaining waste.



1 Cutting the tenon

With the saw blade set to the same height, adjust the fence to place the blade just to the waste side of the tenon. Make the first cut, reverse the work in the jig, and make a second pass over the blade.



2 Sawing the shoulders

Clamp a block of wood to the saw fence and, with the end of the workpiece butted against the block, adjust the fence to place the blade just to the waste side of the shoulder. Adjust the blade height to just remove the waste. Using the mitre fence, pass the work over the blade – the spacer block prevents the waste jamming against the fence. Turn the work over and make a second pass.

MITRED BRIDLE JOINT

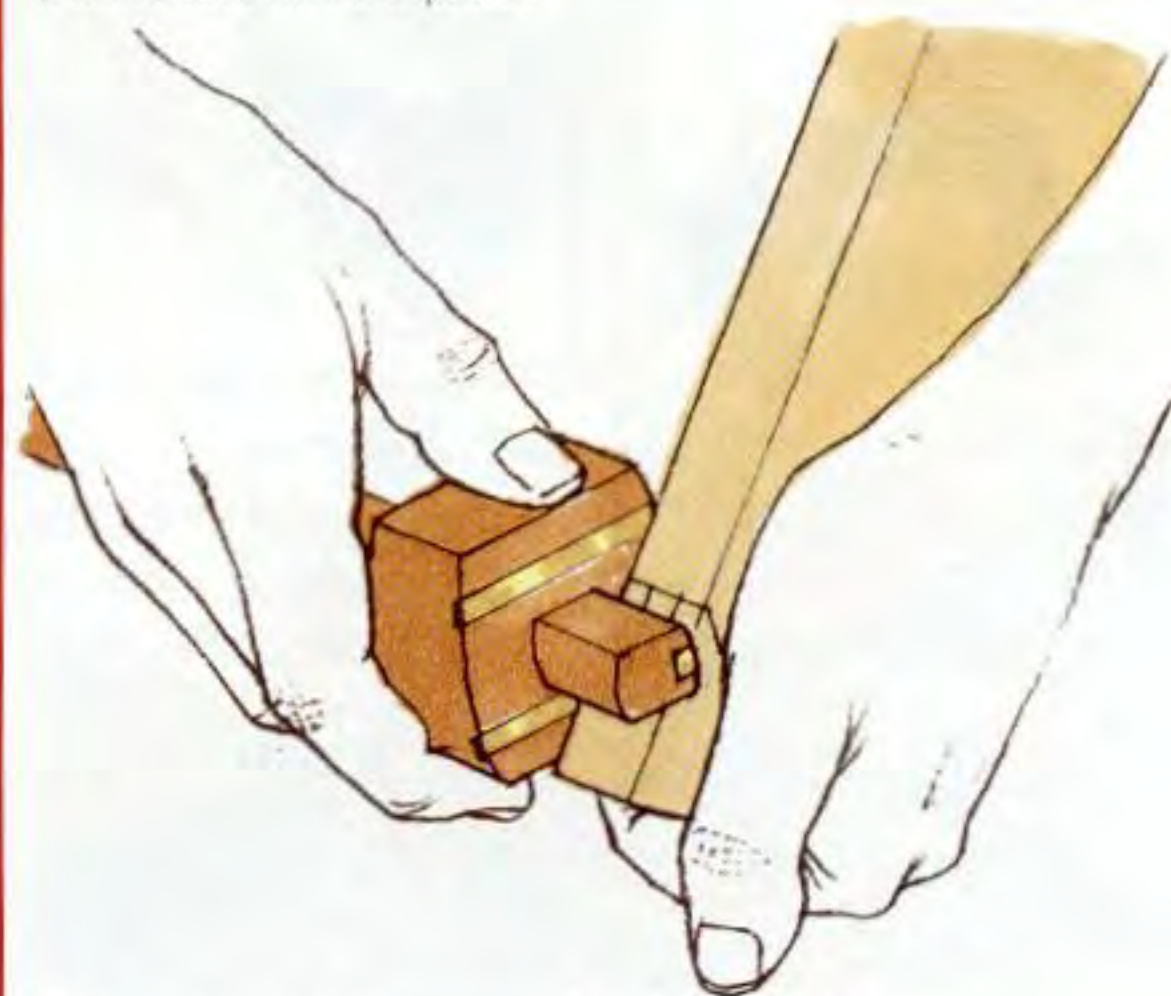
HAND CUT

The mitred bridle is cut in a similar way to the conventional corner joint, but is a more attractive alternative for framing, because end grain appears on one edge only.



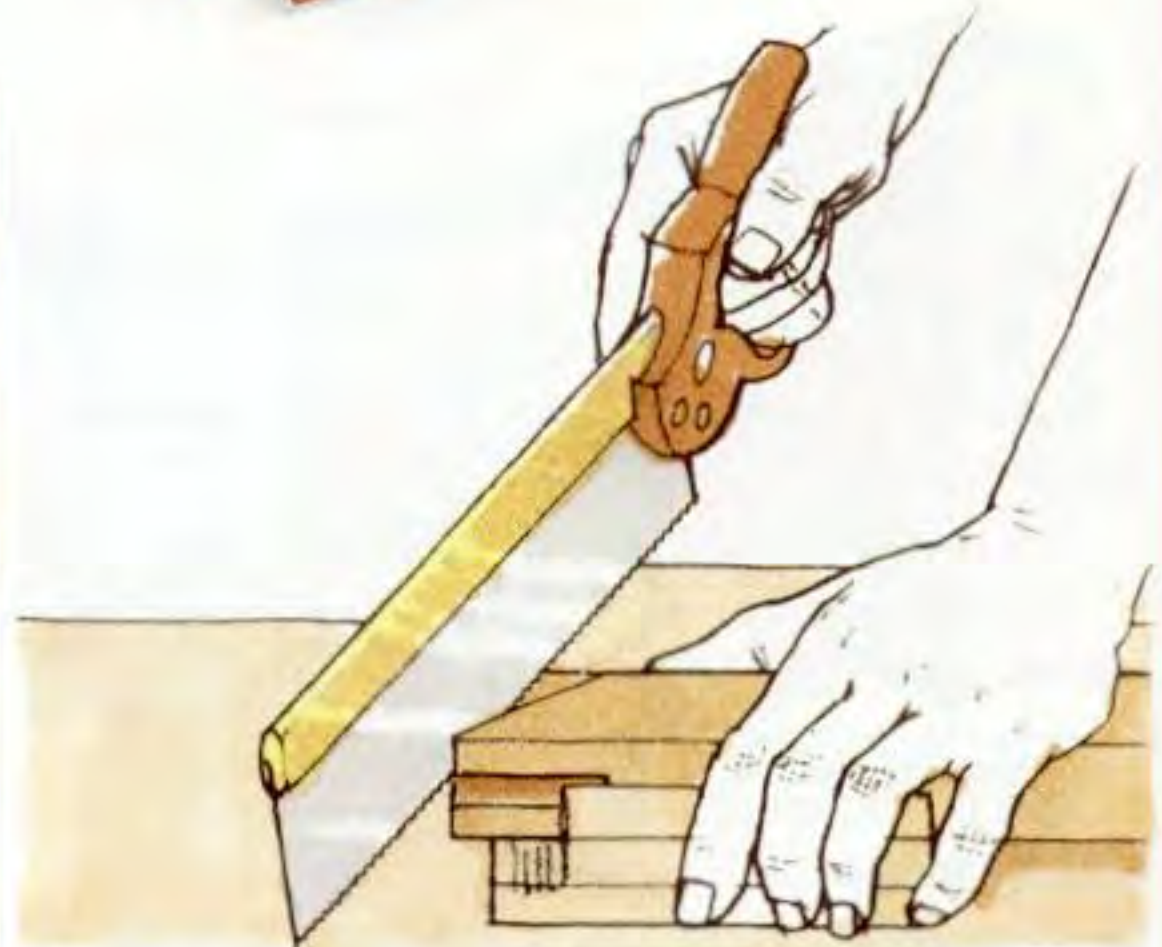
1 Marking the joint

Cut the components exactly to length. Mark the width of the parts on each end and square the shoulders all round, using a try square and pencil. Mark the sloping face of the mitre on both sides of each component with a knife and mitre square.



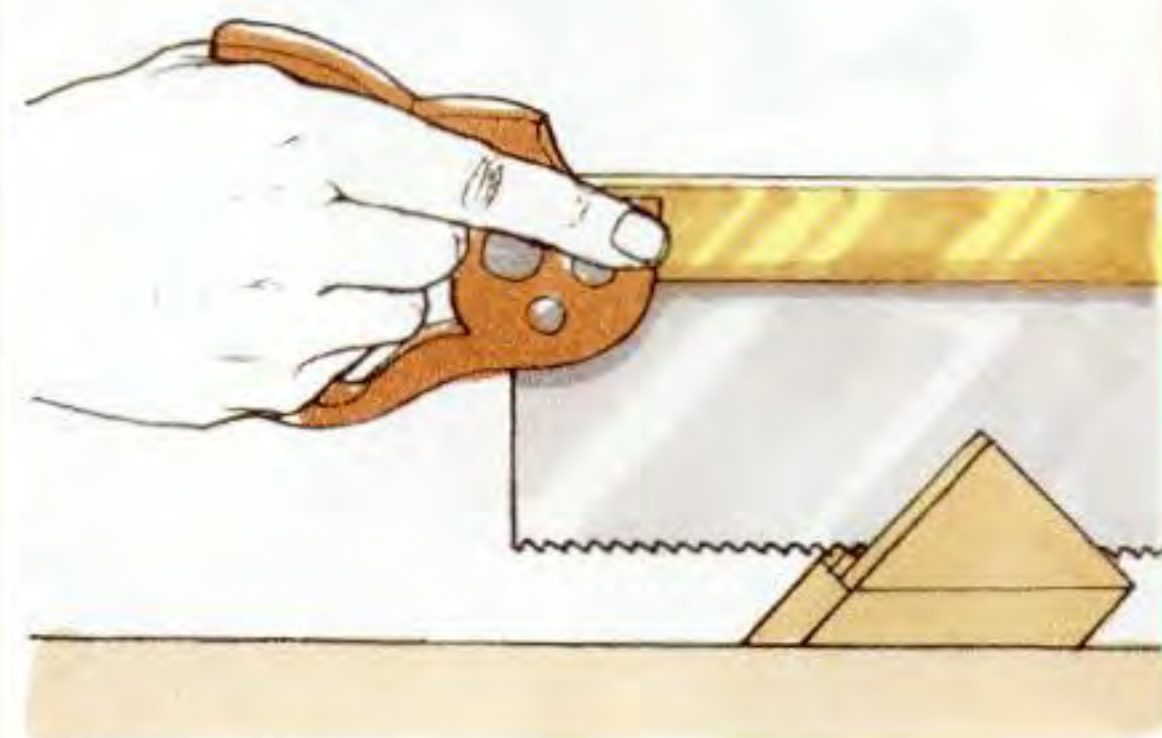
2 Gauging the tenon and open mortise

Set the pins of a mortise gauge to one-third the thickness of the wood, and adjust the stock to centralize the pair of pins on the edge of the work. Scribe the width of the tenon on the inside edge and across the end grain of the appropriate member. On the mortise member, scribe similar lines across the end and on both edges.



3 Cutting the open mortise

Cut out the waste from the mortise as described for a conventional corner bridle joint (see page 36), then hold the work on a bench hook and saw down the marked line to mitre both cheeks of the joint. If the mitres are not perfect, shave them with a block plane.



4 Cutting the tenon

Clamp the tenon member at an angle in a vice and saw down to the mitred shoulder on both sides of the tenon; keep the saw blade just to the waste side of the line. Holding the work on a bench hook, saw along both mitred shoulders to remove the waste. If necessary, trim the mitred surfaces with a shoulder plane.

CANVAS-STRETCHER JOINT

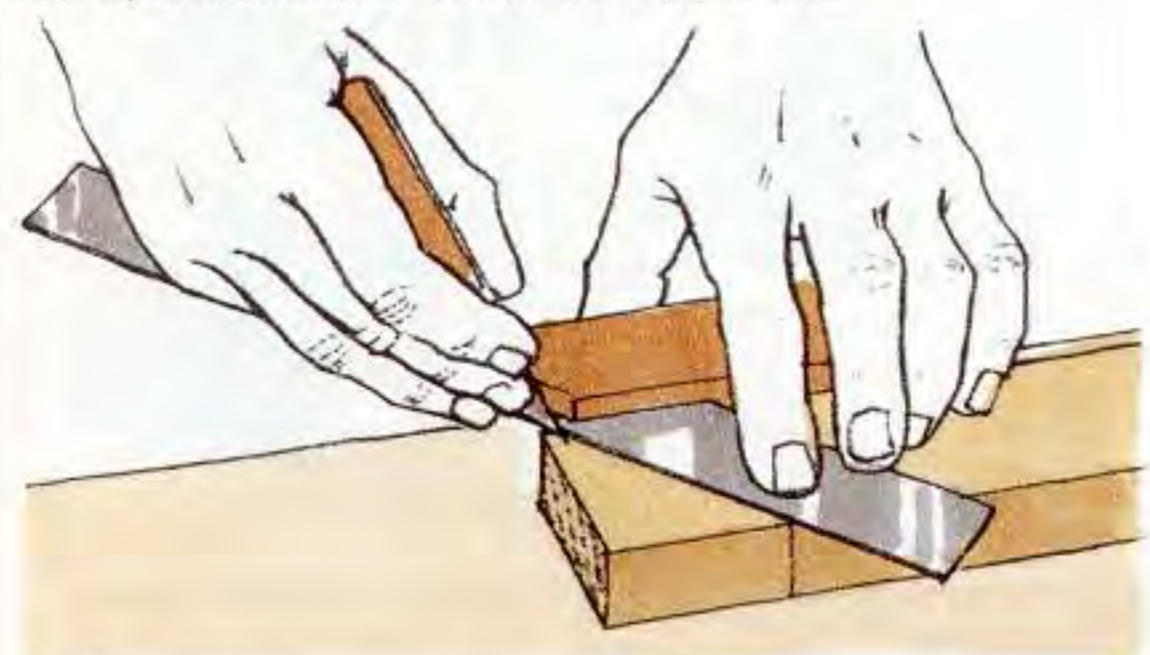
HAND CUT

Traditionally, most paintings are made on canvas stretched over a wooden frame. Ready-made frames are expensive, and it is worth making your own, using a variation of the mitred bridle joint. The frame is assembled without glue so that, if the canvas becomes slack due to changes in humidity, tension can be applied by driving wedges inside each corner of the frame to expand the joints. In the following instructions, the face side of each piece of wood, or 'stretcher', refers to the surface that faces the canvas. Descriptions of right- and left-hand ends of a stretcher mean when they are seen from face side.



1 Marking the square shoulders

Cut four stretchers to length. Draw square shoulders all round, one stretcher-width from each end.

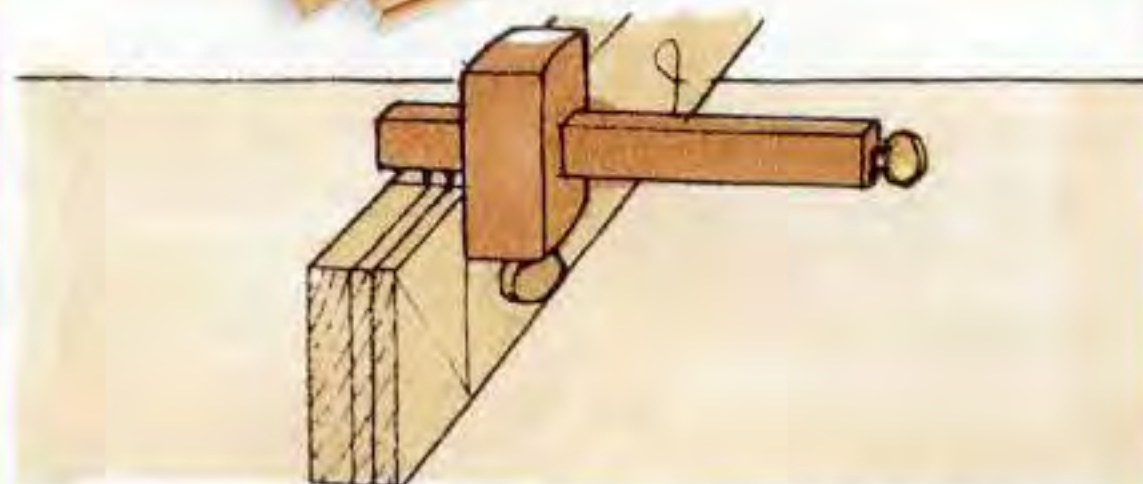


2 Marking the mitred shoulders

Using a mitre square and knife, score a diagonal from the outer corners on both sides of the stretcher

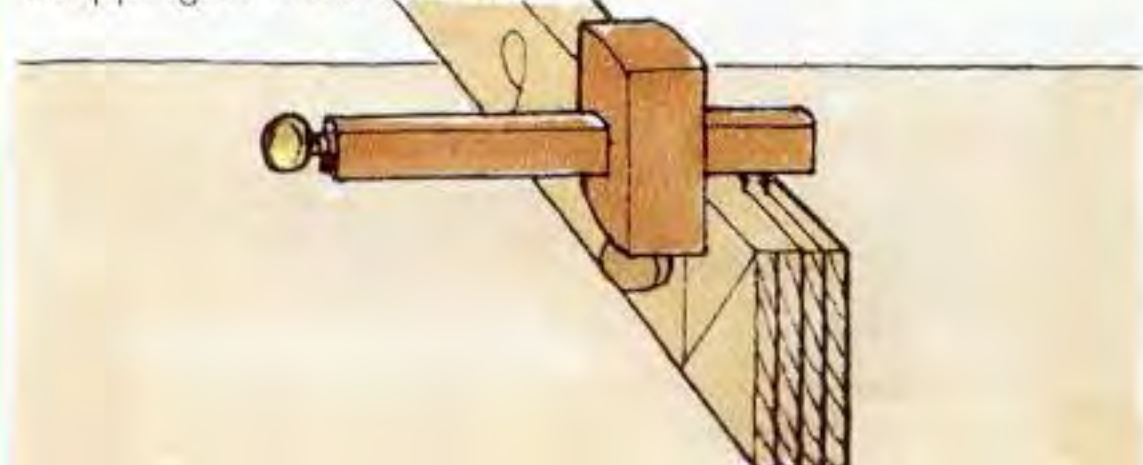
3 Gauging the open mortise and tenon

Set the pins of a mortise gauge to one-quarter of the thickness of the wood. Adjust the stock to place the outermost, fixed pin on the centre line. Working from the face side, scribe two parallel lines on both edges and across the end grain at the left-hand end of each



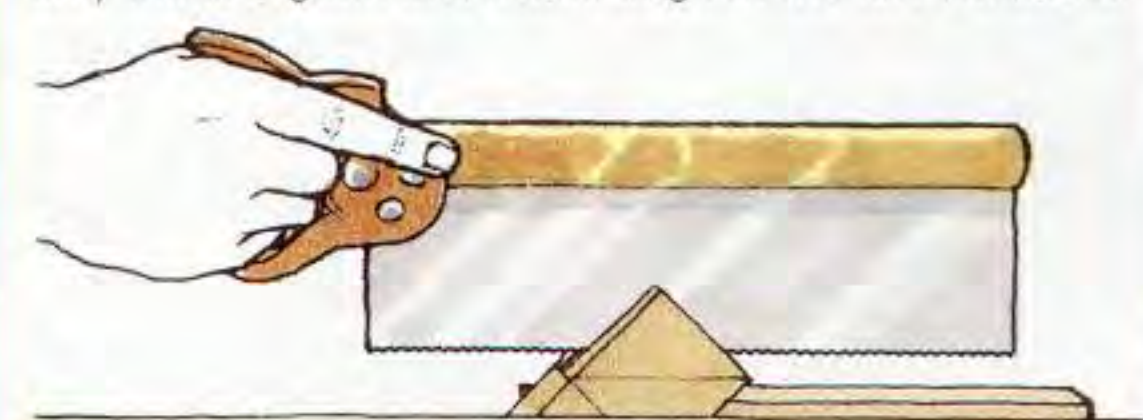
stretcher. On the inside edge only, extend the lines past the shoulder by 9mm ($\frac{3}{8}$ in), to accommodate wedges at a later stage.

At the right-hand end of each stretcher, scribe lines across the end grain and along the inside edge only, stopping at the shoulder.



4 Resetting the mortise gauge

Reset the gauge to place the innermost pin on the centre line. Mark both ends of each stretcher in a similar way, but this time scribe both edges and end grain at the right-hand end (allowing for wedges), and only the end grain and inside edge at the left-hand end.



5 Cutting the joint

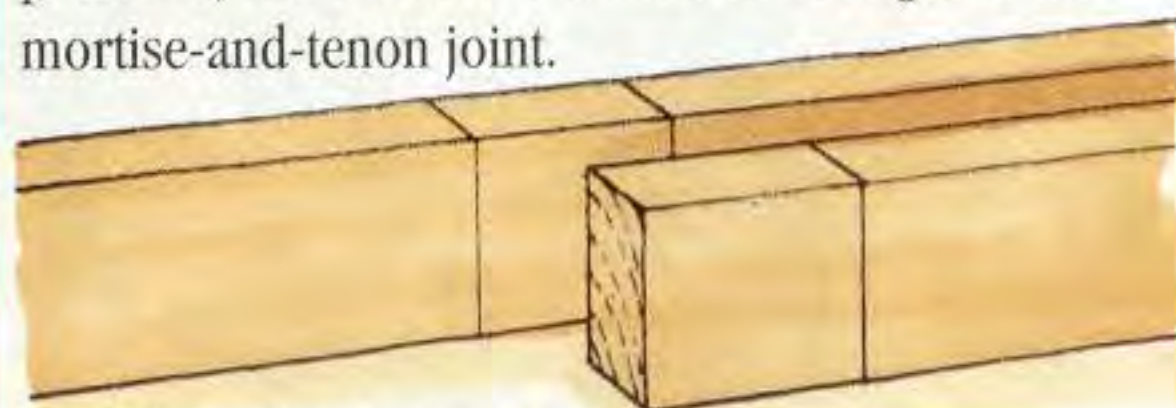
Mark the waste clearly with pencil, to avoid confusion. Saw out the waste, following the gauged lines and mitred-shoulder lines. Plane a small radius along the edges of the stretchers, and plane the face sides to a shallow bevel, sloping towards the inner edges. This prevents the wood marking the canvas.

Once the canvas is stretched over the frame, apply tension by driving two shallow wedges per joint into the slots left on the inside of each corner.

T-BRIDLE JOINT

HAND CUT

The T-bridle serves as an intermediate support for a frame and, with modifications, is sometimes used to joint a table leg to the underframe when a long rail requires support. Unlike the corner bridle, which is relatively weak under sideways pressure, the T-bridle is similar in strength to the mortise-and-tenon joint.



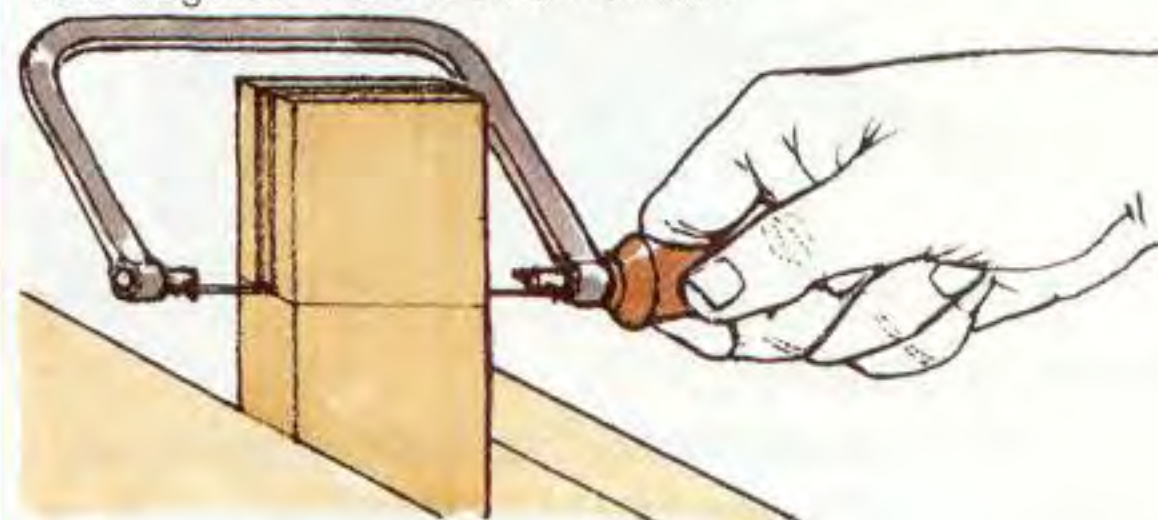
1 Marking the shoulders

Mark the width of the mortise member on the tenon member, using a marking knife to score square shoulders all round. Apply light pressure only across the edges. Allowing for slightly overlong cheeks on the mortise member, mark square shoulders all round with a pencil and try square.



2 Gauging the joint

Set the pins of a mortise gauge to one-third the thickness of the wood, and adjust the stock to centre the pair of pins on the edge of the workpiece. Scribe parallel lines between the marked shoulders on the tenon member, then mark similar lines on the end and both edges of the mortise member.



3 Cutting the open mortise

Cut the mortise as described for a corner bridle joint (see page 36). Alternatively, saw down both sides of the open mortise with a tenon saw, then use a coping saw to remove the waste, cutting as close to the shoulder as possible. If necessary, trim the shoulder square with a sharp chisel.



4 Cutting the tenon member

On both sides of the tenon member, saw the shoulders down to the gauged lines, then make three or four similar saw cuts in between. With the work held firmly, chop out the waste with a mallet and chisel, working from each edge towards the middle. Having assembled the joint, allow the glue to set, then plane the ends of the mortise cheeks flush with the tenon member.

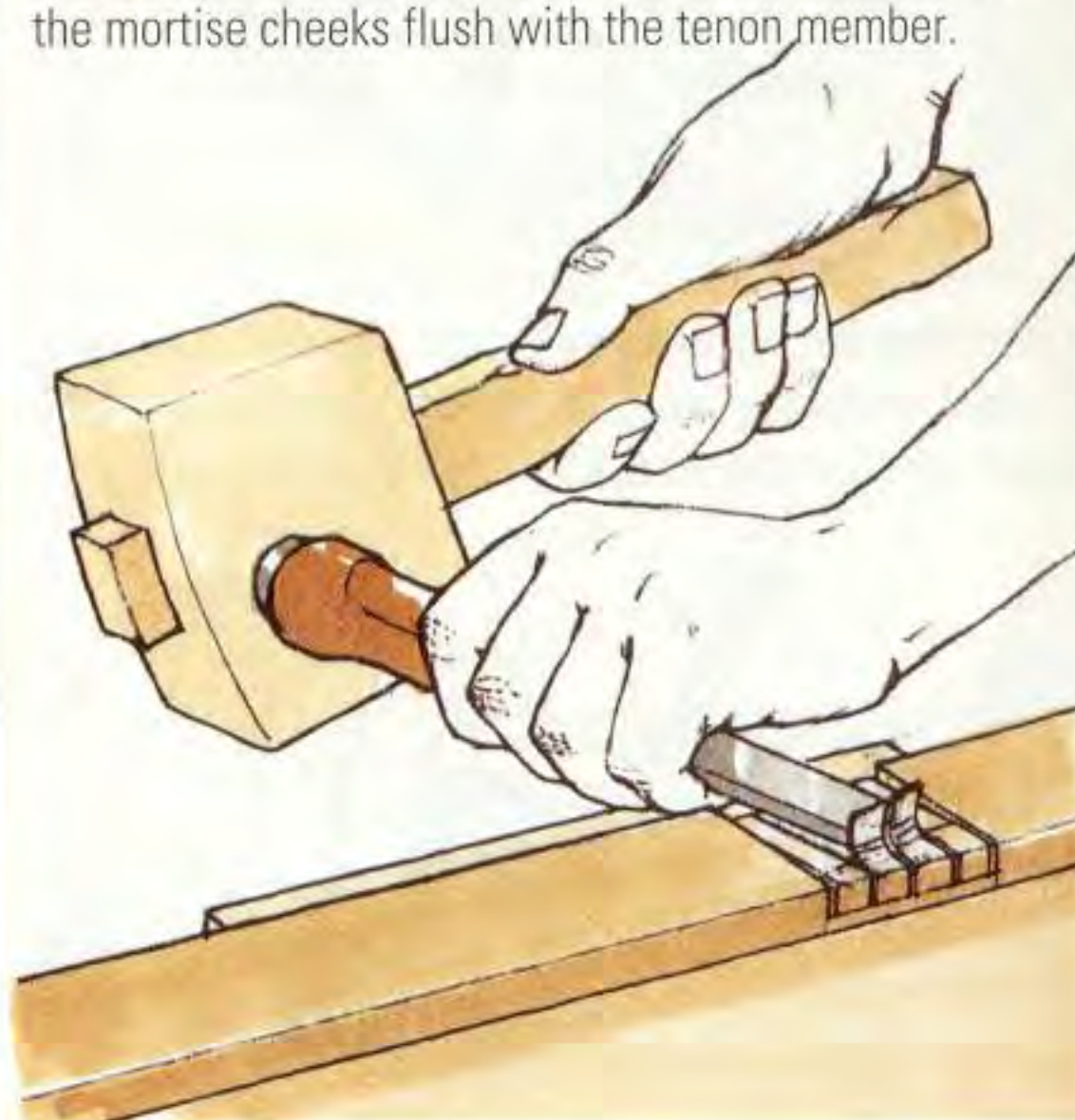
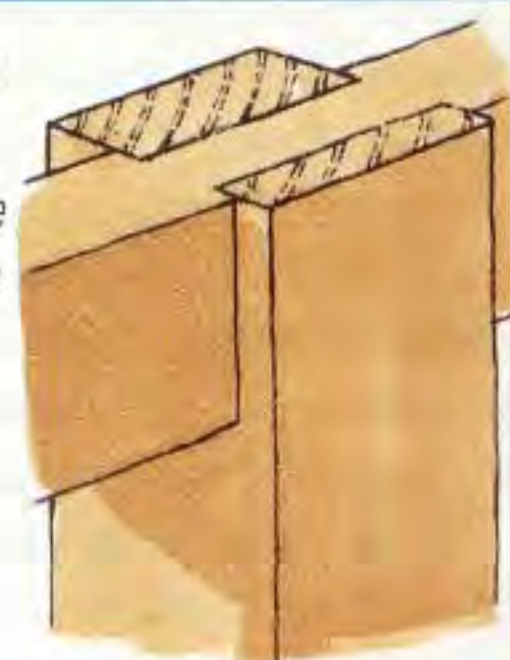


TABLE-LEG VERSION

When joining a square leg to a table underframe, make the 'tenon' about two-thirds the thickness of the rail. Offset the open mortise so that a slightly overhanging table top can conceal the leg's end grain.



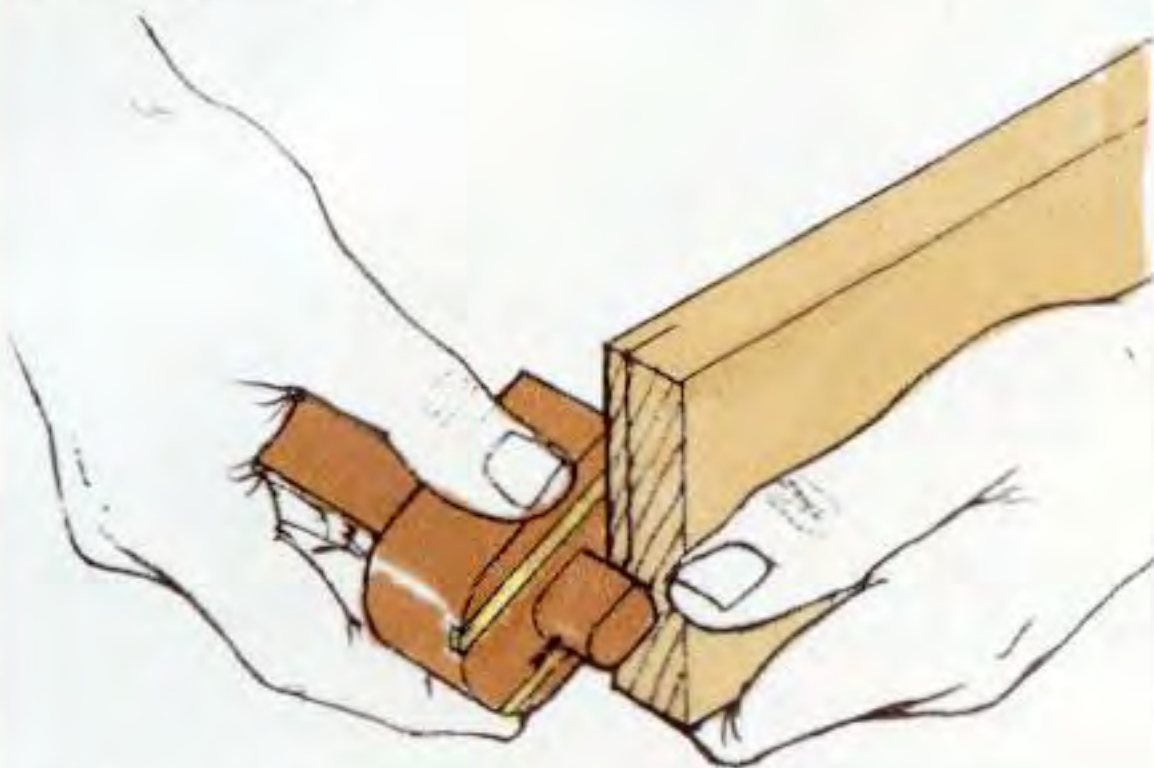
LAP JOINTS

CHAPTER 6 A lap joint is a simple corner joint used to construct box frames and small cabinets. The basic joint requires the ability to plane the ends of workpieces perfectly square and cut a rabbet across the grain. It is only moderately strong, and requires reinforcing with panel pins or modifying to include a tongue and groove to improve its rigidity.

LAP JOINT

HAND CUT

A basic lap joint is only marginally stronger than a straightforward butt joint, but it is an improvement in appearance, since most of the end grain is concealed. As a result, it is sometimes used as a relatively simple way of connecting a drawer front to drawer sides.



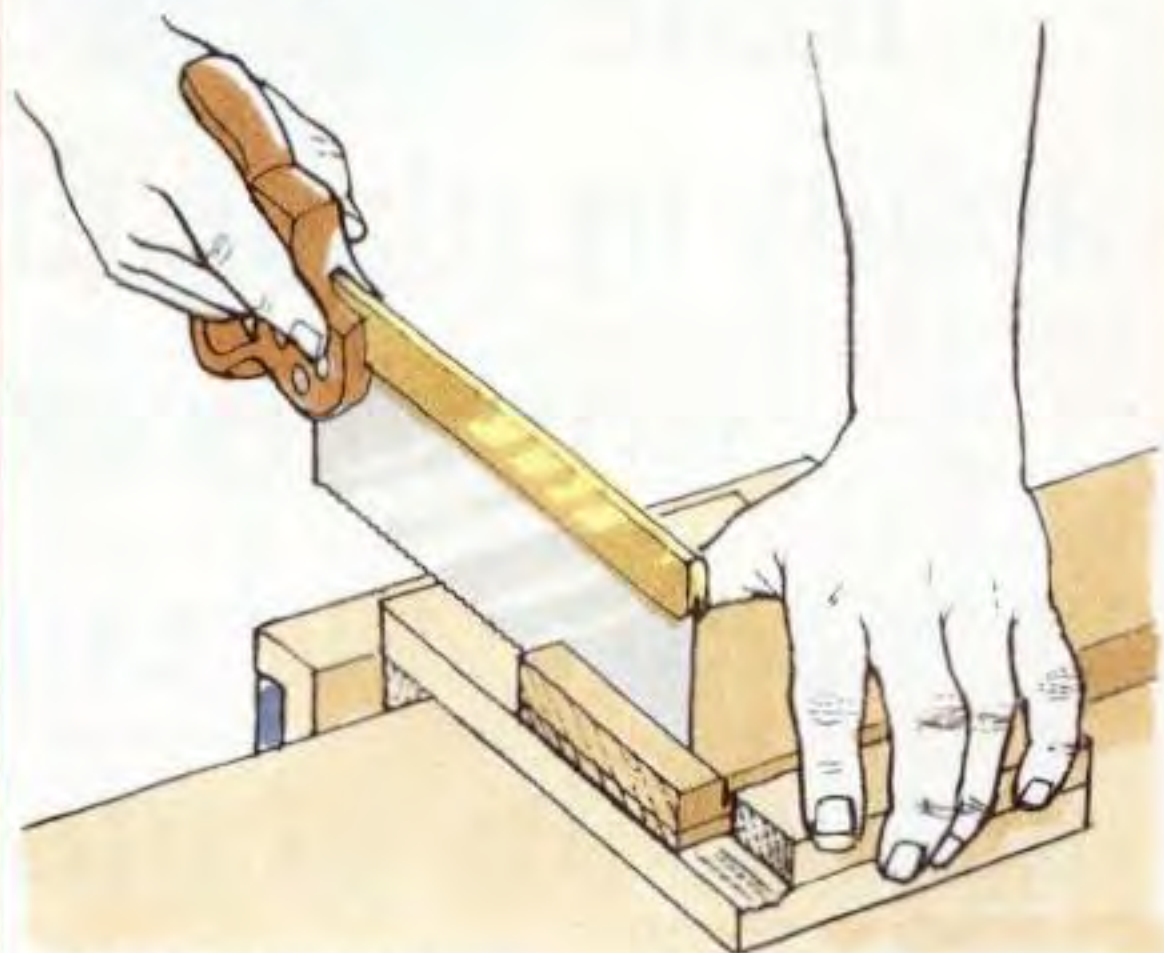
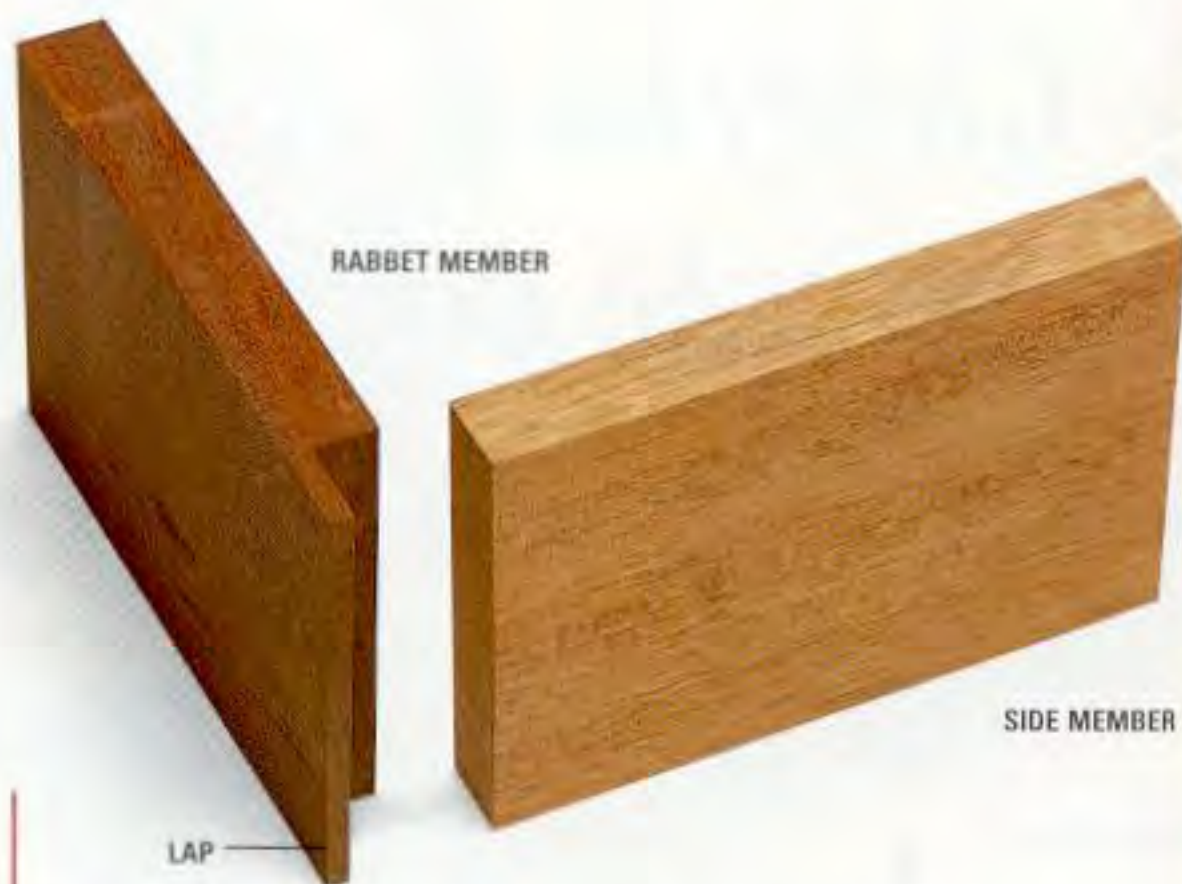
1 Marking out the rabbet

Cut and plane both members square. Adjust a marking gauge to about one-quarter of the thickness of the rabbet member, and scribe a line across the end grain, working from the face side. Continue the line on both edges, down to the level of the shoulder.



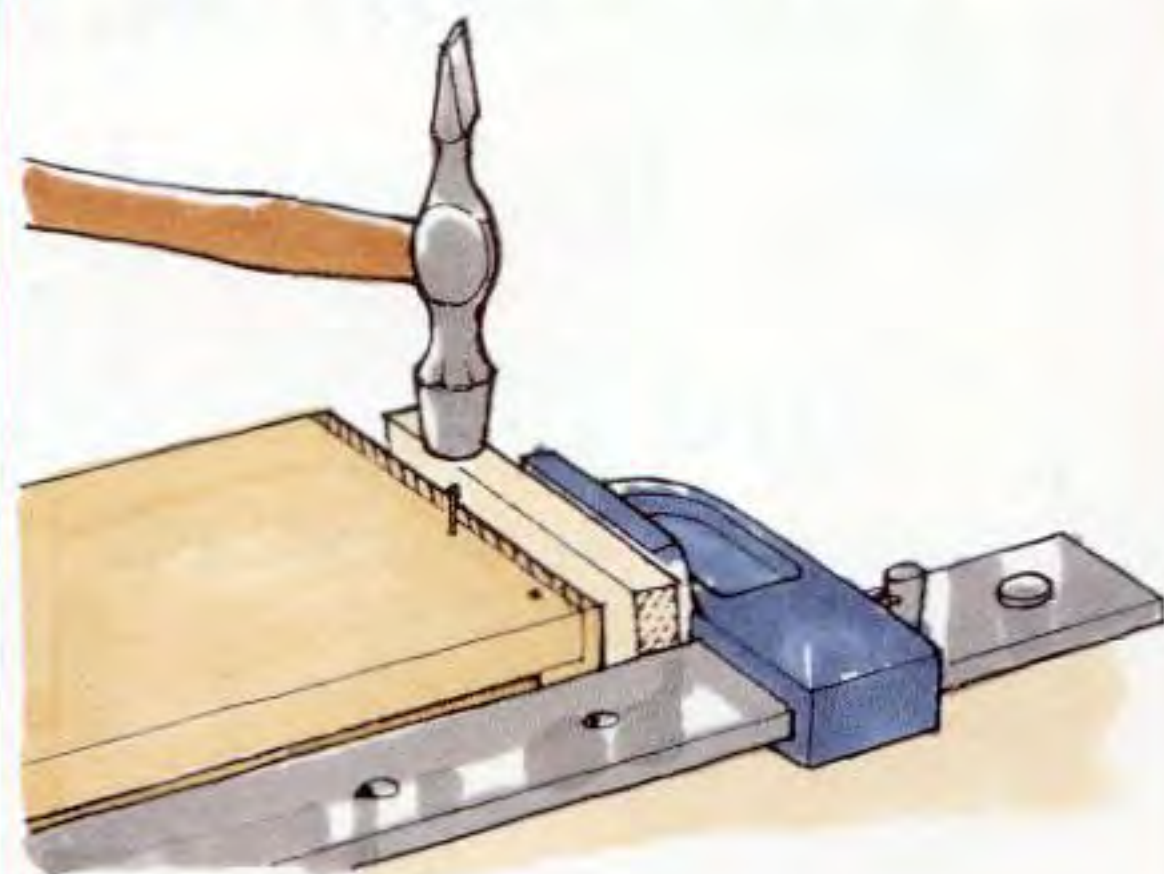
2 Marking the shoulder

Set a cutting gauge to match the thickness of the side member, and scribe a shoulder line parallel to the end grain on the back of the rabbet member. Continue the shoulder line across both edges to meet the lines already scribed.



3 Cutting the joint

Clamp the rabbet member upright in a vice. Following the line scribed across the end grain, saw down to the shoulder line. Lay the work face-down on a bench hook and cut down the shoulder line with a tenon saw to remove the waste. Make a neat joint by cleaning up the rabbet with a shoulder plane.



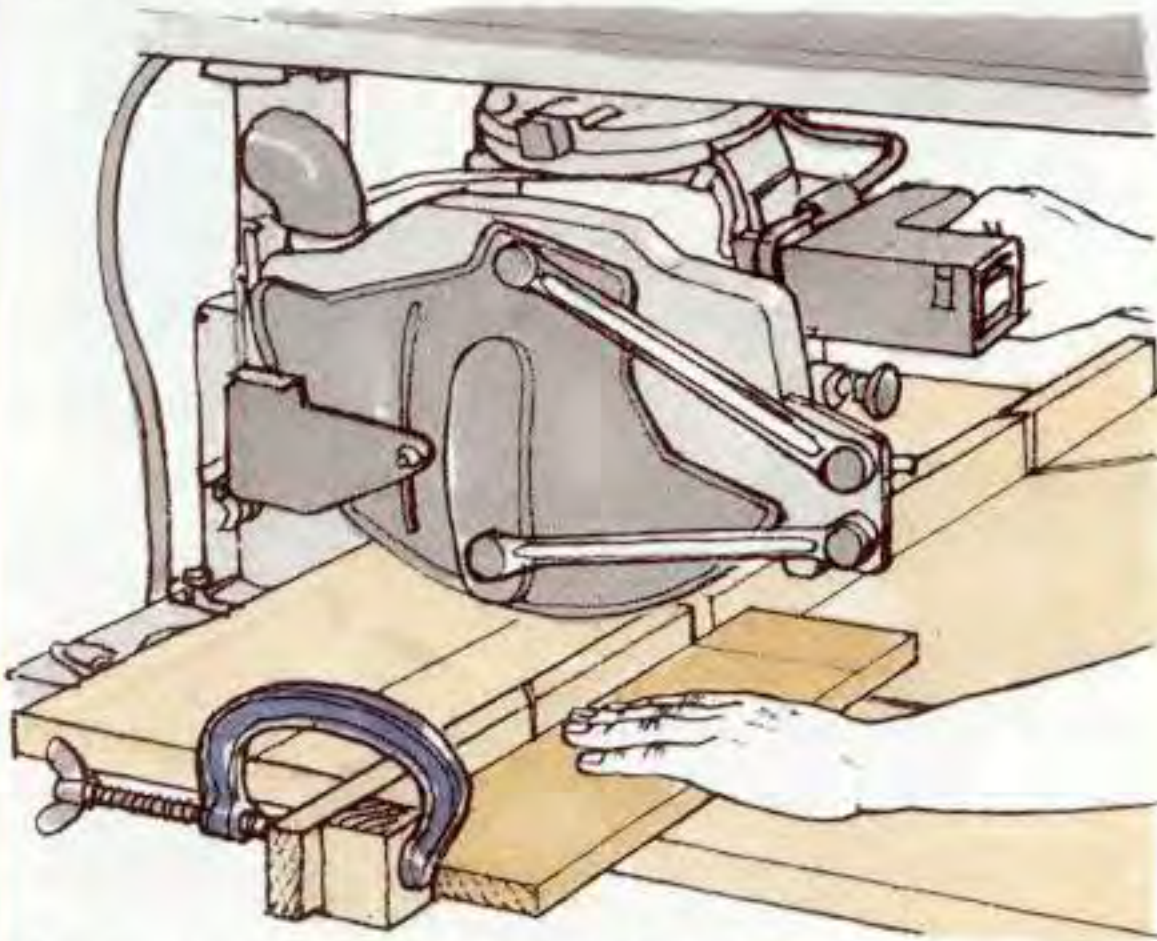
4 Assembling the joint

Glue and clamp the joint, then drive panel pins or small lost-head nails through the side member. Sink the pins with a nail set and fill the holes.

LAP JOINT

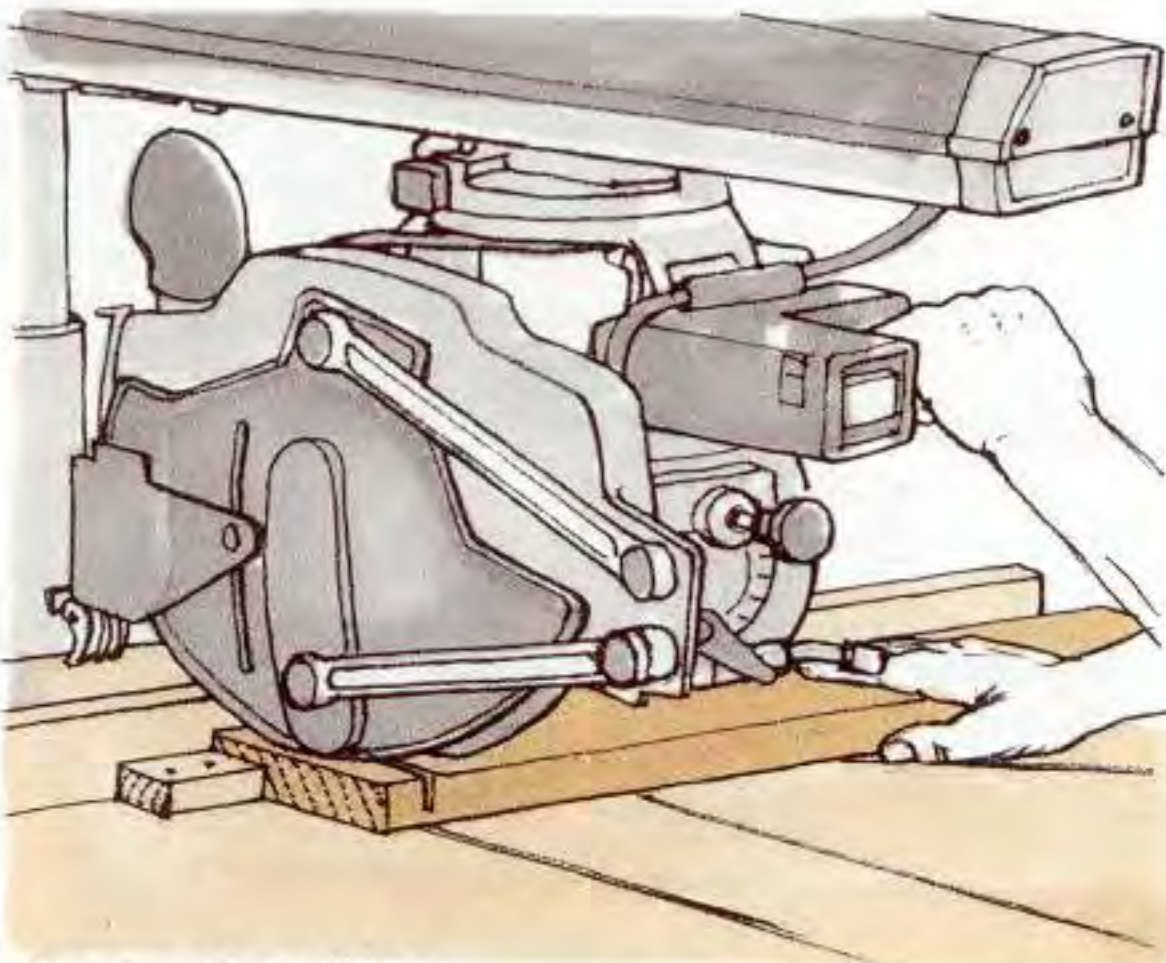
MACHINE CUT

Because it is made with simple saw cuts, the lap joint is particularly easy to produce with a table saw or radial-arm saw.



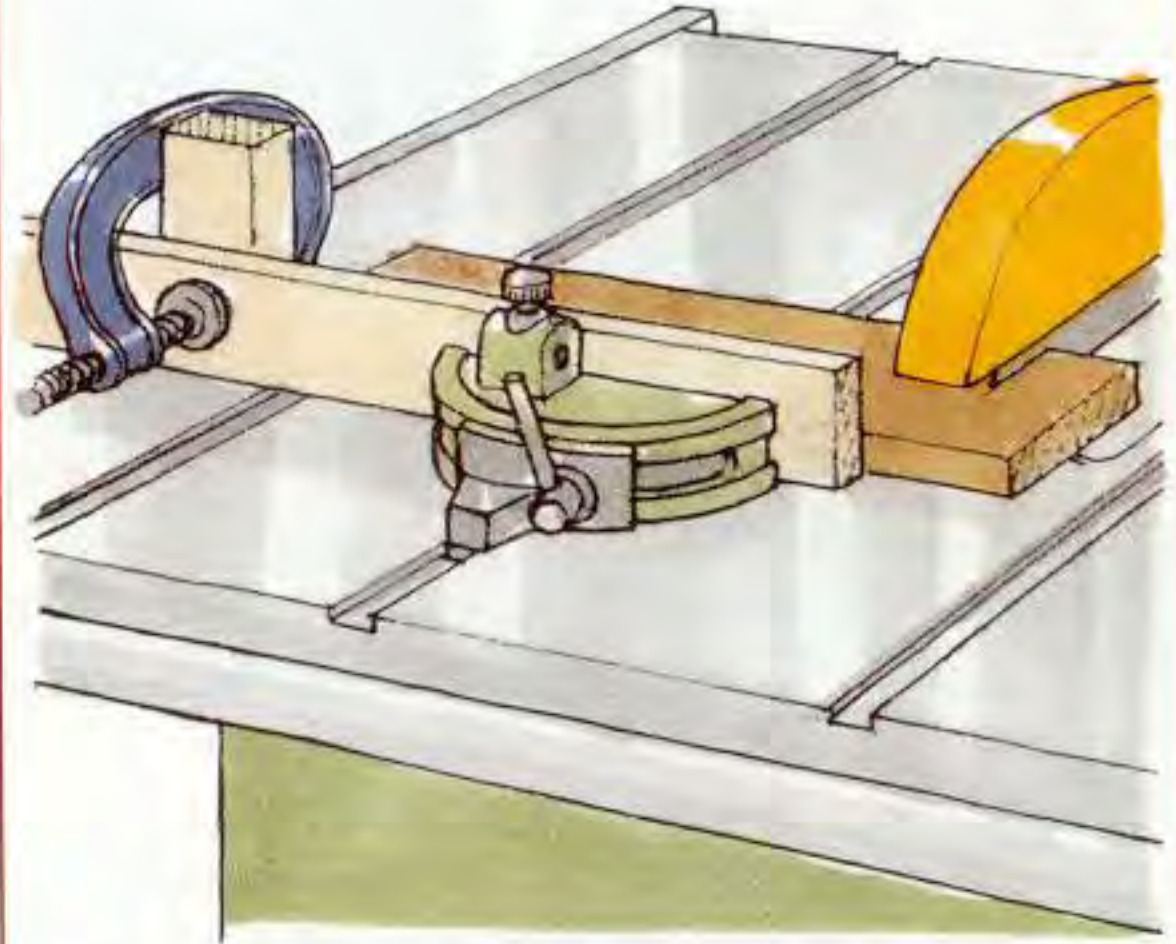
Cutting to length on a radial-arm saw

Holding each component against the fence, pull the saw towards you to cut one end square. Turn the work over and sever the other end. When sawing several identical pieces, clamp an end stop to the fence to save you having to measure each workpiece.



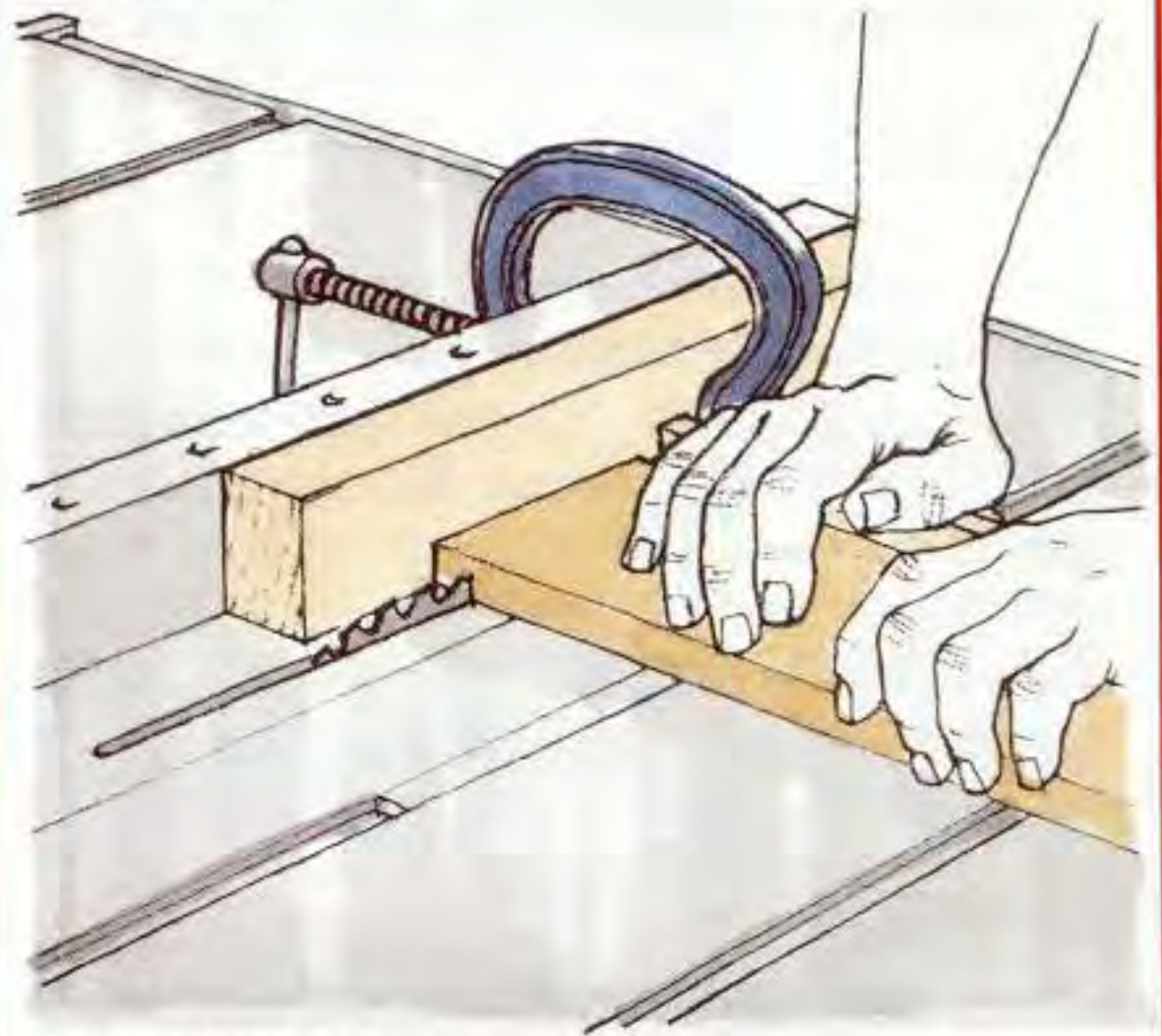
Sawing the rabbet

Adjust the blade to cut three-quarters through the workpiece. Mark the shoulder on the back of the rabbet member, then align it with the blade to cut just to the waste side of the line. Having cut the shoulder, slide the work sideways one blade-width at a time, gradually removing the waste. To cut identical shoulders, align the squared end of the wood with a pencil line drawn on the fence, or butt the end against a block nailed temporarily to the saw's worktable.



Cutting to length on a table saw

Cut square both ends of each workpiece. When cutting identical pieces to length, attach an extension to the table saw's mitre fence and clamp an end stop to it (see page 20).



Cutting the rabbet

Adjust the blade height to saw three-quarters through the workpiece. Butt the end of the work against a spacer block clamped to the saw's rip fence, then adjust the fence to saw just to the waste side of the shoulder line. Make a short trial cut to check the accuracy of your settings, then pass the work over the blade. Slide the work sideways away from the rip fence to remove the waste in stages (see left).

MITRED LAP JOINT

HAND CUT

A mitred lap joint is somewhat neater than the basic version, but is more difficult to cut.



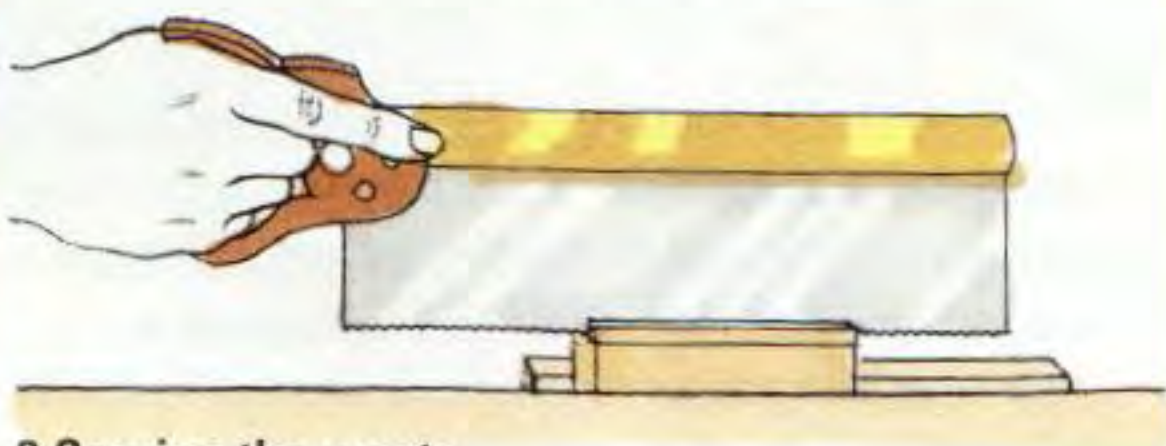
1 Marking and cutting the mitre

Mark out and cut the rabbet as described for the basic joint (see page 42), then use a mitre square and marking knife to score a 45-degree mitre on the end of the projecting lap. Score a line across the inside of the lap to mark the base of the mitre, and carefully plane off the waste down to this line.



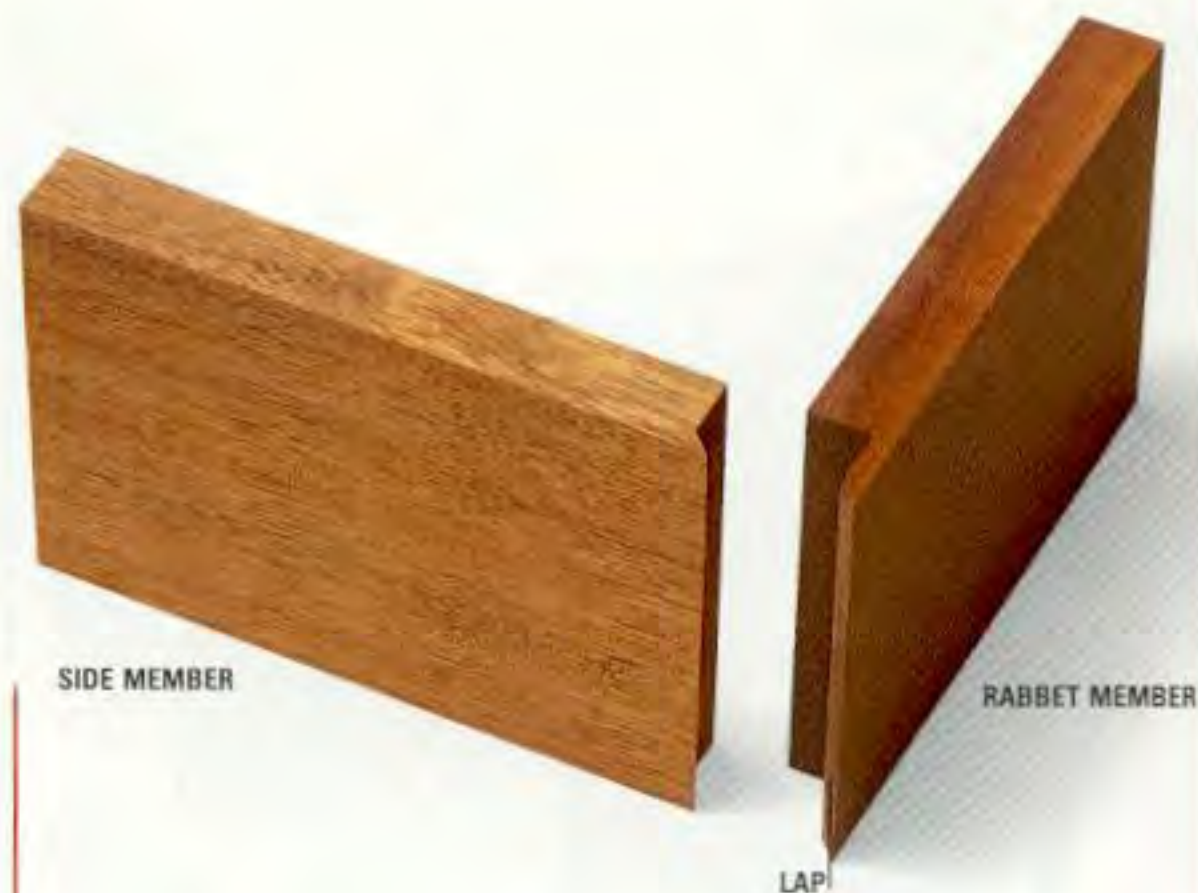
2 Marking the side member

Set a cutting gauge to the thickness of the lap, and use it to scribe a shoulder line across the inside and both edges of the side member. Then, with the stock of the same gauge pressed against the face side, scribe a line across the end grain and down each edge to meet the shoulder line. Mark the slope of the mitre from the outer corner down to the shoulder line.



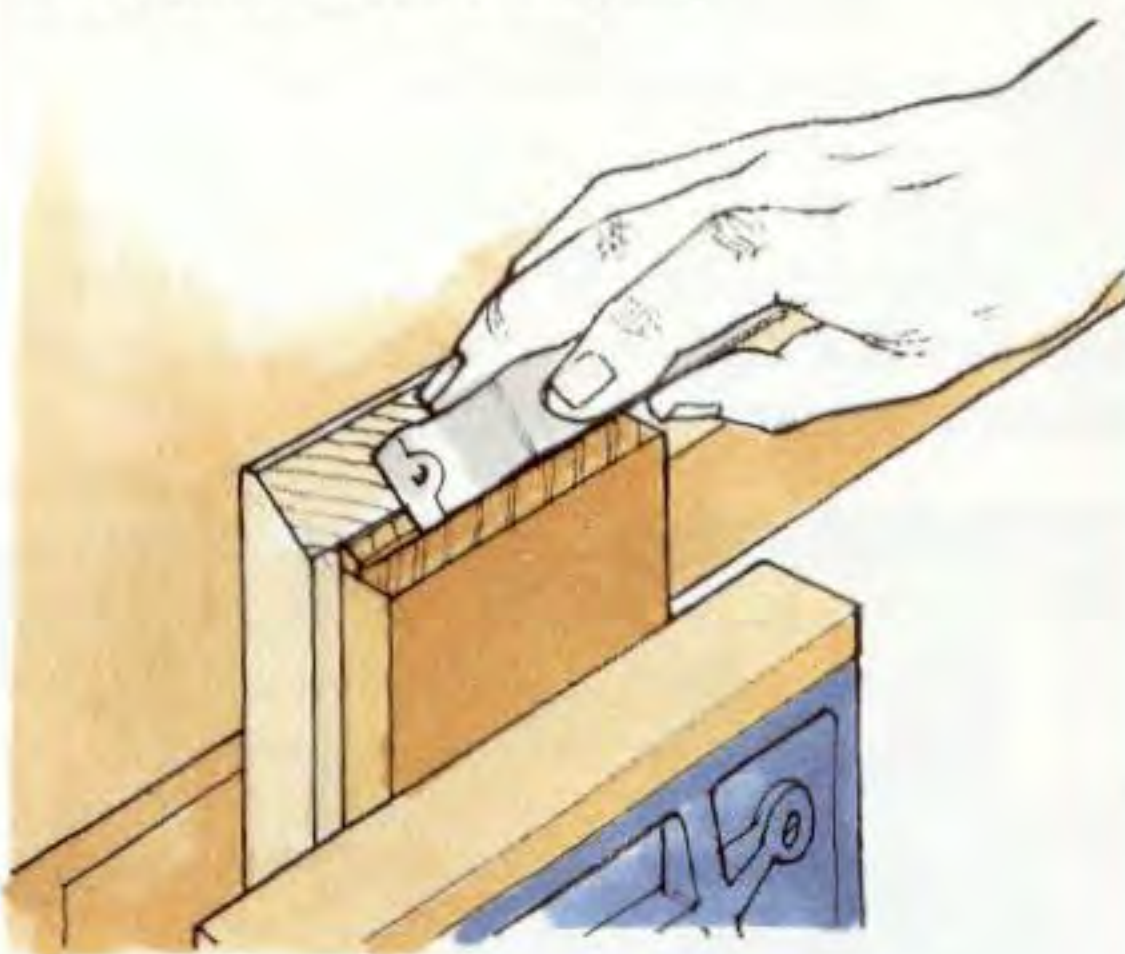
3 Sawing the waste

Set the workpiece upright in a vice and, following the line scribed across the end grain, saw down to meet the shoulder line. Then, holding the side member face-down on a bench hook, saw down the shoulder line to remove the waste.



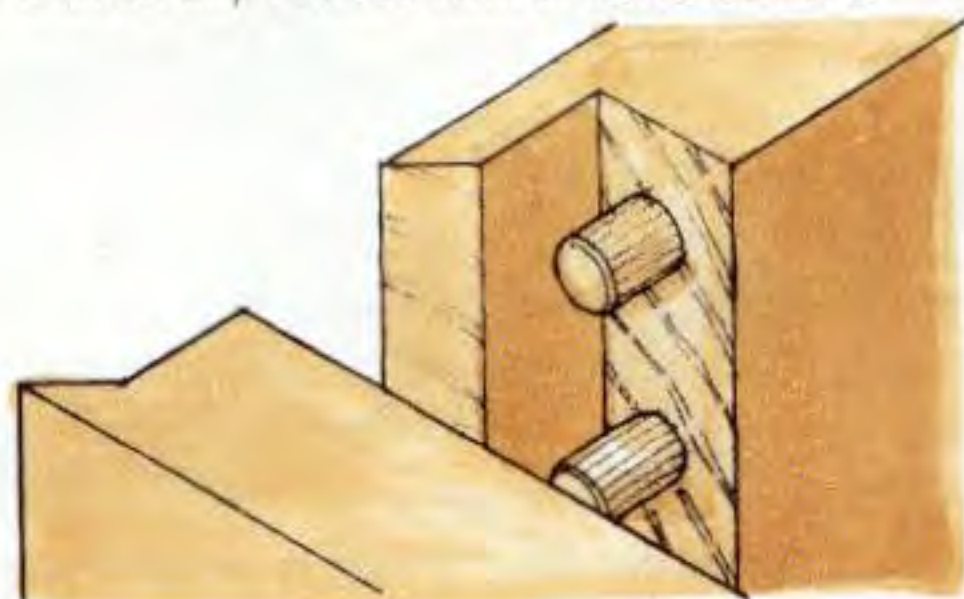
4 Planing the mitre

Use a shoulder plane to trim the mitre, clamping a backing board bevelled to 45 degrees behind the work, to help guide the sole of the plane.



DOWELLED MITRE JOINT

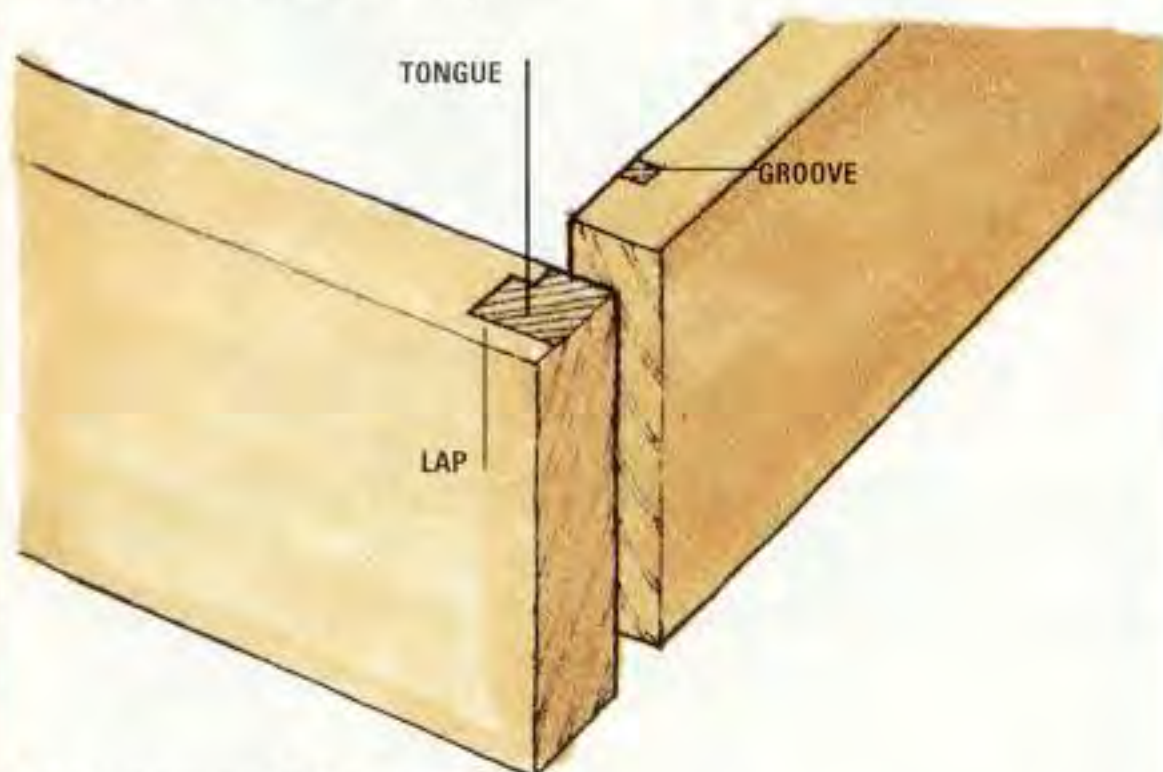
Use stopped dowels if you want to strengthen the joint without any obvious form of reinforcement.



HALF-BLIND LAP JOINT

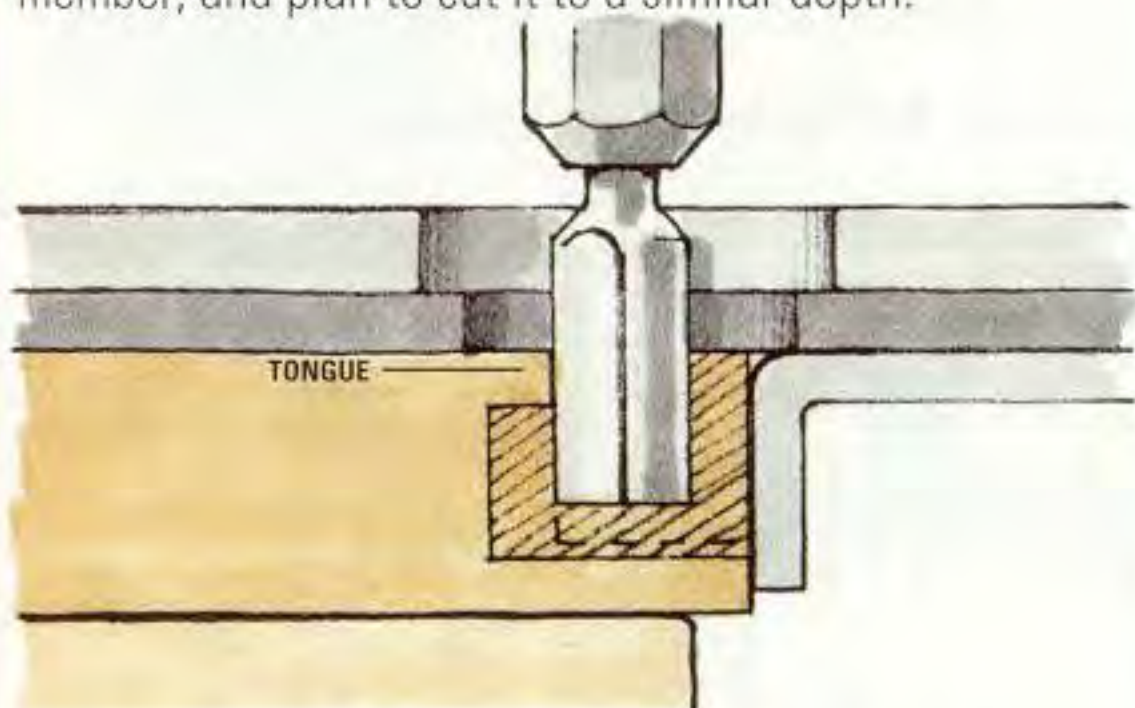
MACHINE CUT

The half-blind lap joint can be cut on a table saw (see page 46), or with a power router, as described here. It is sometimes used by woodworkers as a substitute for the lapped dovetail in drawer construction, but it is not nearly as strong. When making the joint, prepare and sand the work beforehand, since any change in size afterwards will result in a loose joint.



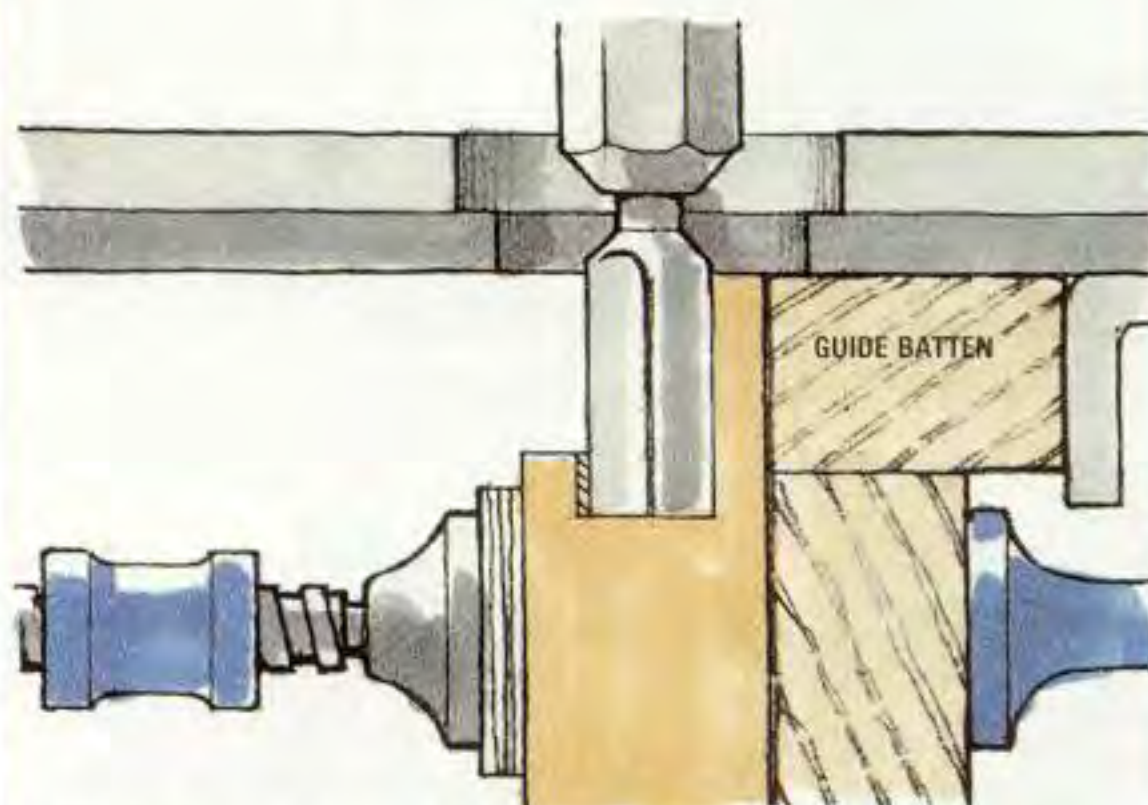
Marking out the joint

In order to visualize the joint and help you set up the router, mark out the joint first on one pair of components. Other identical joints will not require marking. The lap on the rabbet member should be about 4 to 6mm ($\frac{3}{16}$ to $\frac{1}{4}$ in) thick. Choose a router cutter of a similar diameter to machine the groove in the side member, and plan to cut it to a similar depth.



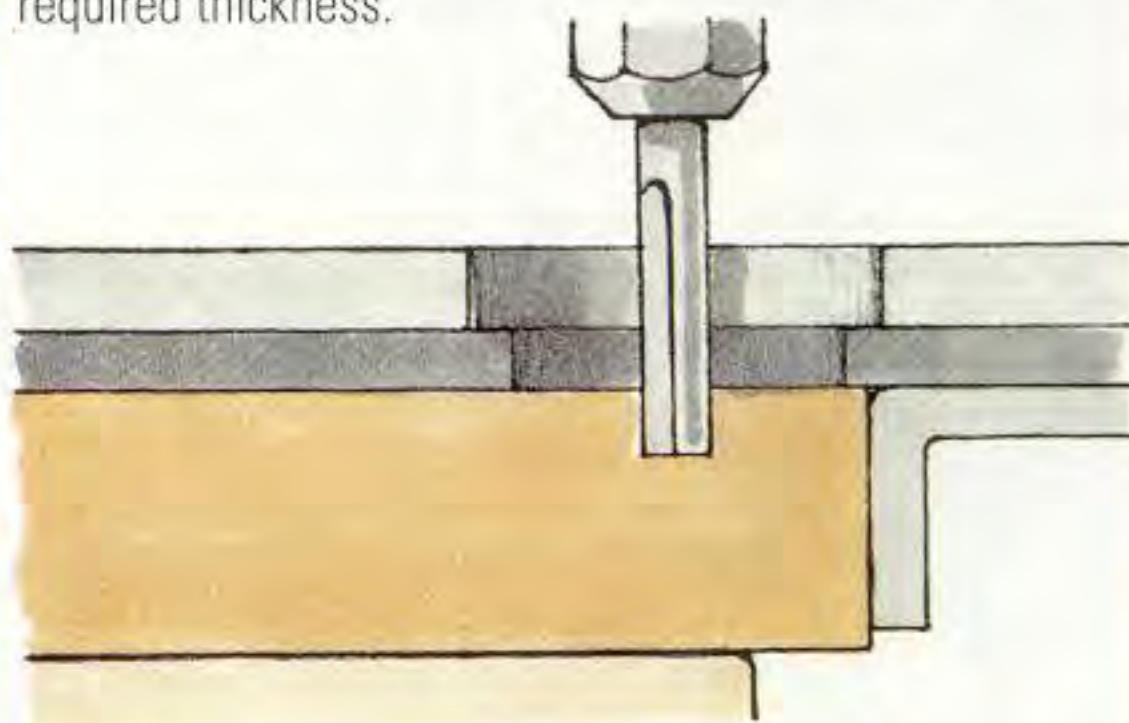
1 Machining the rabbet member – first cut

Clamp the workpiece face-down on the bench. Adjust the router fence until the cutter will remove the waste up to the end of the tongue. Remove the waste in stages, stopping just short of the lap. You can machine several identical components at once if you clamp them side-by-side, flat on the bench.



2 Machining the rabbet member – second cut

Clamp the work upright in a vice. To help steady the router, clamp a guide batten to the face side, flush with the end grain. Adjust the router fence to trim the lap to the required thickness, and set the depth of cut to remove the remaining waste. Reset the fence to make another pass with the cutter, leaving the tongue at the required thickness.



3 Cutting the groove

Set the depth of cut to match the length of the tongue, and adjust the fence to place the groove the required distance from the end of the workpiece. Make the cut with a single pass. Once again, you can save time by machining several workpieces at once.

LOCK MITRE JOINT

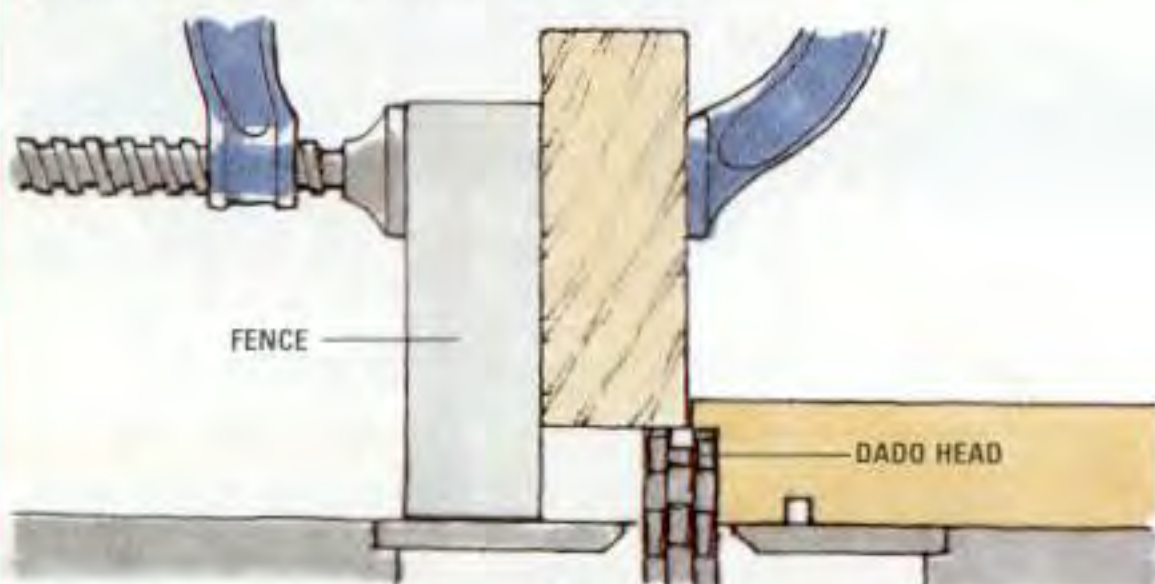
MACHINE CUT

The lock mitre is similar to the half-blind lap joint, but is made with a small mitre that conceals the end grain, or the core of suitable man-made boards, at the corner. The joint can be cut entirely on a table saw – using a dado head enables you to cut the joint quickly, but you can remove the waste in stages using a conventional saw blade.



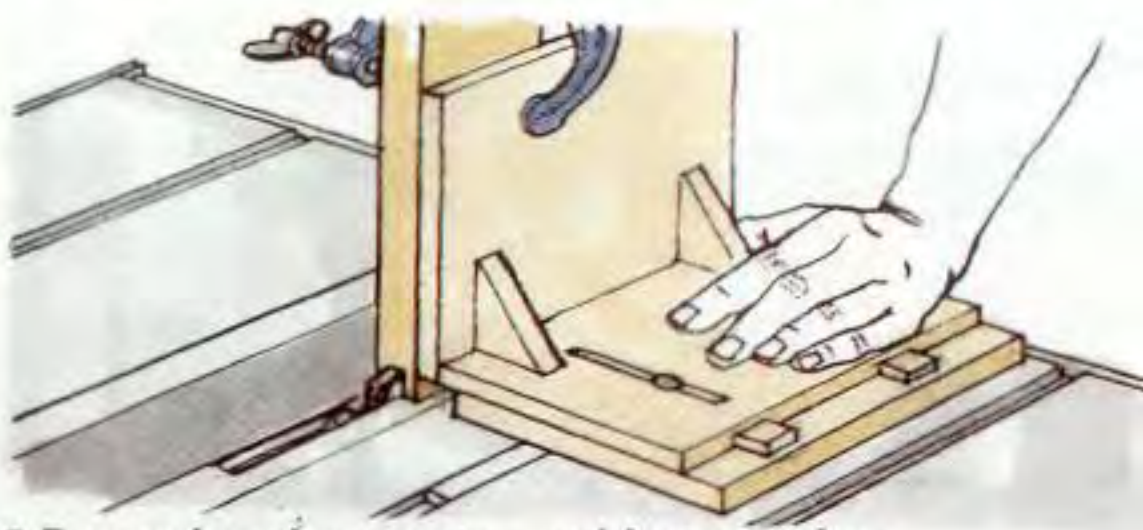
1 Cutting the groove – side member

Cut the groove across the side member with a single pass across the circular saw blade.



2 Cutting the rabbet – side member

Set up the saw with a dado head and adjust the height to remove enough waste to leave a short square lap that will form the mitre at a later stage. Clamp a wooden spacer to the rip fence, just above the dado head, against which you can butt the end of the work.



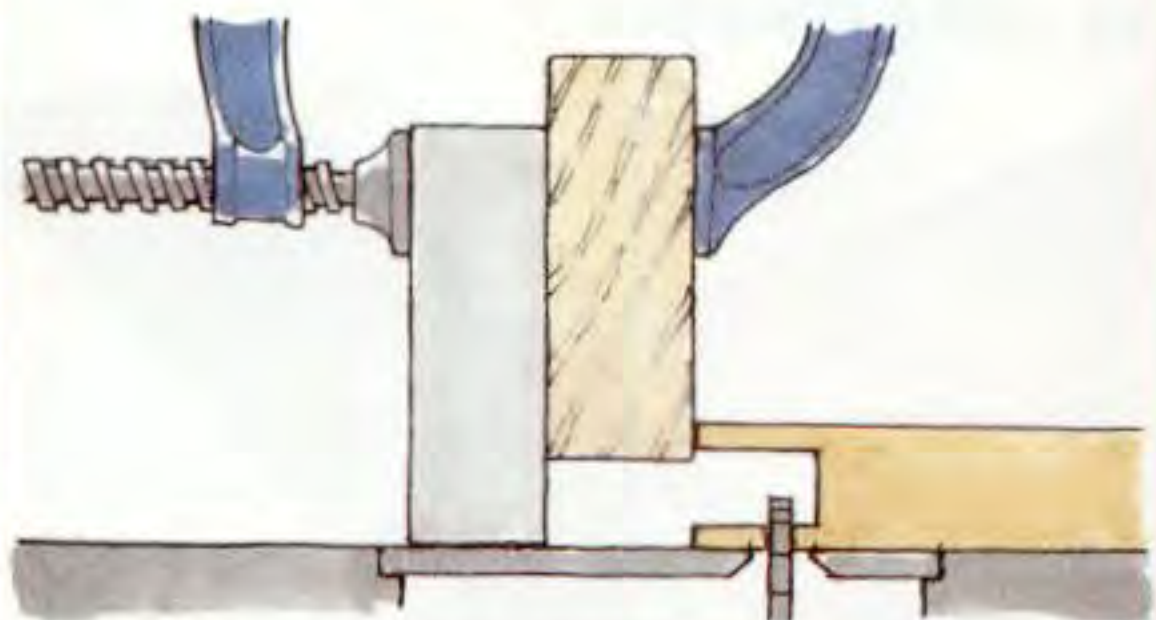
3 Removing the waste – rabbet member

Adjust the saw and use a dado head that will leave a lap that is about one-quarter of the wood's thickness, and a tongue on the inside that will fit the groove cut in the side member. Set the height of the dado head to match the thickness of the side member. Then clamp the rabbet member upright in a tenon-cutting jig (see page 80), and remove the waste with one pass across the saw blade.



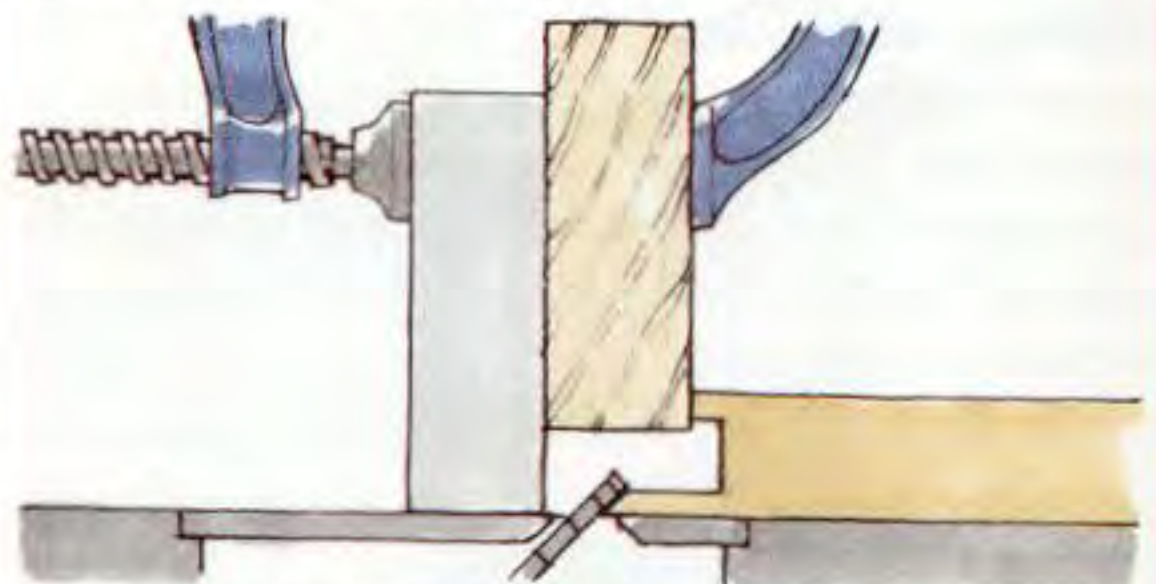
RABBET MEMBER

SIDE MEMBER



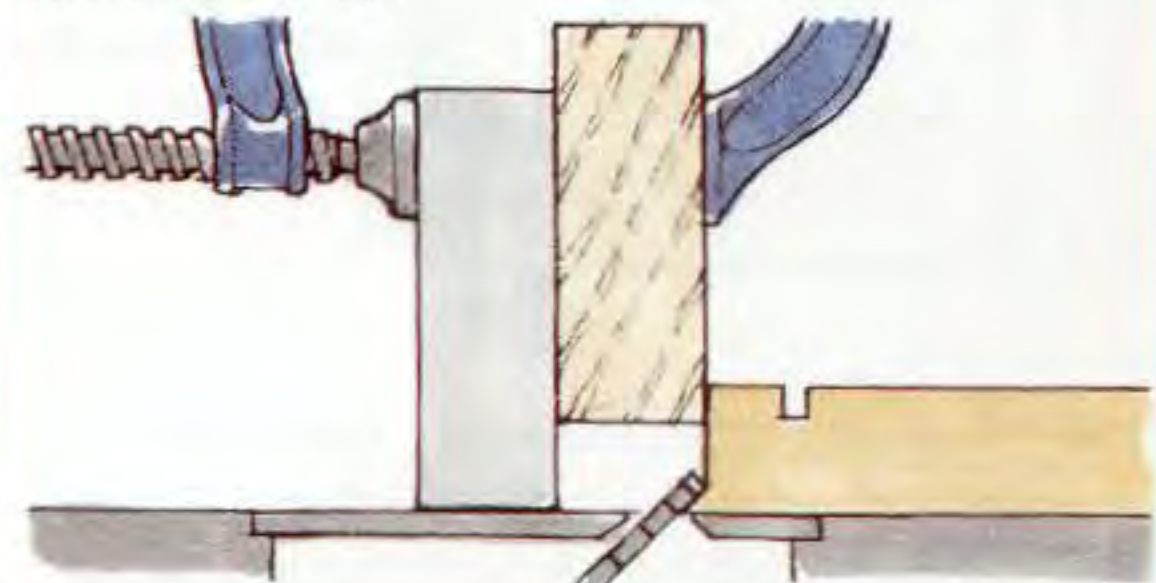
4 Cutting the tongue – rabbet member

Change to a conventional saw blade, and set the rip fence to cut the short tongue to length.



5 Cutting the mitre – rabbet member

Tilt the blade, and then adjust the saw's settings to trim the end of the lap to 45 degrees, taking care not to shorten the lap.



6 Cutting the mitre – side member

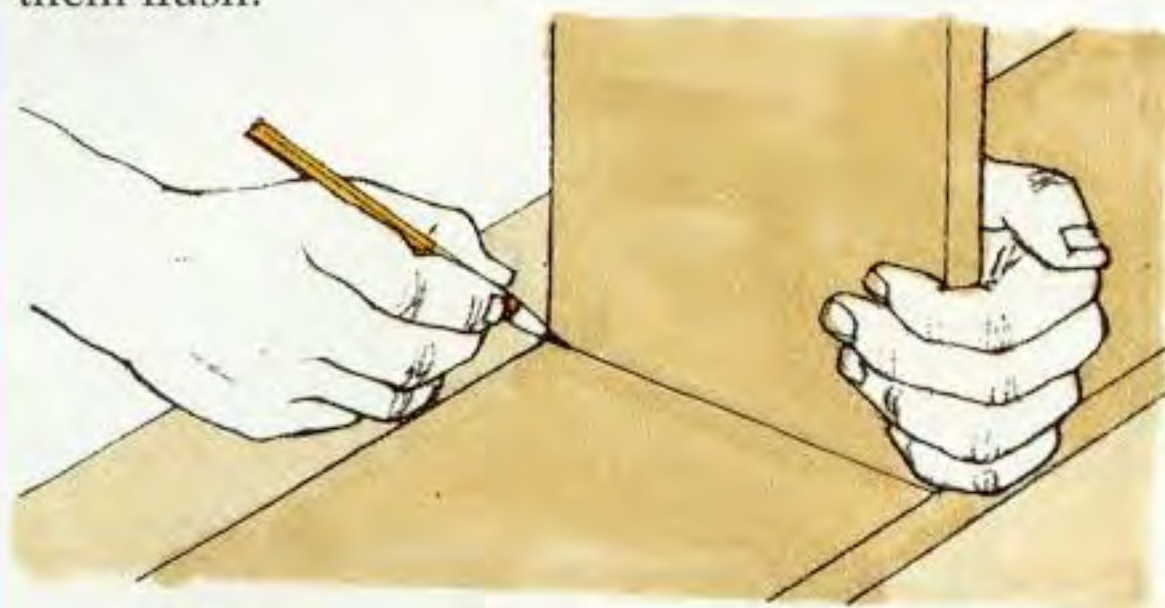
Adjust the saw to mitre the short square lap on the side member to 45 degrees. Adjust the blade precisely, to avoid scoring a notch across the shoulder.

CHAPTER 7 A housing is a groove cut across the grain. When used as a joint, it houses the end of a board, most frequently a fixed shelf or dividing panel. The housing is either stopped short of the front edge of the work or, for less-important work, the joint may emerge as a through housing. The shelf or panel is usually glued into a simple straight-sided housing. However, for a more positive joint, a dovetail can be included.

THROUGH HOUSING JOINT

HAND CUT

This simple through joint shows on the front edges of side panels. It is suitable for rough shelving, or for cupboards with lay-on doors that cover the front edges. If you plan to lip the boards, it is best to apply the lippings first, so it is easier to plane them flush.



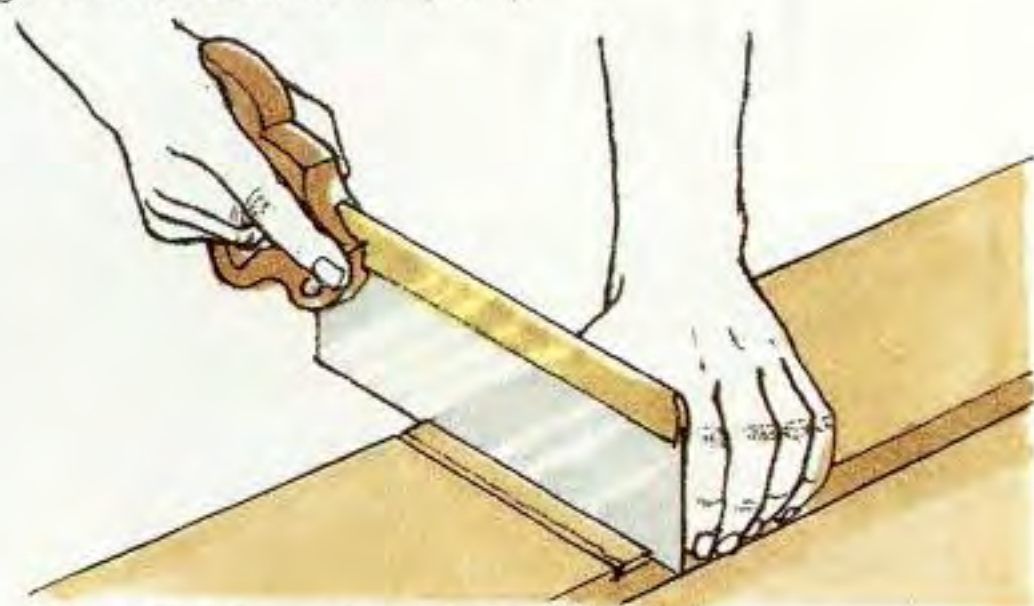
1 Marking the face of the side panel

Measure the width of the housing from the shelf, then score the two lines across the workpiece, using a try square and marking knife.



2 Marking the edges

Square the same lines onto the edges of the panel, then scribe a line between them, using a marking gauge set to about 6mm (1/4in).



3 Sawing the housing shoulders

To make it easier to locate a saw across a wide panel, take a chisel and pare a shallow V-shape groove up to the marked line on both sides of the housing, then use a tenon saw to cut each shoulder down to the lines scribed on each edge.



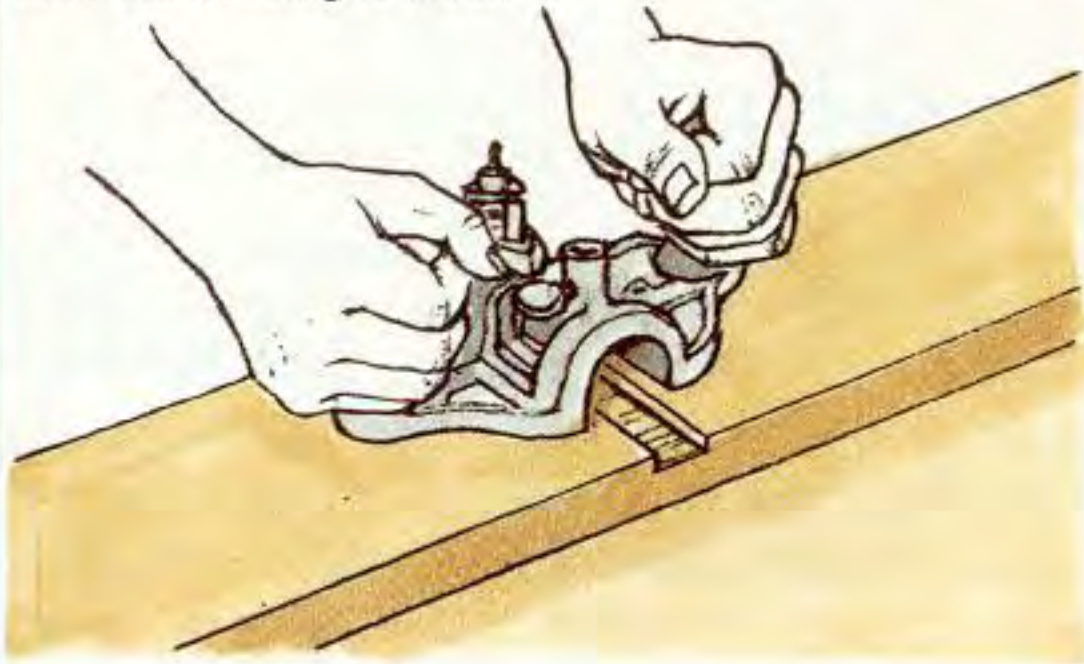
4 Removing the waste

Pare out the waste from a narrow panel with a chisel, working from each side towards the middle.



USING A ROUTER PLANE

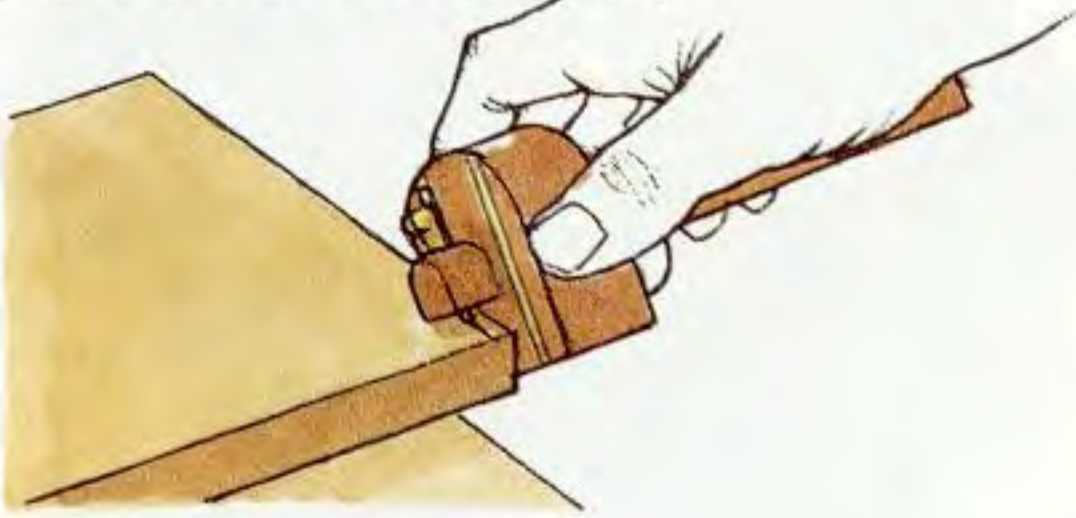
Having chiselled out most of the waste, pare the bottom of a housing level, using a special router plane fitted with a narrow, adjustable L-shape blade. When a panel is too wide to use a chisel conveniently, remove all the waste in stages by making several passes with the router plane, lowering the cutter each time the housing is level.



DOVETAIL HOUSING JOINT

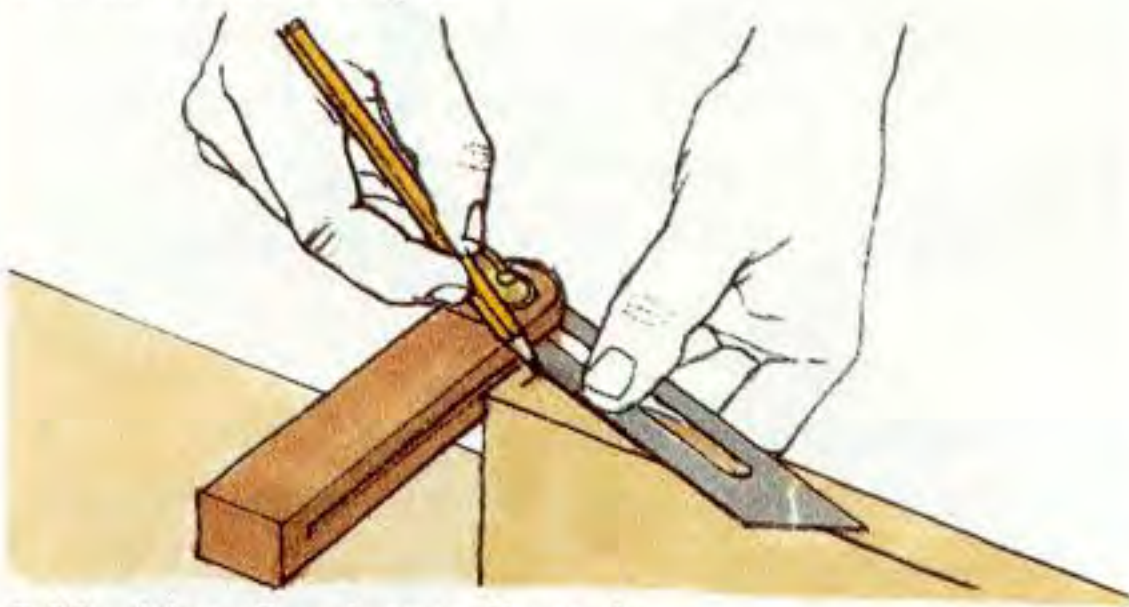
HAND CUT

When cutting this joint by hand, incorporate a single dovetail along one side of the housing. Double-sided dovetails are best cut with a router (see page 51). Since the shelf member must be slid into place from one end of the housing, the joint needs to be cut accurately.



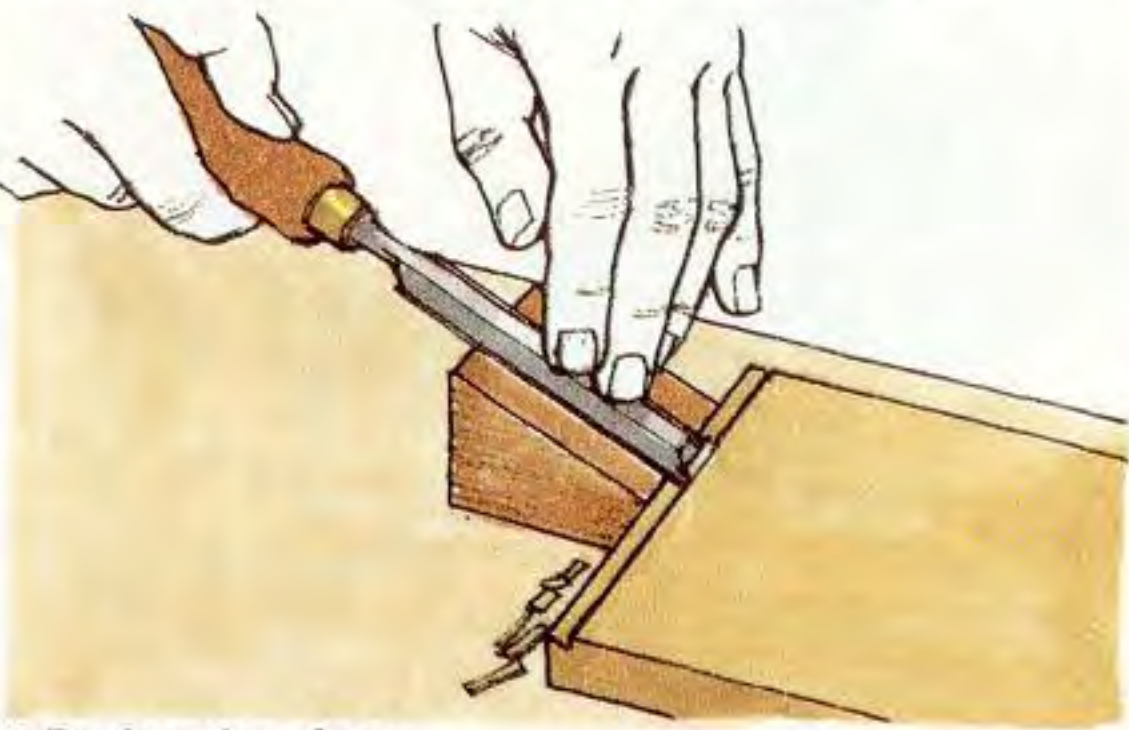
1 Marking the shoulder

Set a cutting gauge to about one-third the thickness of the wood and score a shoulder line on the underside of the shelf. Using a try square and pencil, continue the line across both edges.



2 Marking the dovetail angle

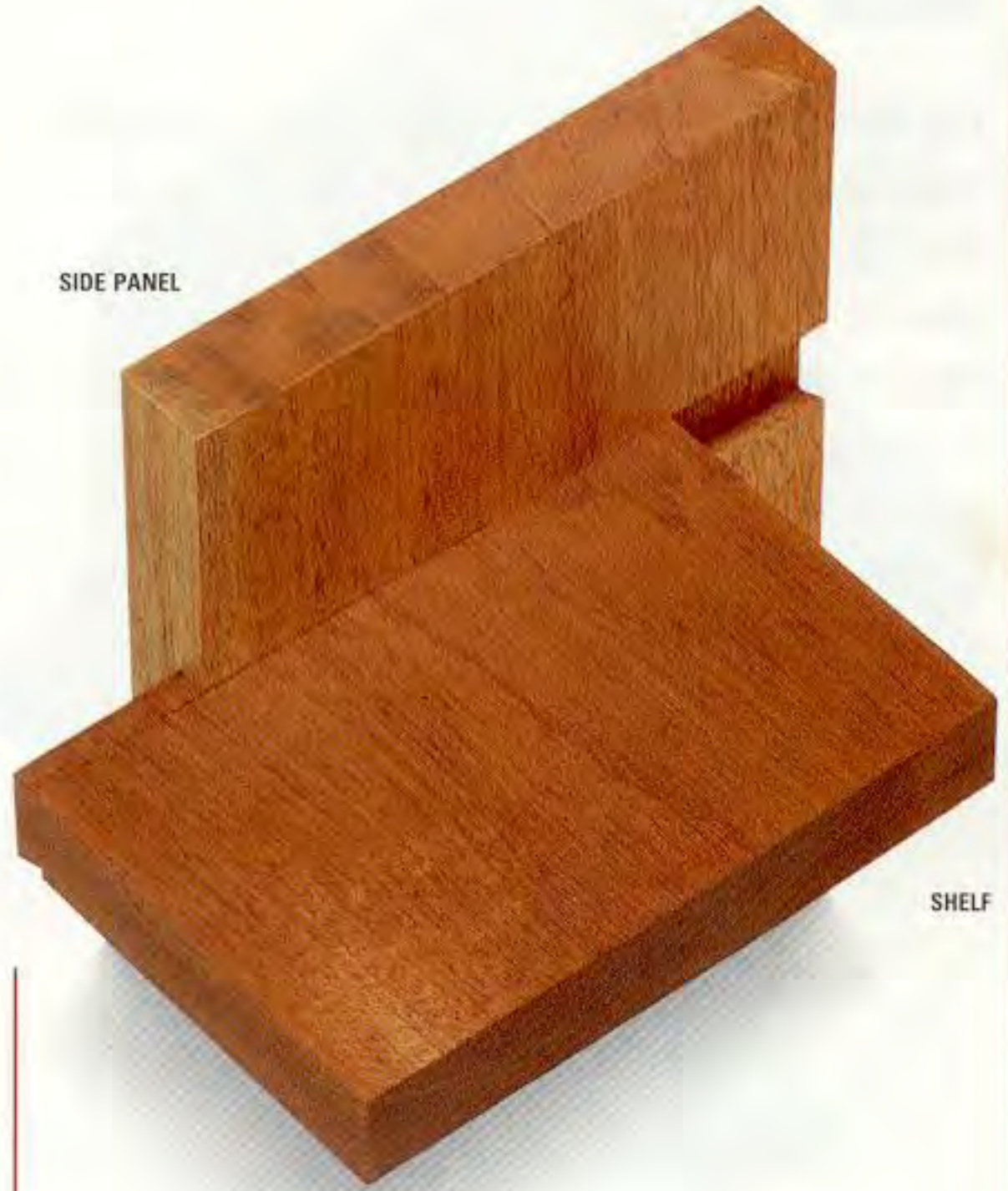
Set a sliding bevel to a dovetail angle (see page 82), and mark the slope of the joint, running from the bottom corner to the marks drawn on both edges.



3 Paring the slope

Saw along the shoulder line, down to the base of the slope, then pare out the waste with a chisel. To help keep the angle constant, use a shaped block of wood to guide the blade.

SIDE PANEL



SHELF

4 Cutting the housing

Mark out the housing as described opposite, and use the sliding bevel to mark the dovetail on both edges of the panel. Saw both shoulders, using a bevelled block of wood to guide the saw blade when cutting the dovetail. Remove the waste with a router plane, or use a bevel-edge chisel to clear the undercut.

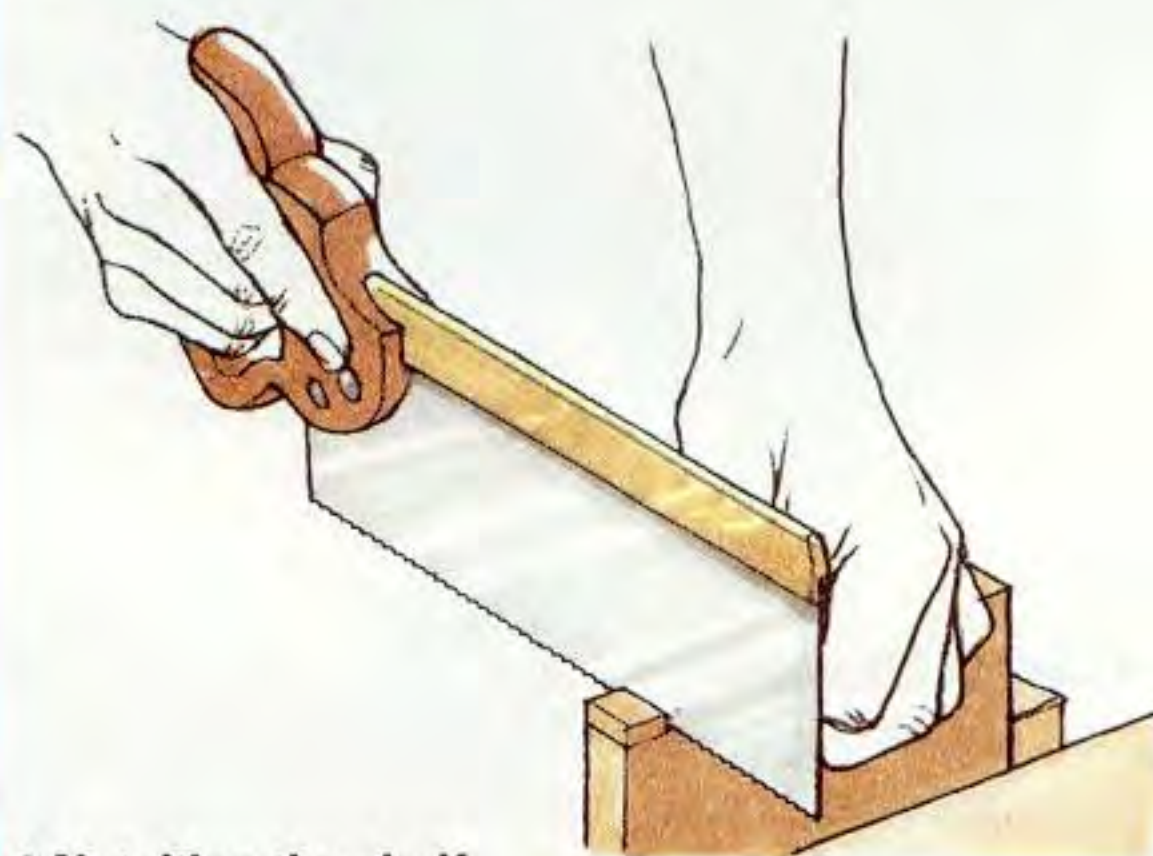


STOPPED HOUSING JOINT

HAND CUT

For decorative effect, the housing is often stopped short of the front edge of the side panel by about 9 to 12mm ($\frac{3}{8}$ to $\frac{1}{2}$ in). Occasionally, the shelf is also cut short, fitting the housing exactly – useful when making a cupboard with inset doors.

Generally, however, the front edge of the shelf is notched so that its front edge finishes flush with the side panel. The instructions below explain how to cut the joint with handtools, but a power router is perhaps the ideal tool for cutting a stopped housing (see opposite).



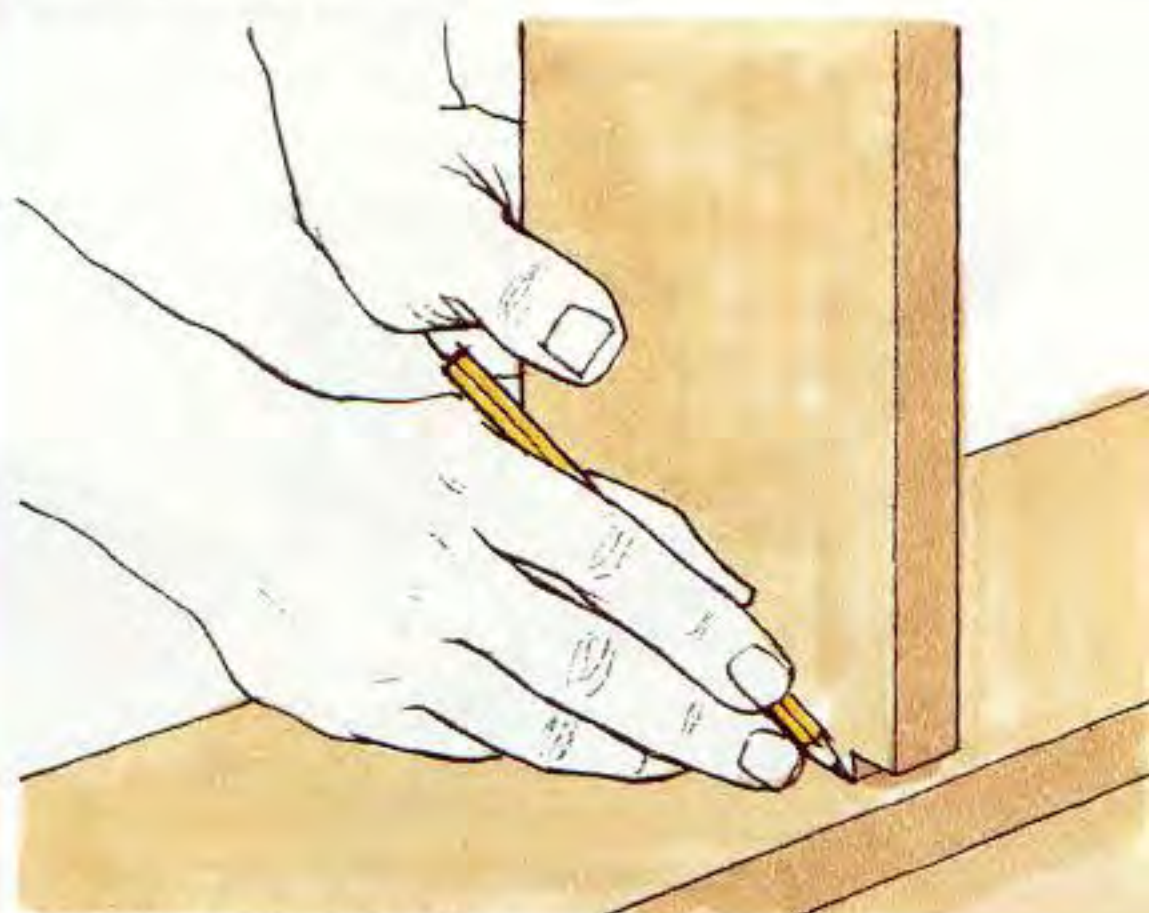
1 Notching the shelf

Set a marking gauge to the planned depth of the housing, and use it to mark the notch on the front corner of the shelf. Cut the notch with a tenon saw.



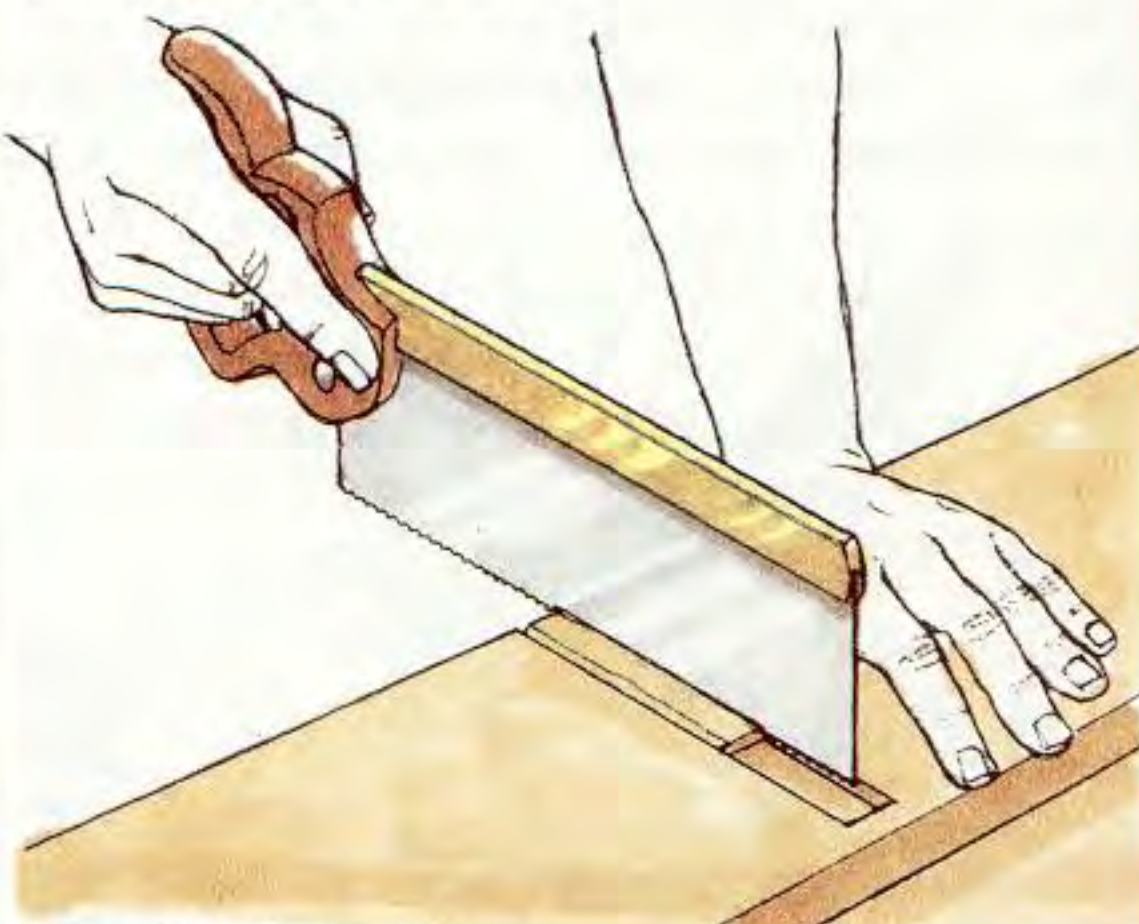
3 Cutting the stopped end

To provide clearance for sawing the housing, first drill out the waste at the stopped end and trim the shoulders square with a chisel.



2 Marking the housing

Use the notched shelf to mark the dimensions of the housing, then score the lines across the side panel with a try square and marking knife. Scribe the stopped end of the housing with a marking gauge.



4 Sawing the housing

Saw along the scored shoulders down to the base of the housing, then pare out the waste from the back edge with a chisel, or use a router plane.

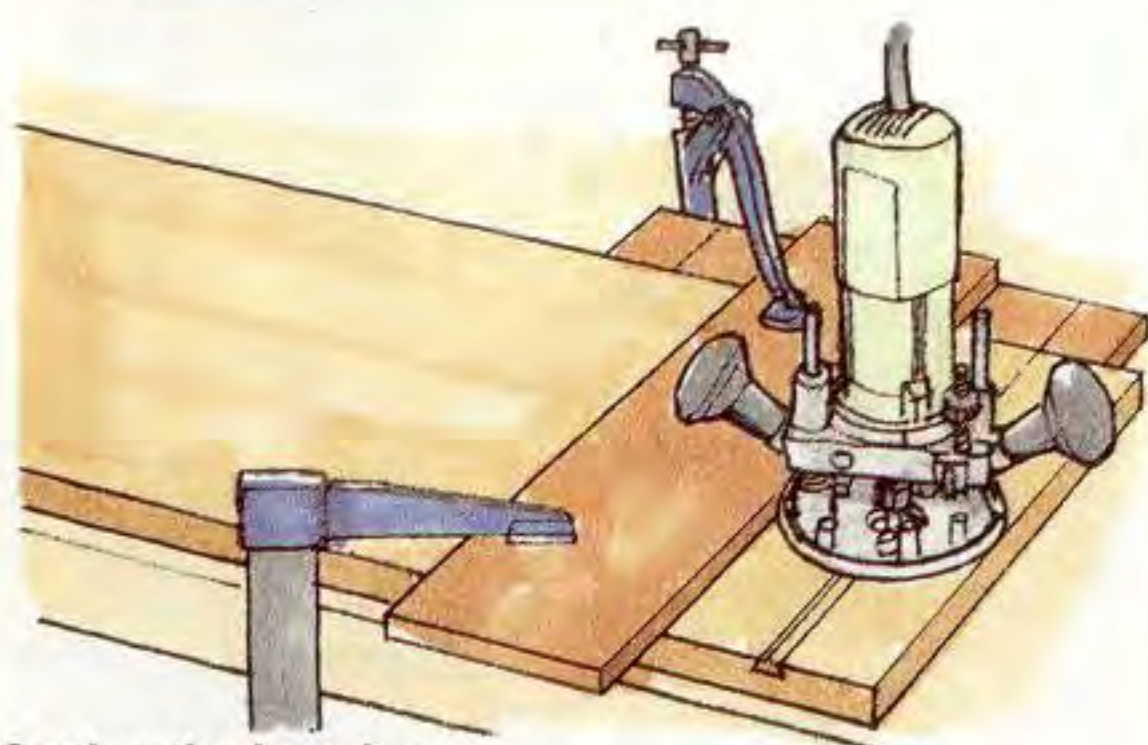
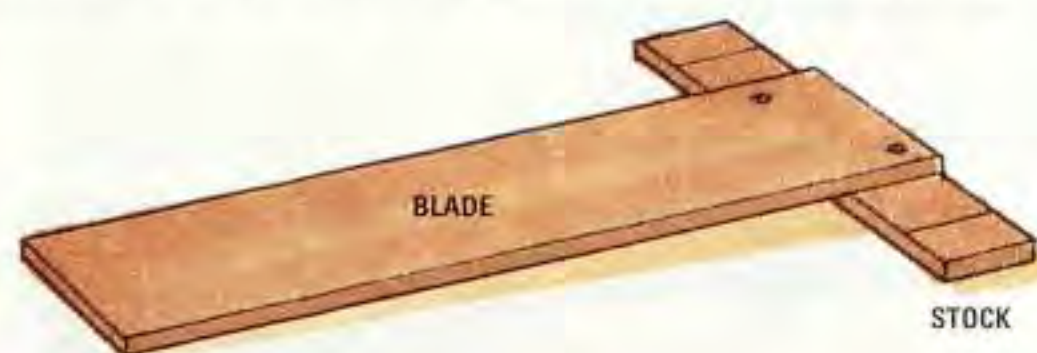
STOPPED STRAIGHT DOVETAIL HOUSING JOINT

MACHINE CUT

You can cut any form of housing joint with a power router, and there is no better tool for machining the fully dovetailed version. The cutter removes the waste and shapes the sides of the housing in one operation. Use a wooden straightedge clamped to the work as a guide for the router or, to make it easier to repeat similar housings, make a T-square from wood. One advantage of using this housing is that the shelf can be sanded after the joint has been cut, without it resulting in a loose fit.

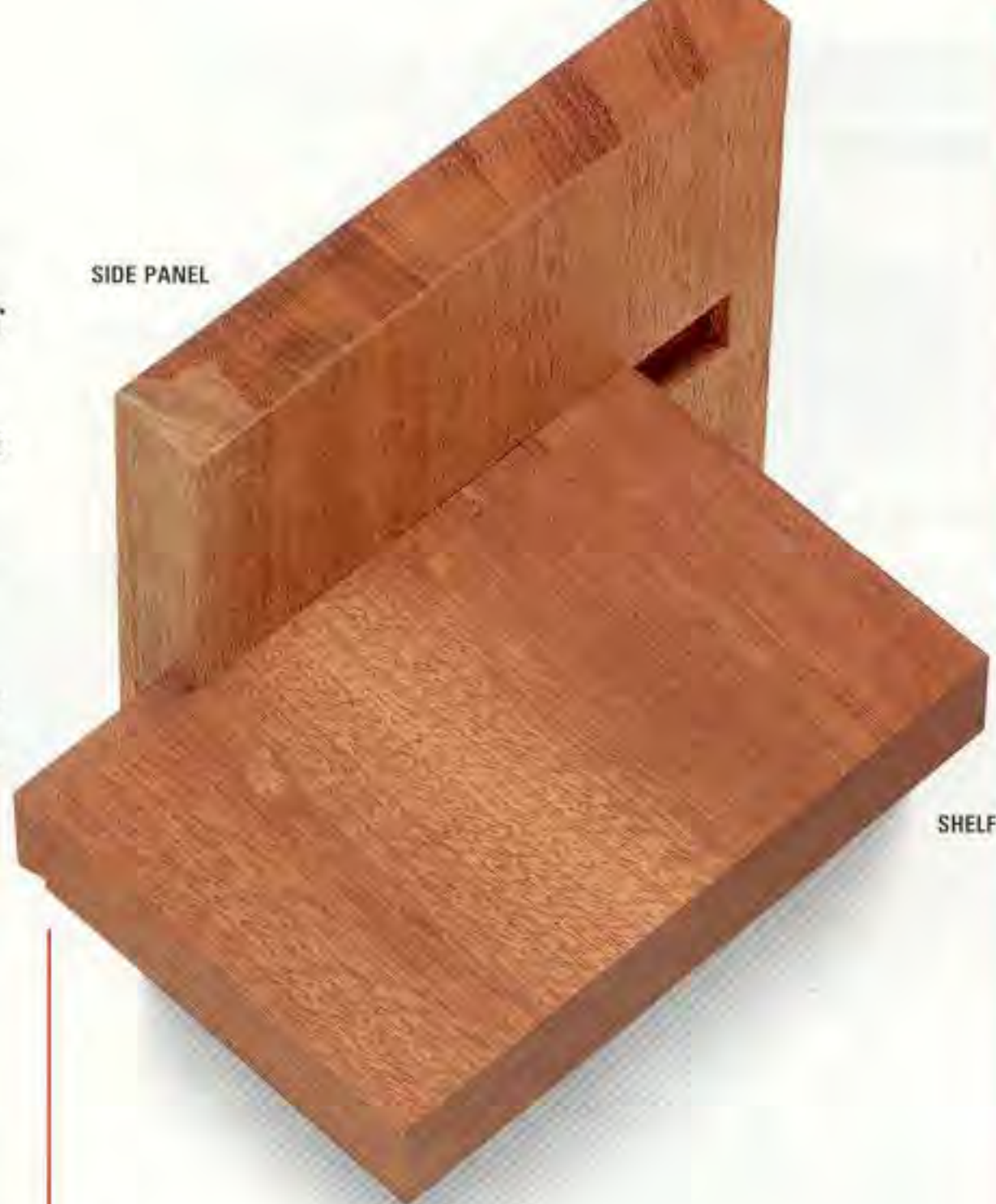
MAKING A T-SQUARE

Prepare 150 x 12mm (6 x 1/2in) straight-grained hardwood, and cut from it a 600mm (2ft) T-square blade. Cut a 400mm (1ft 4in) stock from 75 x 12mm (3 x 1/2in) wood. Screw and glue the blade to the stock at 90 degrees. Mark both ends of the stock with a line that is the same distance from the edge of the T-square blade as the centre of the router cutter is from the edge of the tool's base. Use these lines to position the cutter on the centre line of the housing.



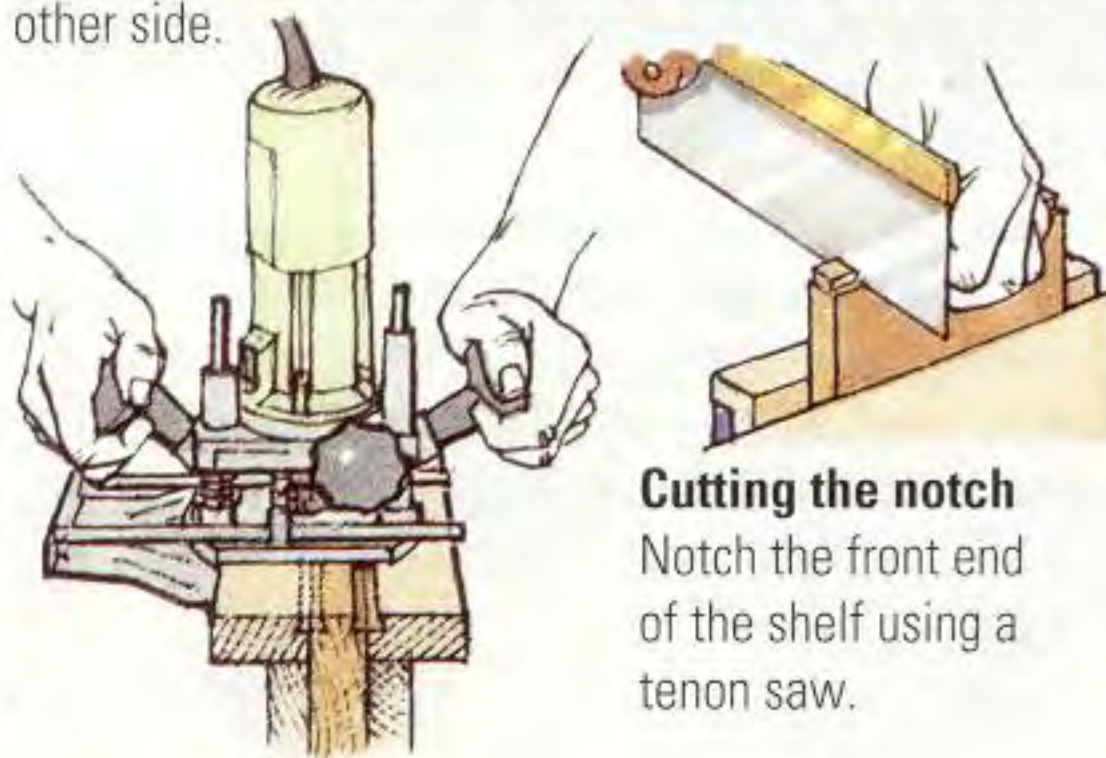
Cutting the housing

Align the mark on the T-square stock with the centre line of the housing pencilled across the workpiece. Clamp the T-square onto the work. Adjust the router cutter to the required depth (about one-third the thickness of the wood), then machine the housing, stopping about 12mm (1/2in) from the front edge of the panel. Square the end of the housing with a chisel.



Machining the shelf

Set the work upright in a vice and clamp an L-shape guide batten on each side, flush with the end grain. Adjust the side fence to machine a dovetail along one side of the work, then reset the fence to dovetail the other side.

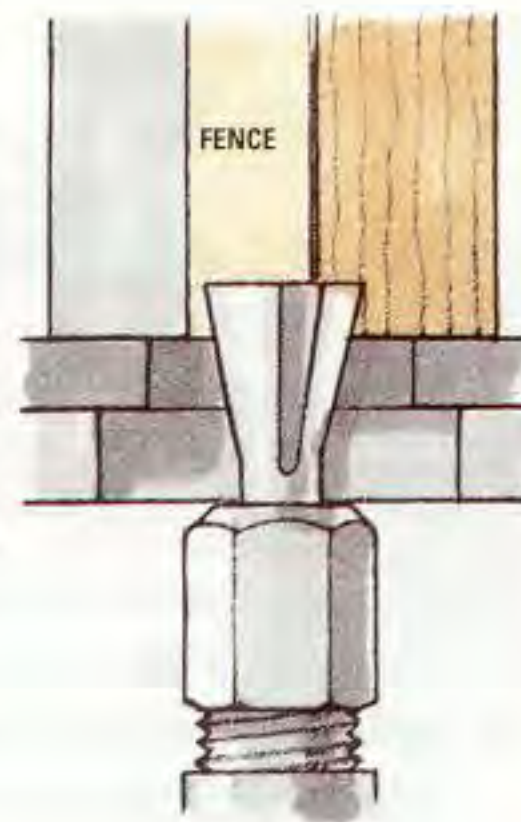


Cutting the notch

Notch the front end of the shelf using a tenon saw.

USING A ROUTER TABLE

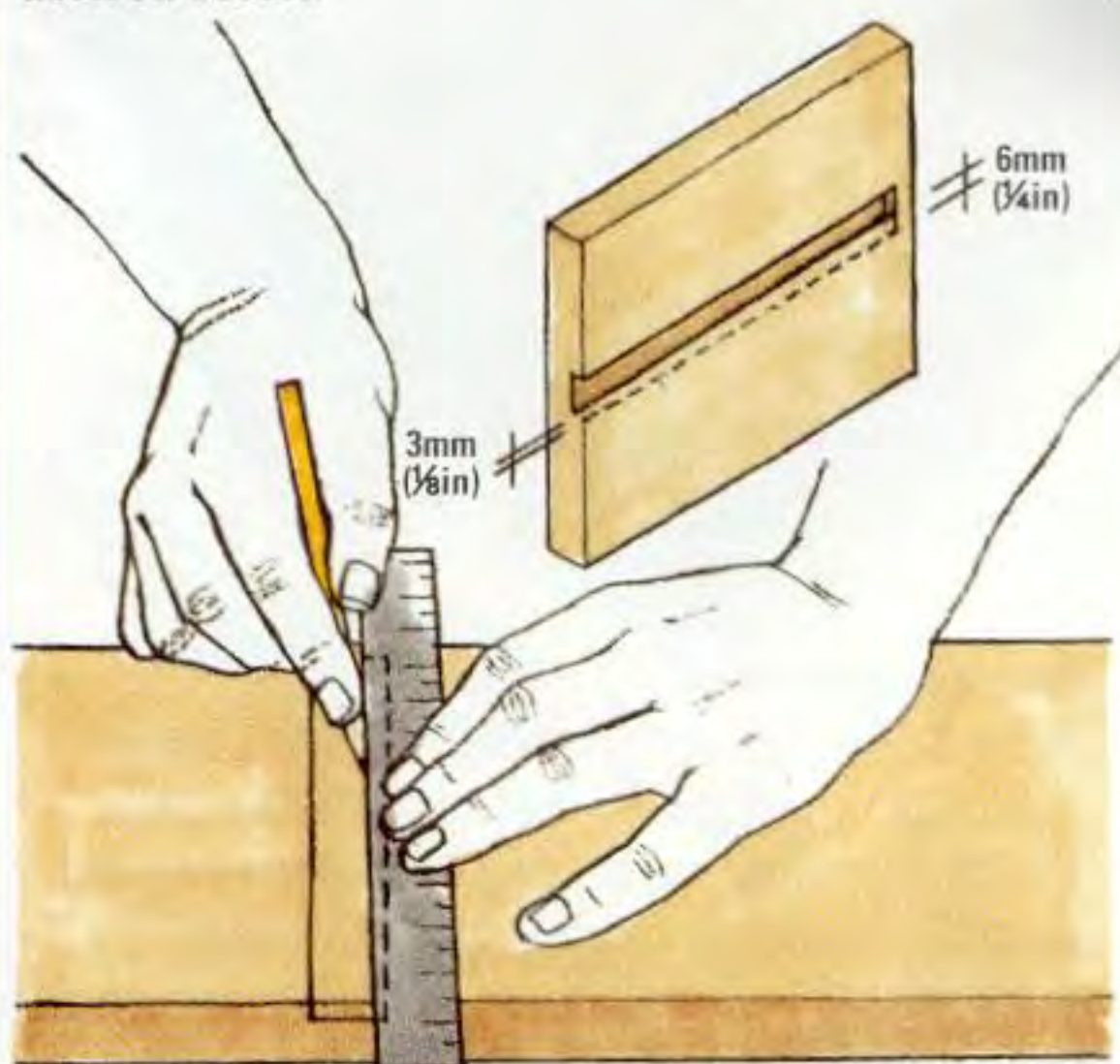
As an alternative method of cutting the dovetail, invert the router in a worktable, and set the table's fence to guide the workpiece past the cutter. Having made one pass, reverse the work and dovetail the other face.



TAPERED STOPPED HOUSING

HAND CUT

The tapered stopped housing is a variant of the stopped housing, having a dovetail slope along one side, but also tapering towards the stopped end. It is particularly useful for deep cabinets, because it remains slack while you assemble the joint, finally pulling itself tight at the last moment. However, it requires very precise making to achieve the desired result.



1 Marking the housing

Pencil a straight-sided, stopped housing on the side panel, then rule a line representing the tapered shoulder of the housing. Allow for the dovetail by starting the line 3mm ($\frac{1}{8}$ in) above the lower shoulder at the back end of the housing, and then tapering to 6mm ($\frac{1}{4}$ in) above the line at the stopped end.



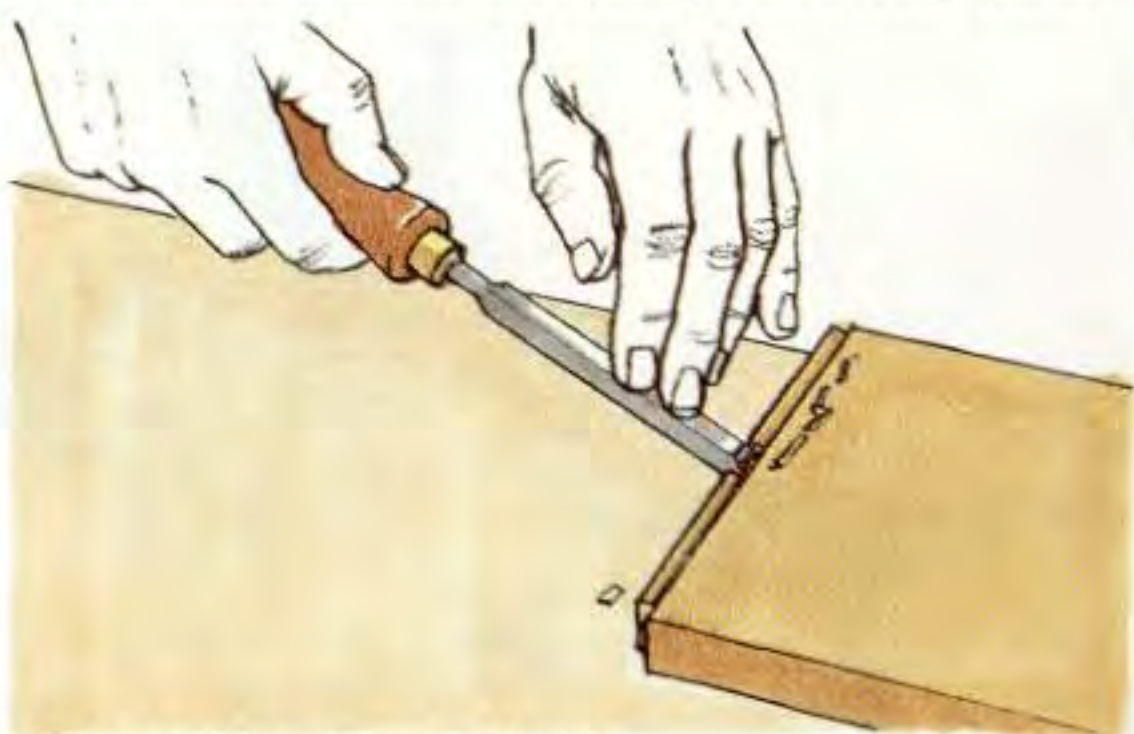
2 Chiselling grooves along the shoulders

Deeply score both the square and tapering shoulders with a marking knife, then chisel out the waste up to the scored lines, forming shallow V-shape grooves.



3 Sawing the shoulders

Chop out the waste from the stopped housing end to provide saw-blade clearance, then cut both shoulders with a saw. Undercut the tapering shoulder to an angle of 80 degrees, using a shaped block to guide the blade. Pare out the waste and level the housing with a router plane.



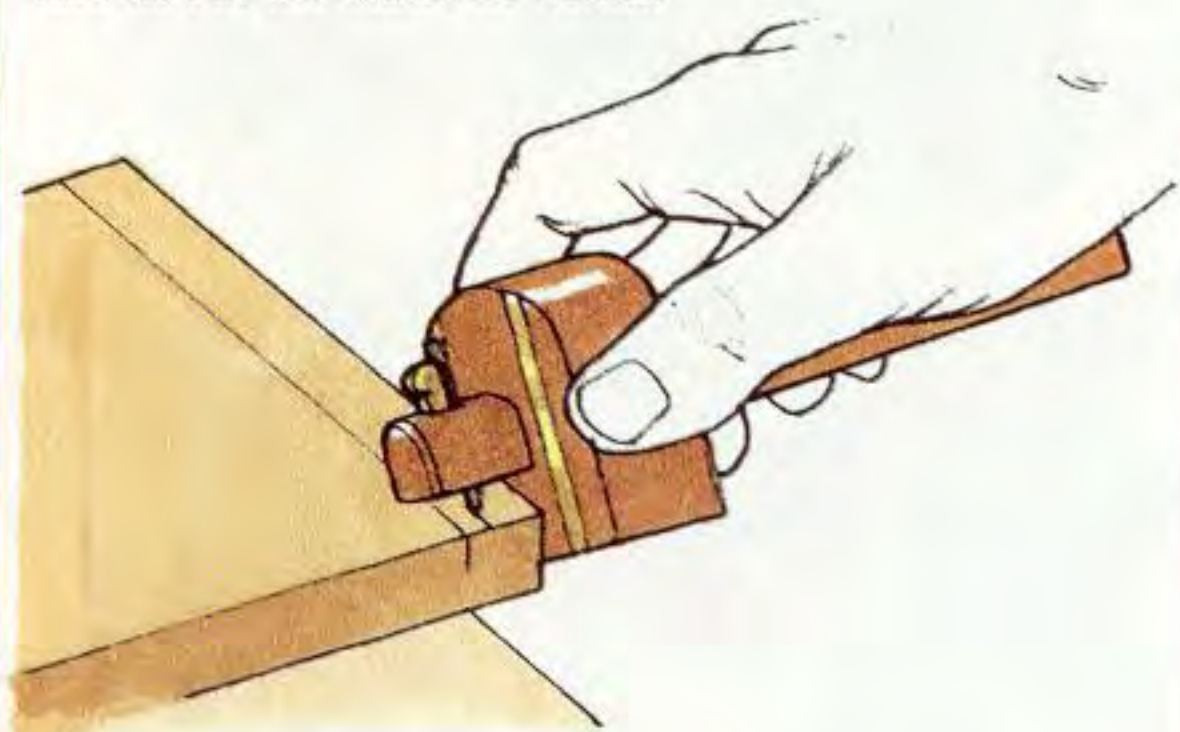
4 Dovetailing the shelf end

Mark the shoulder line on the underside of the shelf, using a cutting gauge, and mark the taper on the end grain, taking the dimensions from the housing. Cut out the notch at the stopped end, and saw along the shoulder line. Pare out the waste with a chisel, following the dovetail angle. Try assembling the joint, and relieve any tight spots until it fits snugly.

BAREFACED HOUSING JOINT

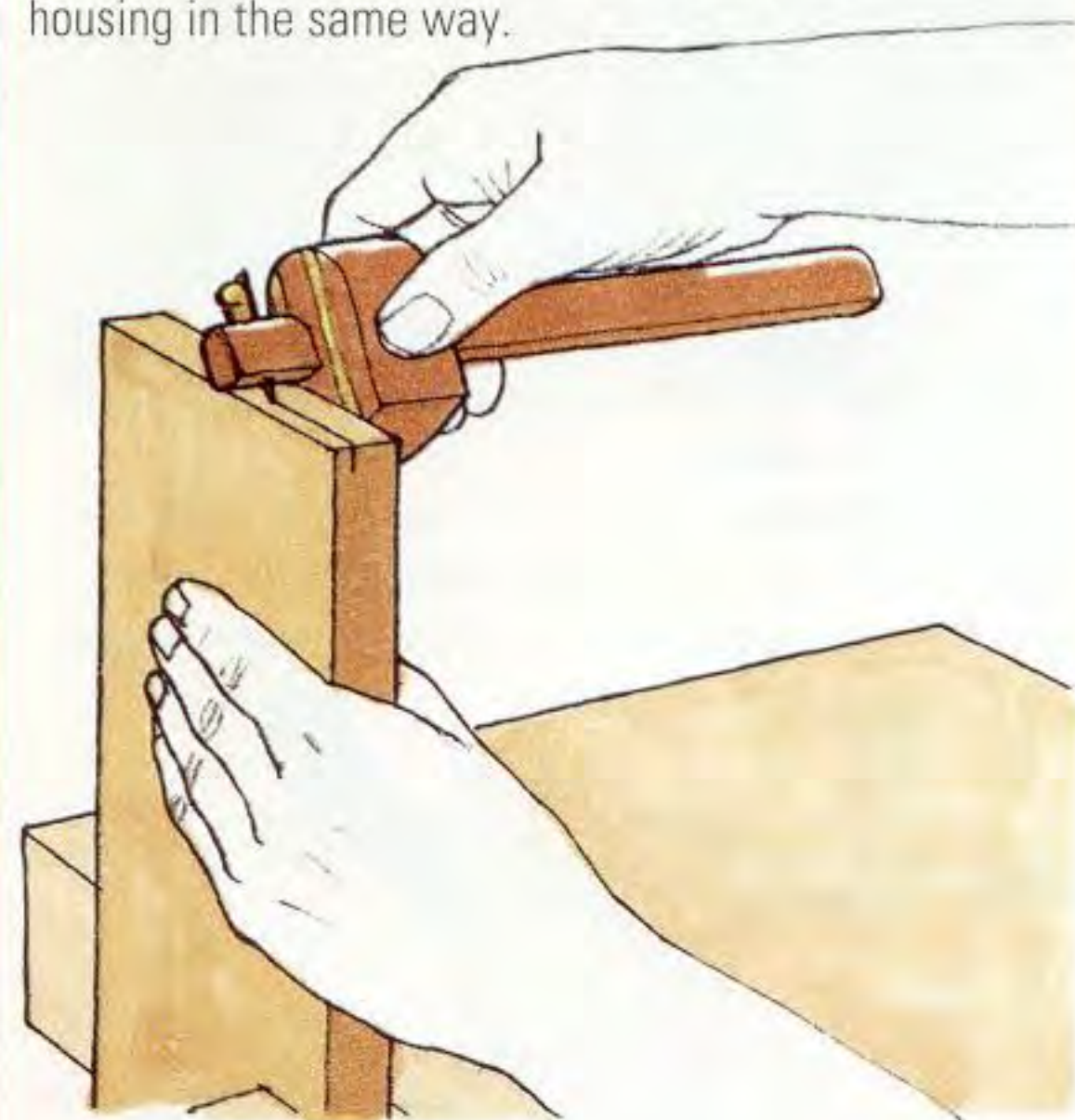
HAND CUT

The barefaced housing joint is a variation on the basic lap joint, adapted for making box-frame or cabinet corners. The housing should be no deeper than about one-quarter the thickness of the wood, and about the same in width.



1 Marking the housing

Cut and plane square the ends of both components. Set a cutting gauge to the thickness of the horizontal member, and lightly scribe the bottom edge of the housing across the side panel and down both edges. Reset the gauge and scribe the top edge of the housing in the same way.



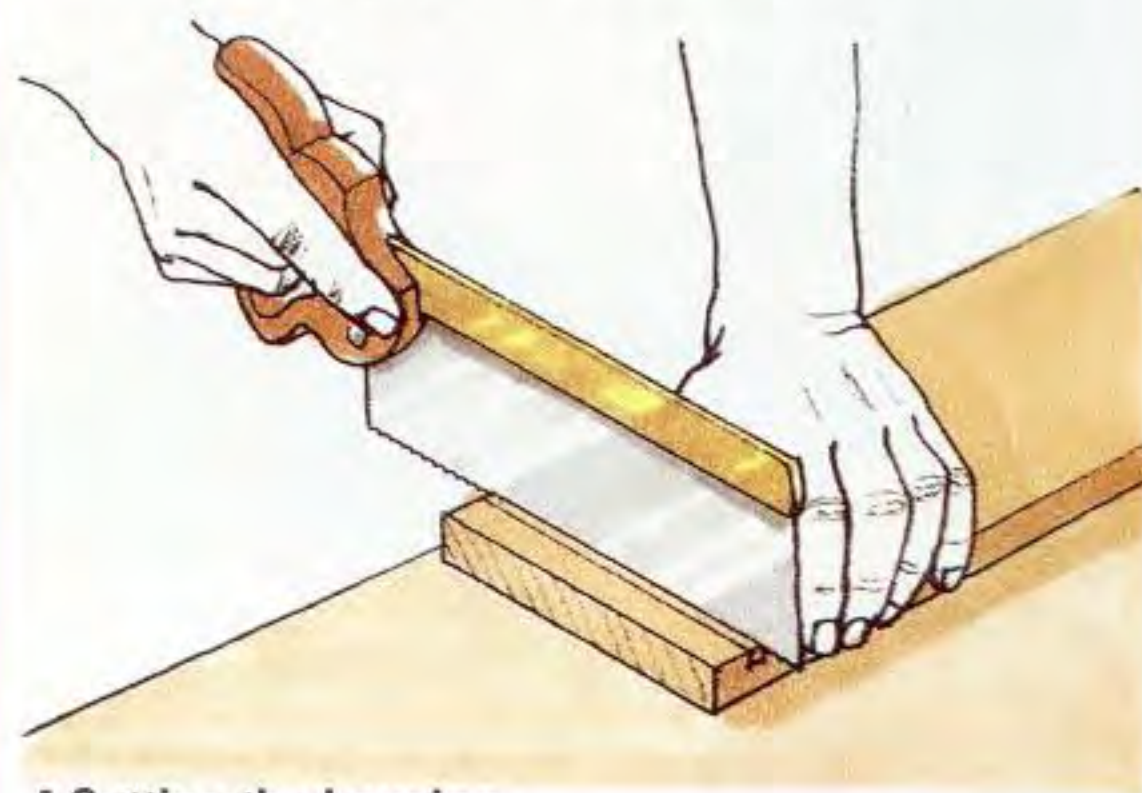
2 Marking the tongue

Using the gauge with the same setting, mark the tongue on the end and down both edges of the horizontal member, working from the face side.



3 Marking the rabbet shoulder

Reset the gauge to about one-third the thickness of the side panel, and mark the rabbet shoulder line across the face side and down both edges of the horizontal member. Form the rabbet by removing the waste with a saw and cleaning up with a shoulder plane.



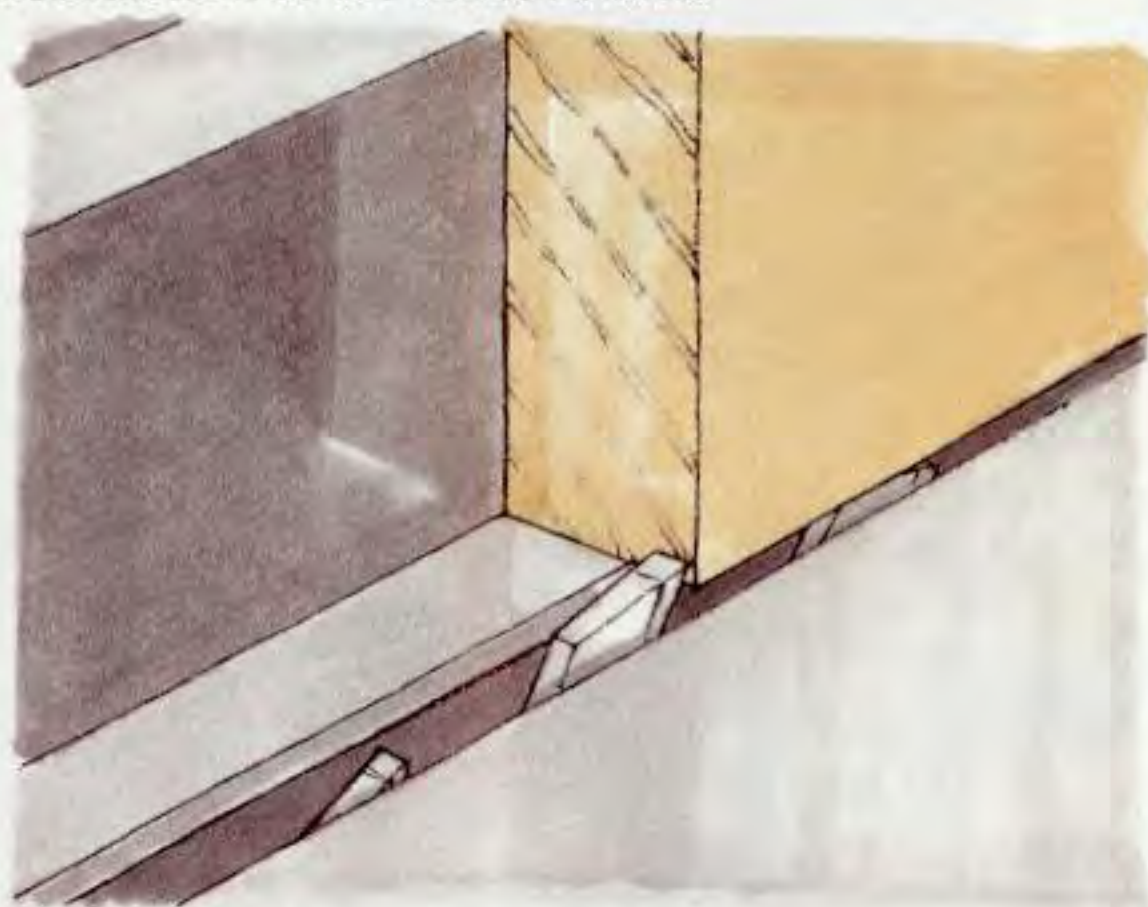
4 Cutting the housing

Mark the depth of the housing on the edges of the side panel and remove the waste with a saw and chisel, as described for a through housing joint (see page 48).

BAREFACED HOUSING JOINT

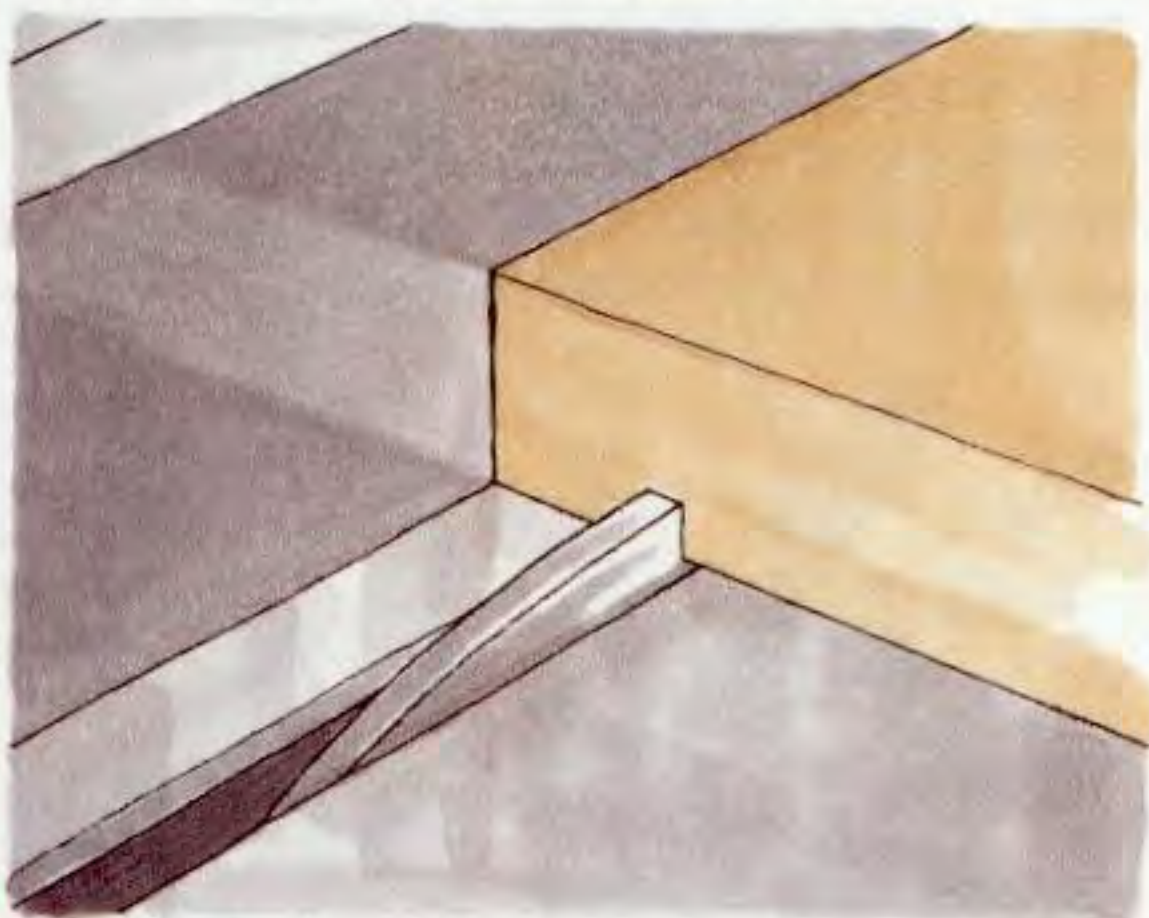
MACHINE CUT

The simplicity of the barefaced housing joint lends itself to cutting by machine. You could use a router for cutting the housing, or use a table saw, as shown here, for cutting the entire joint. You may need a dado head (see page 122) to make a wide cut, or you can fit wobble washers which cant the saw blade to a slight angle, making a wider-than-normal kerf as the blade rotates.



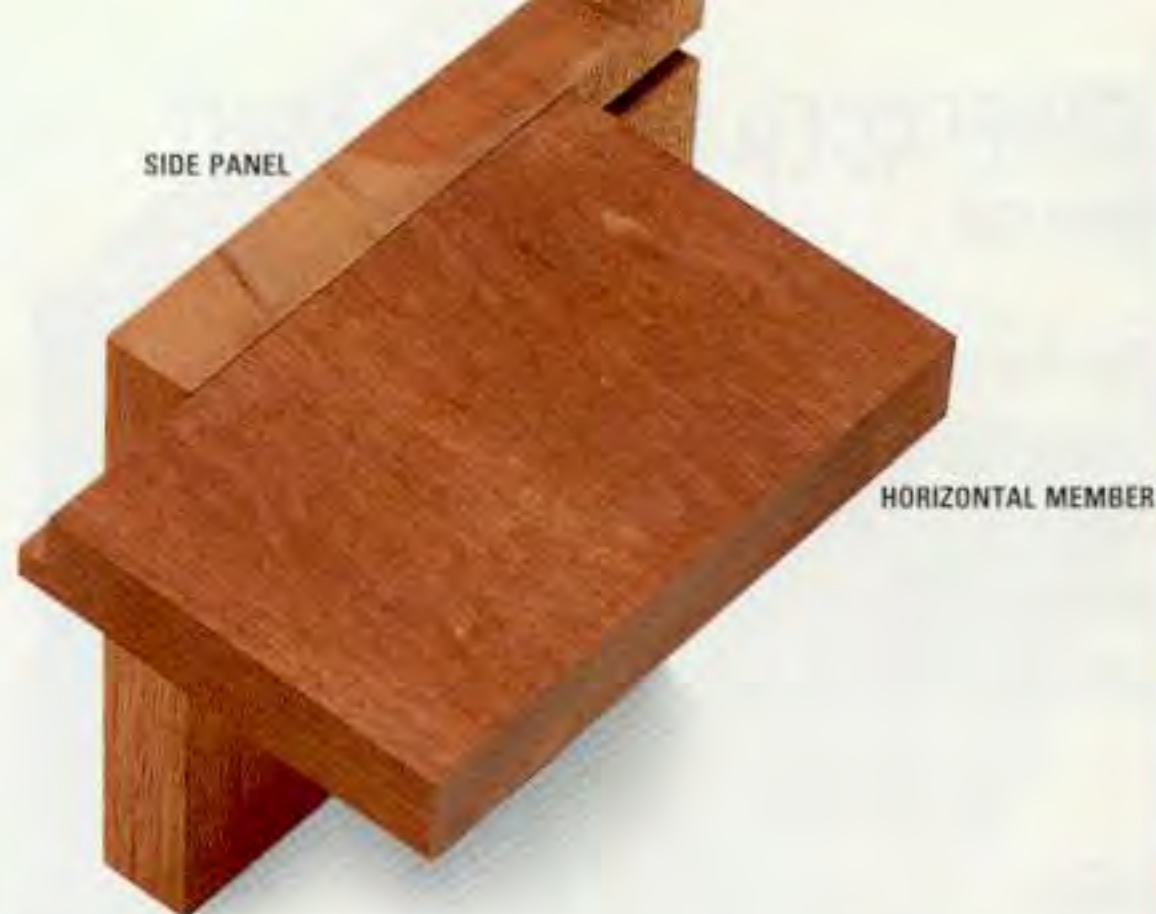
1 Setting up for cutting the housing

Using the horizontal member as a guide, set the rip fence to place the saw blade flush with the outside face of the wood. If you are using wobble washers, check that the blade is canted to its full extent.



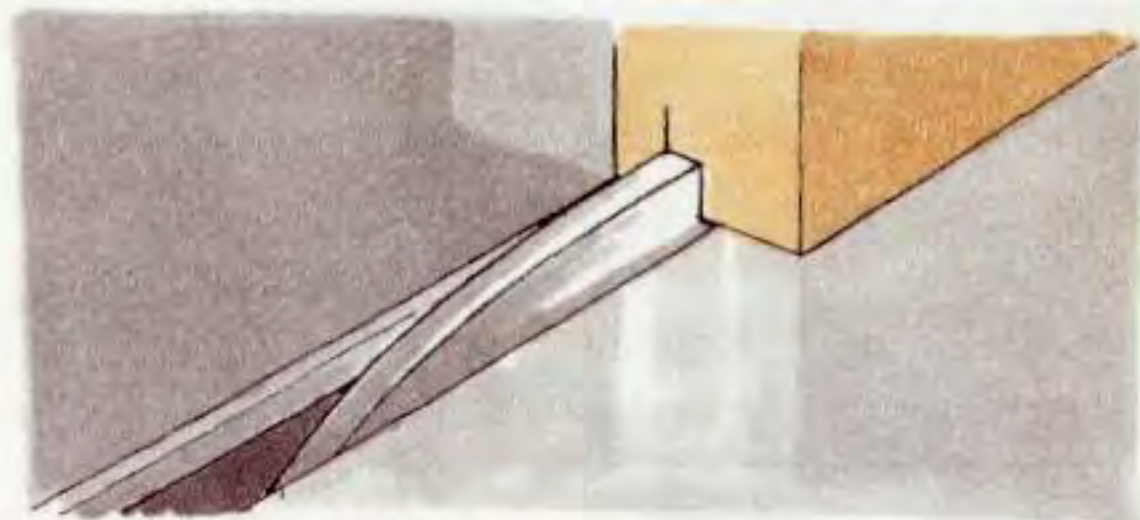
2 Cutting the housing

Raise the blade to one-quarter of the side-panel thickness. Lay the side panel flat on the saw table, its end butted against the rip fence, and pass the work over the blade. Adjust the rip fence sideways to make a second cut for a wider housing. Use the saw's mitre fence to steady a narrow workpiece.



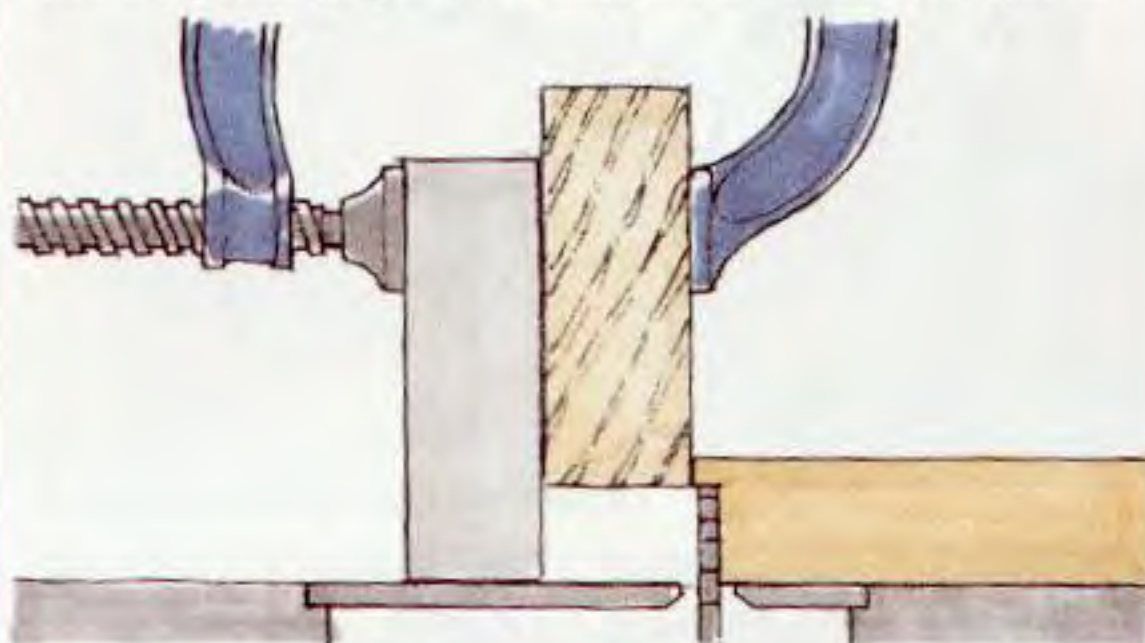
3 Setting up for cutting the tongue

Mark the width of the tongue on the horizontal member, using the housing as a template. Reset the rip fence to cut just to the waste side of the mark.



4 Cutting the tongue

Holding the work on end, run the horizontal panel against the fence to cut a kerf alongside the tongue. Use a jig (see page 37) to support a narrow workpiece.



5 Cutting the rabbet shoulder

Clamp a wooden spacer to the rip fence; the end of the tongue will run against this. Raise the saw blade and adjust the fence to cut the rabbet, leaving a tongue that will fit the housing precisely.

CHAPTER 8 Halving joints are employed exclusively for framing, using wood of equal thickness for both components of a joint. They are very easy to cut, even with handtools, and the basic joint can be adapted to make right-angle corners, T-joints and cross frames.

HALVING JOINTS

CROSS HALVING JOINT

HAND CUT

With a cross halving joint, both halves of the joint are identical. Although the joint is equally strong whichever way the components run, convention dictates that the vertical member or divider appears to run through, although, in reality, half the thickness is removed from each piece of wood.



1 Marking the shoulders

Lay both components side-by-side and score the shoulder lines across them, using a try square and marking knife. Continue both sets of marked lines half-way down each edge.



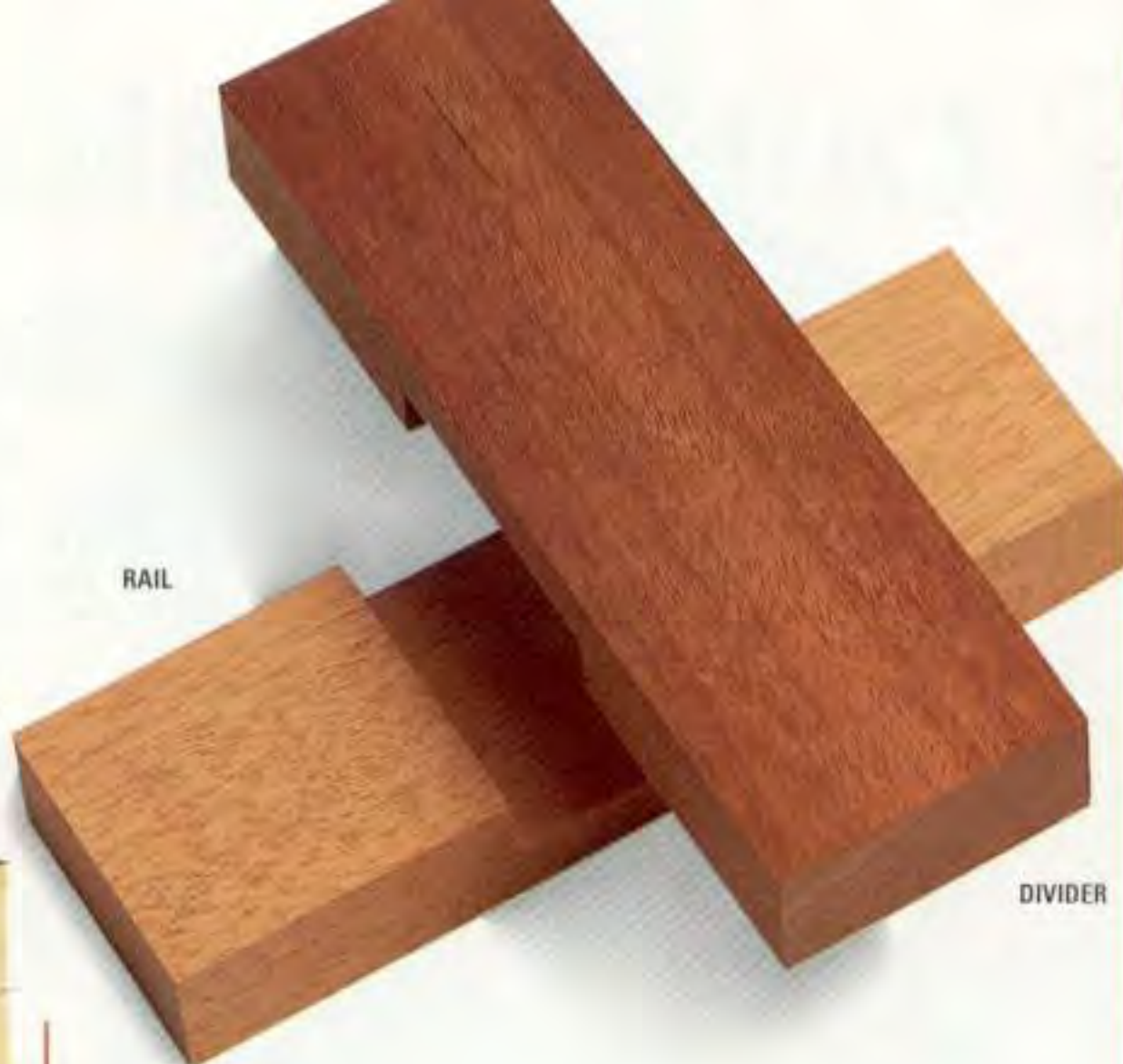
2 Marking the depth of the joint

Set a marking gauge to exactly half the thickness of the wood, and scribe a line between the shoulders marked on the edges of both components.



3 Cutting the joint

Saw halfway through both pieces of wood on the waste side of each shoulder line. Divide the waste wood between the shoulders with one or two additional saw cuts.



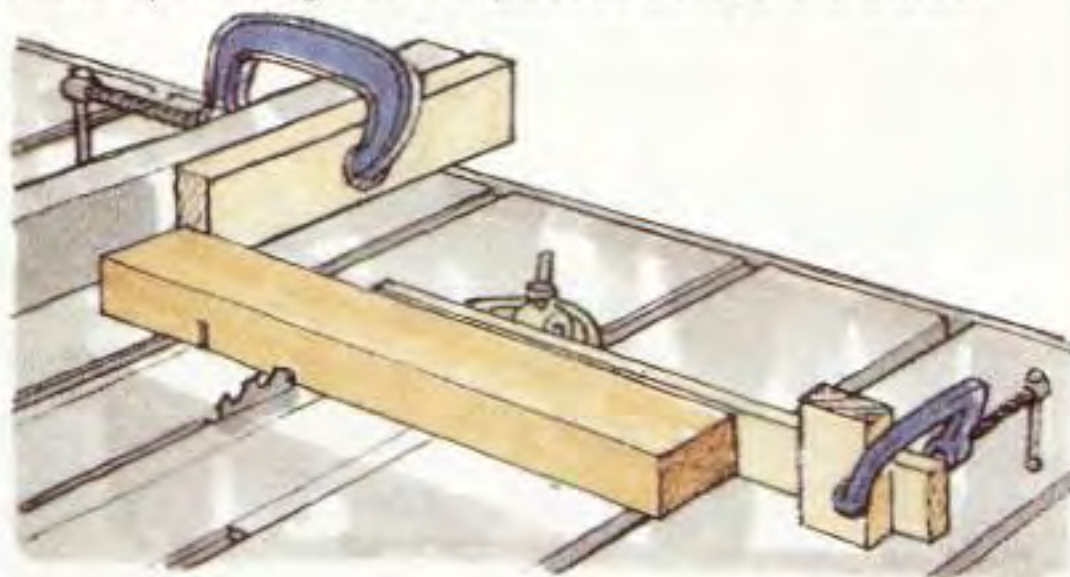
4 Chopping out the waste

Clamp the work in a vice and chisel out the waste, working from each side towards the middle of each component. Pare the bottom of each resulting recess flat with a chisel.



USING A TABLE SAW

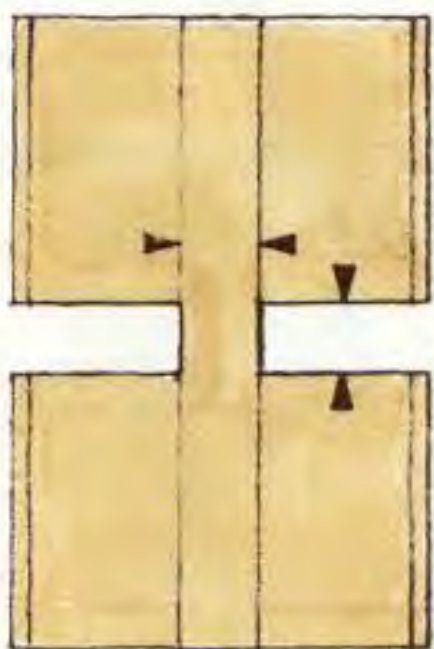
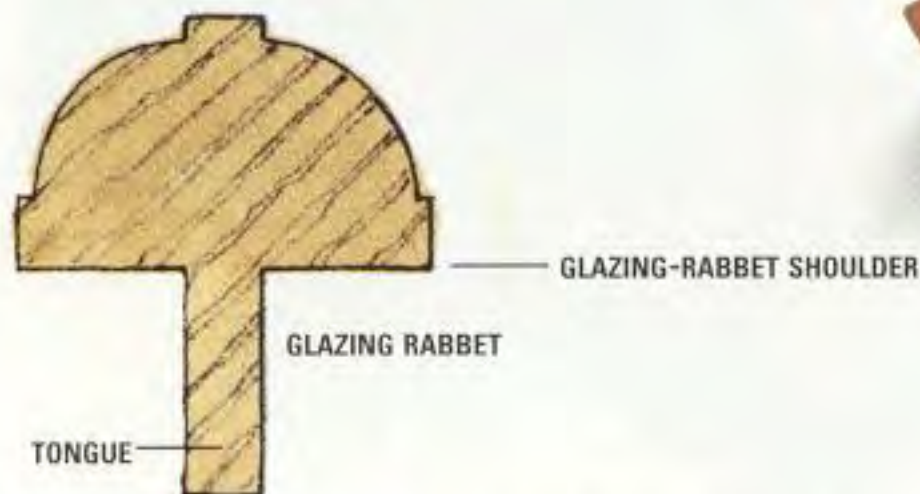
Adjust the saw blade to cut halfway through the workpiece. Saw one shoulder, then slide the wood sideways and saw the second one. To cut identical shoulders on several pieces of wood, set up the saw so that you can butt each workpiece against the rip fence at one end and against a block of wood clamped to the mitre fence at the other. Remove the waste by making several passes across the blade.



GLAZING-BAR HALVING JOINT

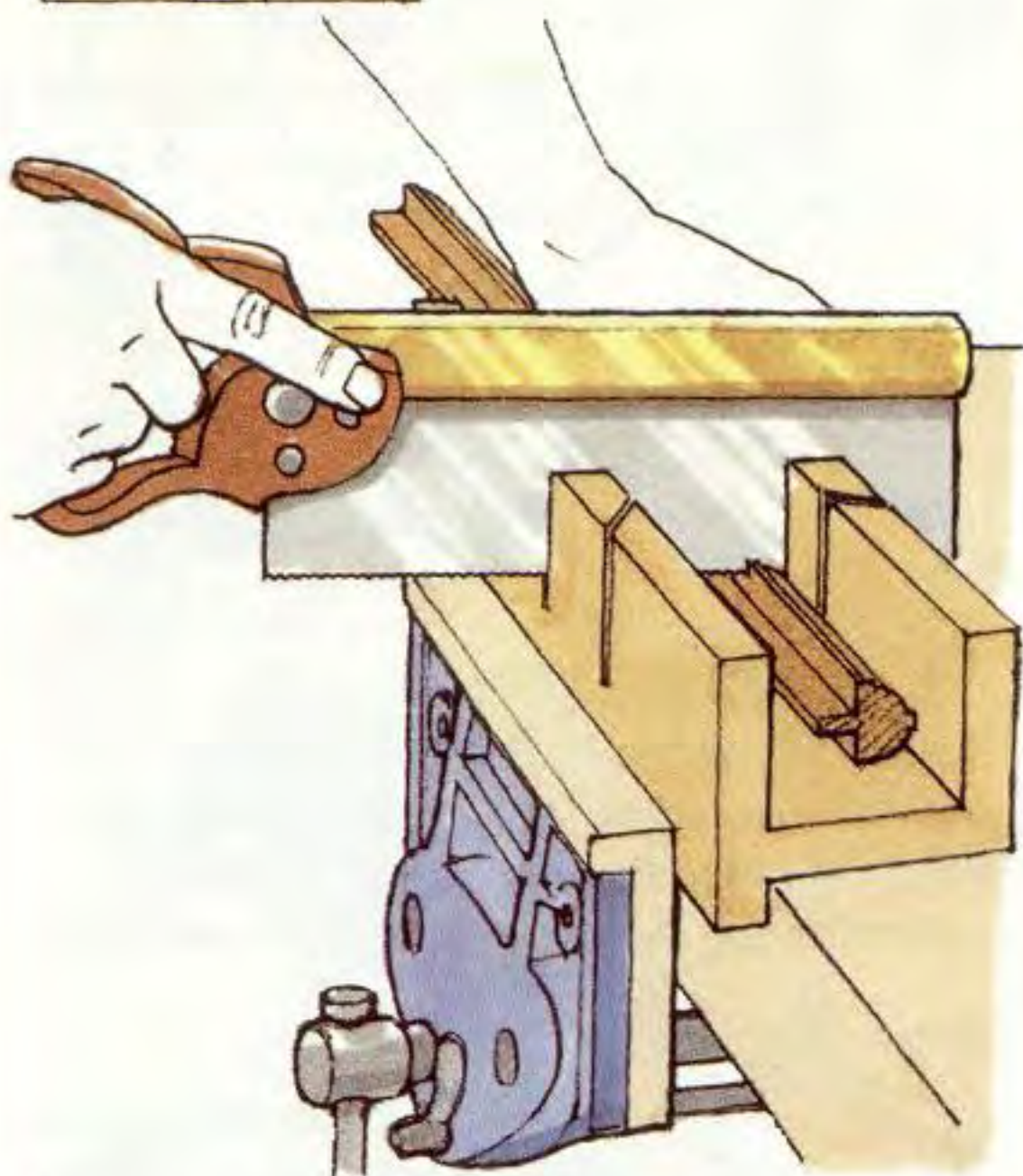
HAND CUT

Cutting a halving joint in glazing bars involves a similar method to that used to cut a simple cross halving joint, but there are complications which result from joining moulded sections.



1 Cutting slots

Cut a narrow slot on each side of both moulded components, down to the level of the glazing-rabbit tongue. Make each slot as wide as the tongue.



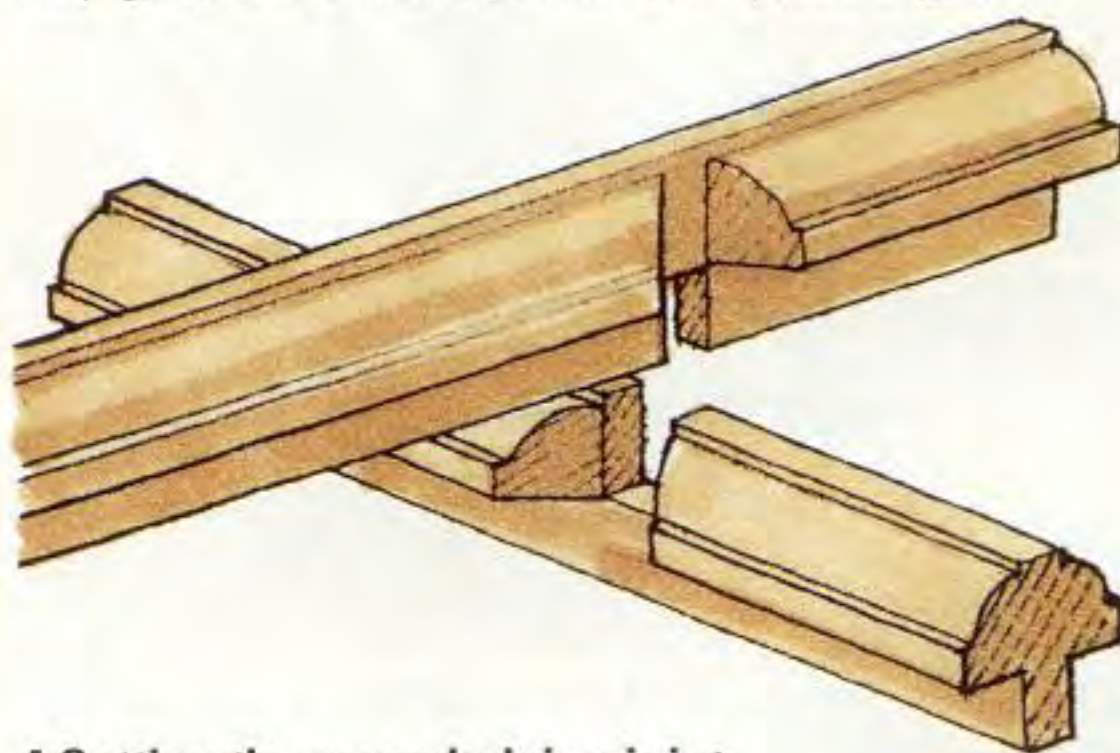
2 Using a mitre box as a guide

Since it is difficult to mark a moulded section, it pays to hold the work in a mitre box, using the 90-degree guides when sawing the slots.



3 Paring the mitres

Pare the waste on each side of the slots to form a 45-degree mitre. Make a mitre block from scrap wood to help guide the chisel blade at the required angle.



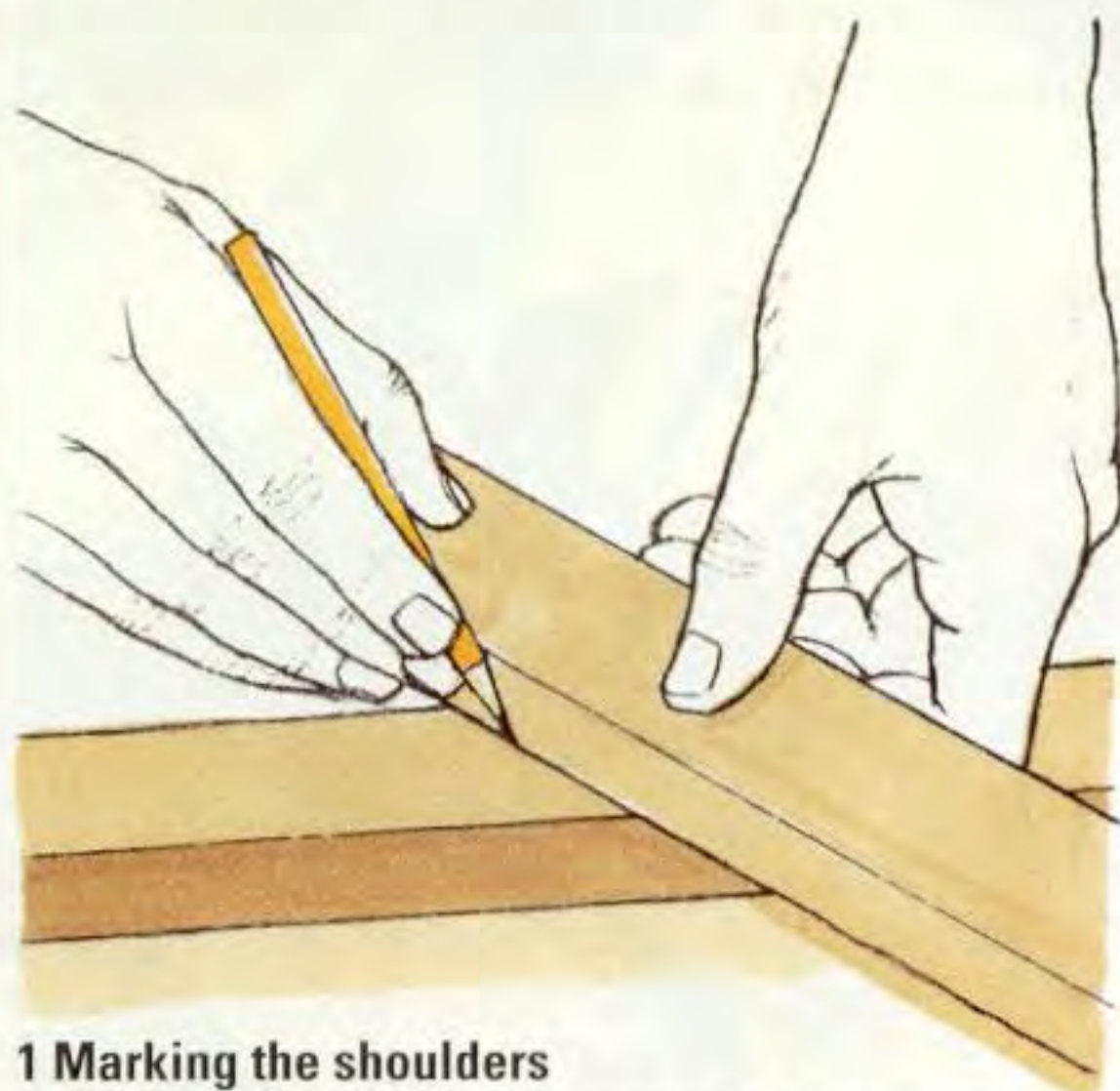
4 Cutting the cross halving joint

All that remains is to cut recesses in each component to form the actual halving joint. Cut the recesses down to the level of the glazing-rabbit shoulder.

OBLIQUE HALVING JOINT

HAND CUT

This oblique joint is identical to the right-angle version, except for the fact that the recesses are set at an angle. Use a mitre square to mark out a 45-degree joint or a sliding bevel for other angles.



1 Marking the shoulders

Score one shoulder line across one component and, placing the second piece of wood against the line, mark its width with a pencil. Score the line with a square and marking knife. Mark the other component similarly.



2 Marking the width of the recess

Mark the width of each recess, then use a try square to continue the shoulder lines down each edge. Scribe a line between them with a marking gauge set to half the wood's thickness.



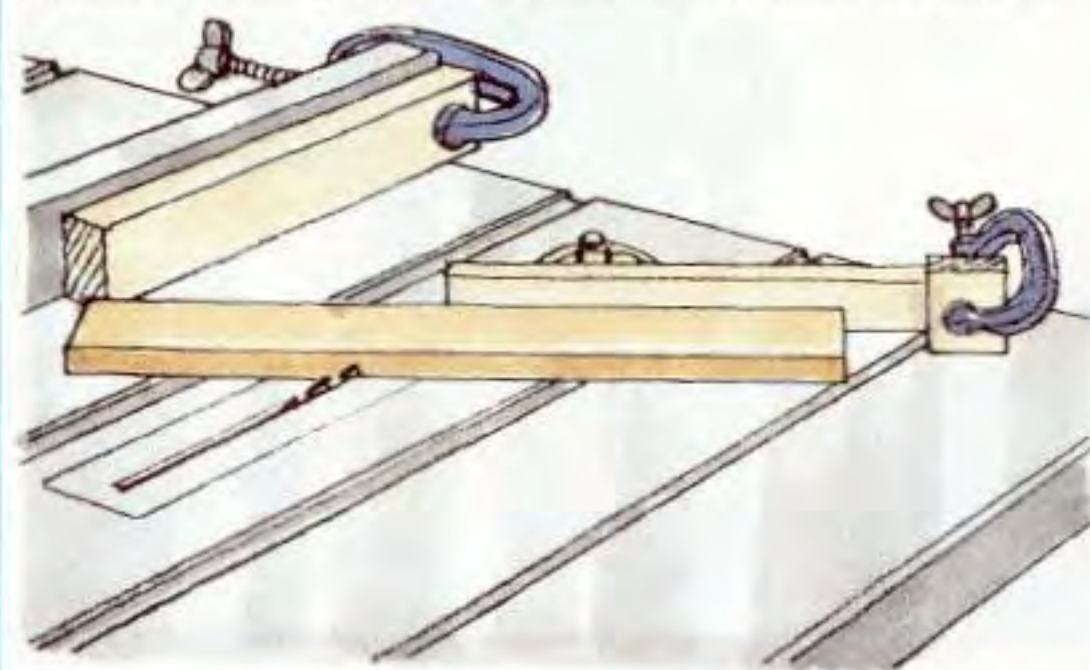
3 Cutting the joint

Saw and chisel out the waste as described for a right-angle cross halving joint (see page 56).



USING A TABLE SAW

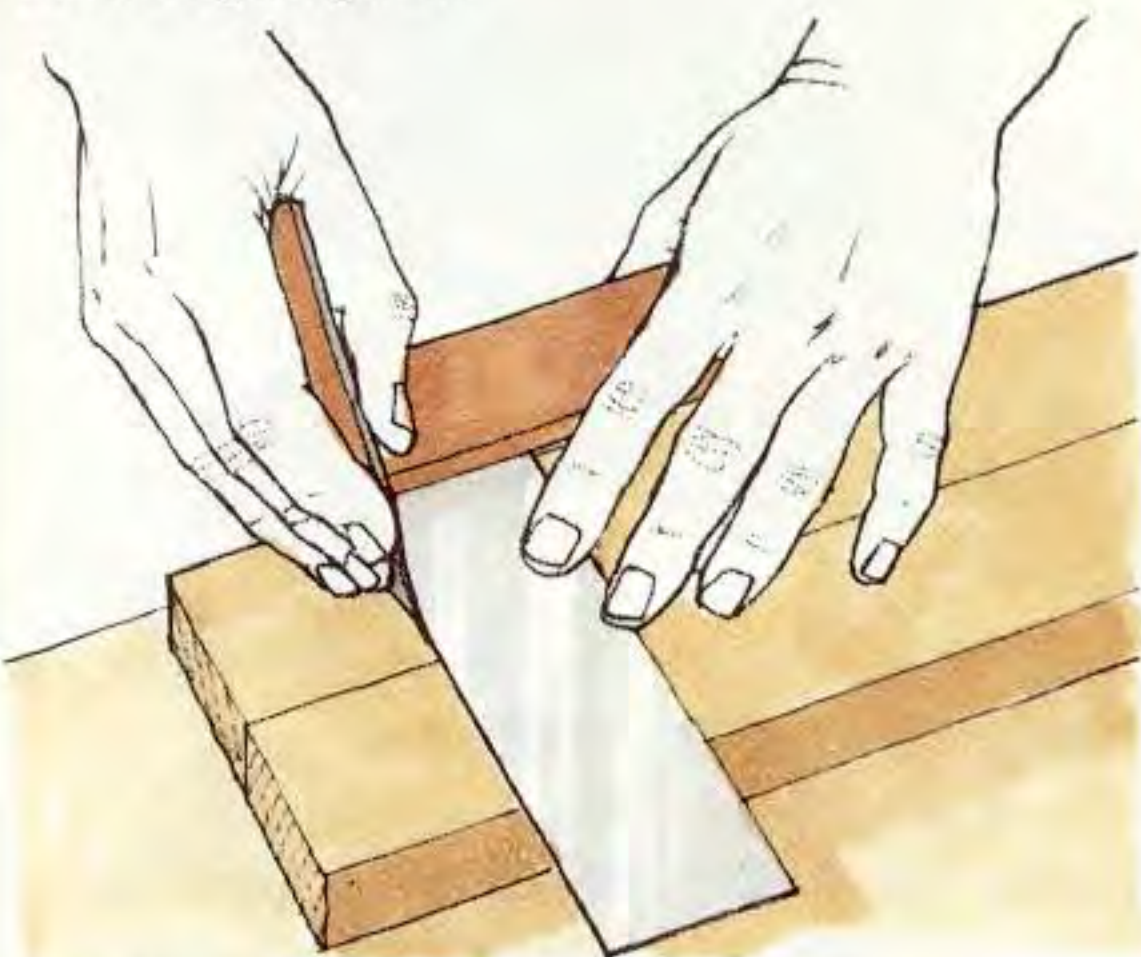
Cut an oblique halving joint on a table saw as described on page 56, but set the mitre fence at an angle. Hold the work firmly against the fence to prevent it being drawn backwards by the saw blade.



CORNER HALVING JOINT

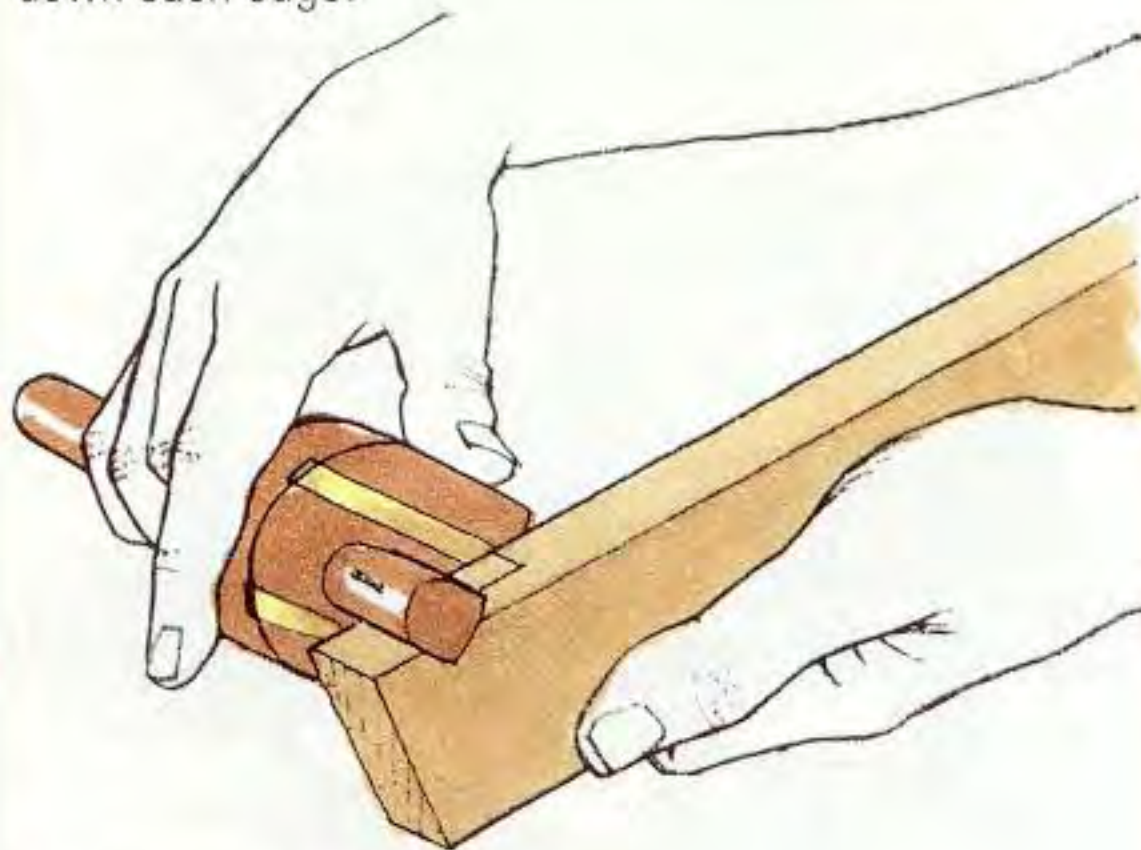
HAND CUT

You can construct a simple framework with halving joints at each corner, but since the joint relies almost entirely on the glue for strength, you may need to reinforce it with screws or dowels. Cut the joint by hand, using the method described below, or cut it on a power saw (see page 60). The mitred halving joint is a refined version, but with even less gluing area.



1 Marking the basic halving joint

Lay the components side-by-side, and mark the shoulder line across both of them. Continue the lines down each edge.



2 Gauging the depth

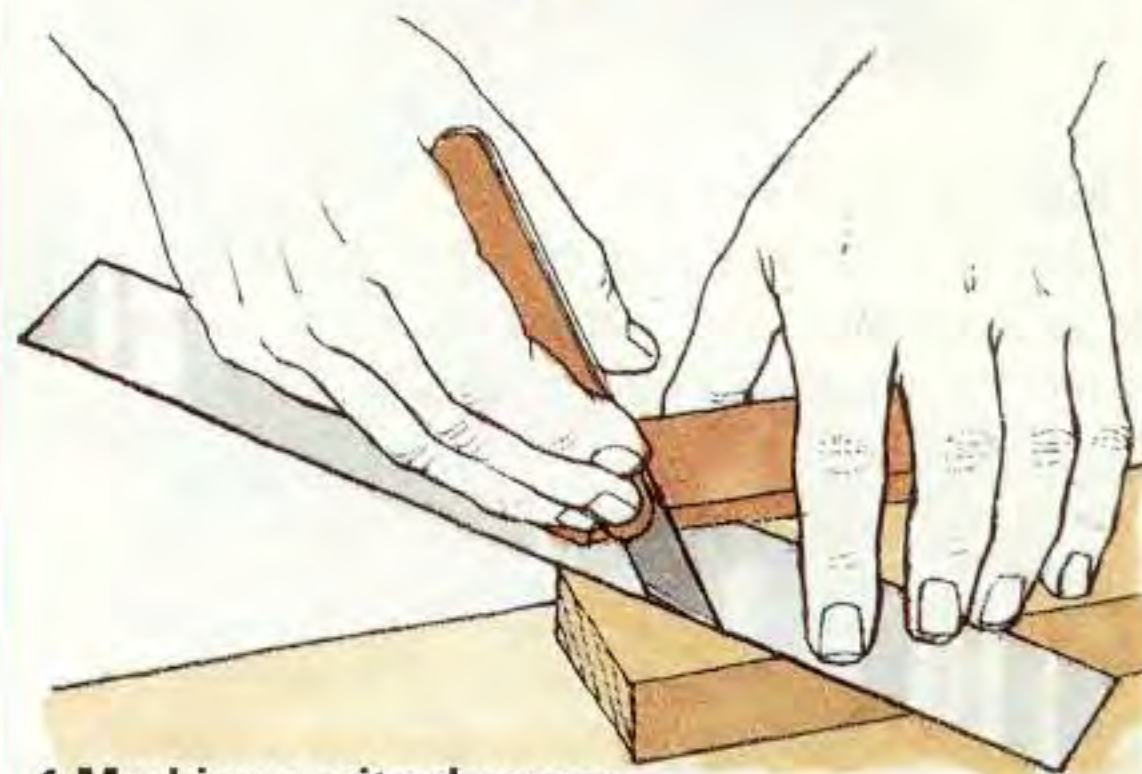
Set a marking gauge to half the thickness of the wood and scribe a line up both edges and across the end grain. Remove the waste with a tenon saw, cutting downwards from the end grain, followed by sawing across the shoulder.

HALVING JOINTS

Corner halving joint

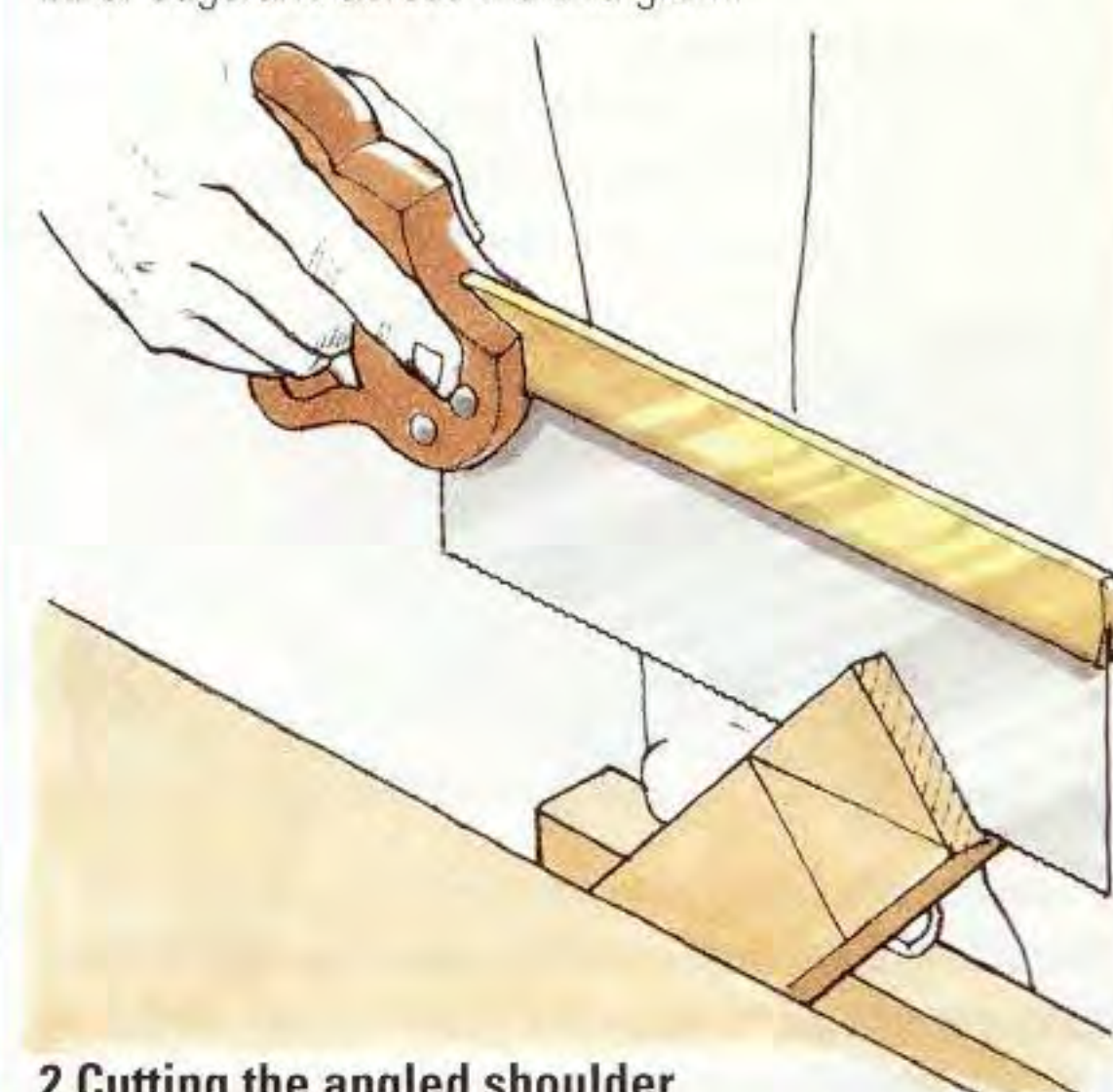


Mitred halving joint



1 Marking a mitred corner

Mark and cut one component as described left, then cut the lap to 45 degrees. Score the angled shoulder line across the face of the second component, using a knife and mitre square, then scribe the centre line up the inner edge and across the end grain.



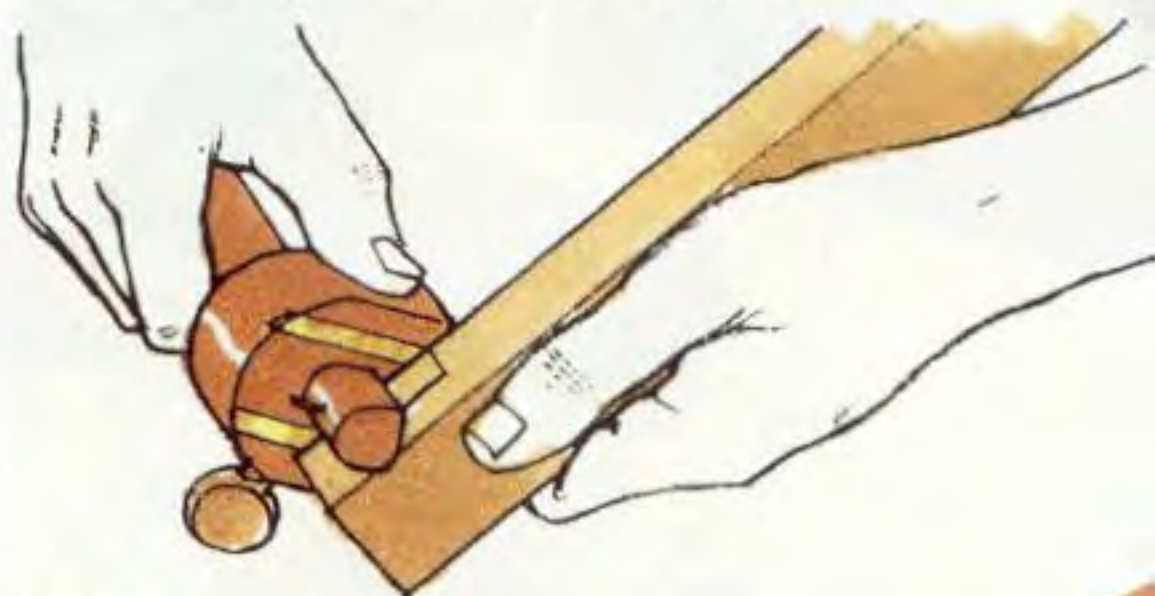
2 Cutting the angled shoulder

Clamp the work at an angle in a vice and saw on the waste side of the centre line, down to the shoulder. Lay the work on a bench hook, and remove the waste by sawing down the shoulder line.

T-HALVING JOINT

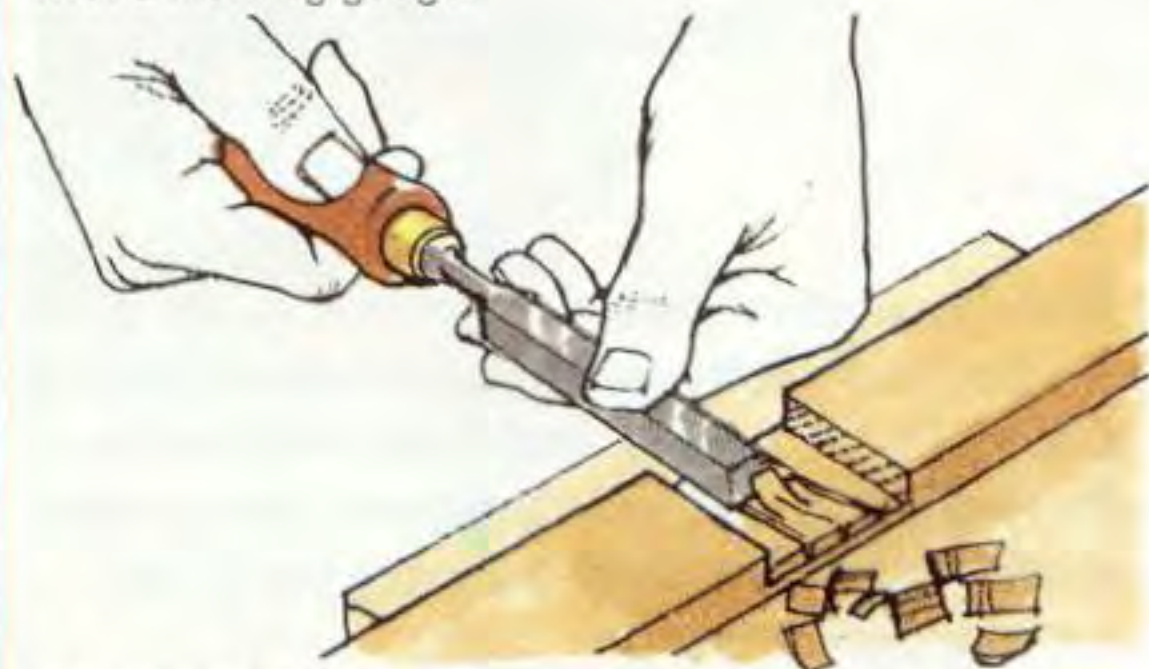
HAND CUT

A means of joining an intermediate support to a frame, the T-halving joint is a combination of the cross-halving and corner-halving versions.



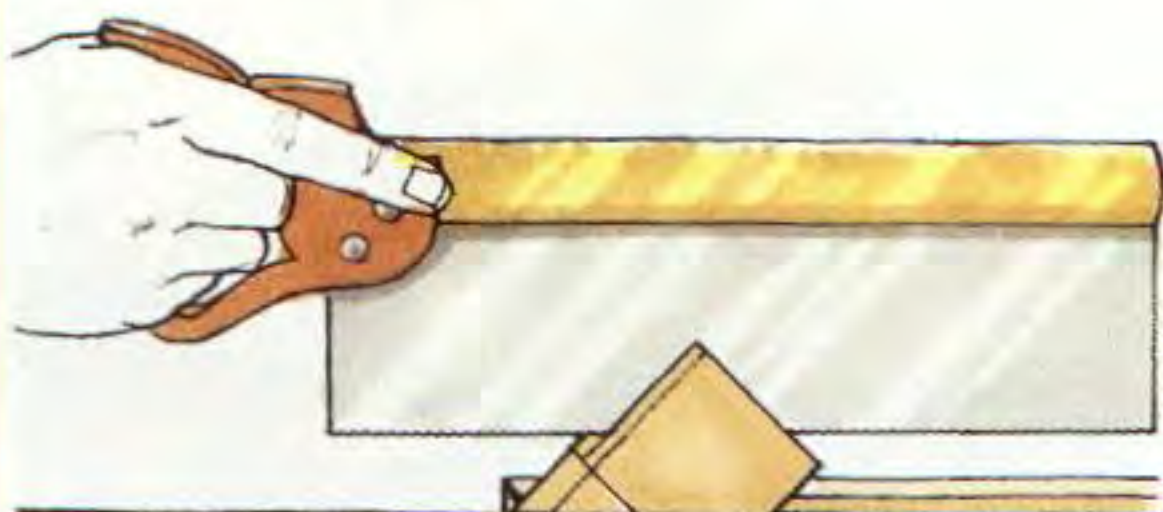
1 Marking out the joint

Taking the dimensions from the relevant components, score the shoulder lines with a knife and try square, and scribe the depth of the joint on each workpiece with a marking gauge.



2 Cutting the recess

Chisel out the waste from between the shoulders. Use the long edge of the chisel blade to check that the bottom of the recess is flat.



3 Sawing the lap

Saw down to the shoulder, keeping the saw blade just to the waste side of the gauged line. You may find it easier to keep the cut vertical if you tilt the work away from you while sawing down one edge. Turn the work round and saw down the other edge, then finish off by sawing squarely down to the shoulder. Saw the shoulder line to remove the waste.

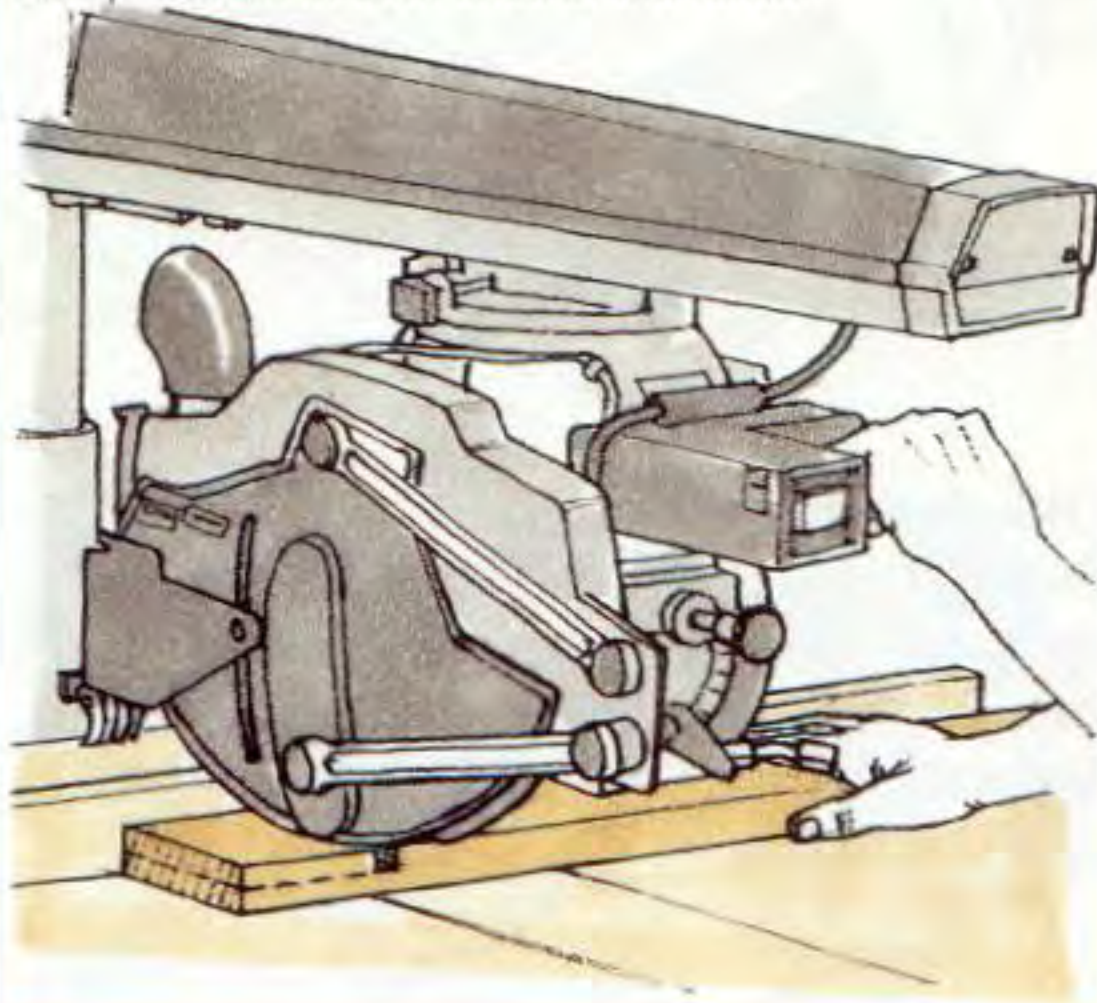


USING A RADIAL-ARM SAW

The radial-arm saw is an excellent machine for cutting halving joints, since you can clearly see the shoulder lines you are sawing. Using a dado head removes more waste wood at one pass than a standard setup.

Adjust the blade to cut halfway through the work, and pull the saw towards you to cut the shoulder. Slide the work to one side, gradually removing more waste with each pass.

Clamp an end stop to the fence to cut a shoulder in the same place on identical workpieces. When cutting recesses for cross halving or T-halving joints, clamp a block at both ends of the fence.



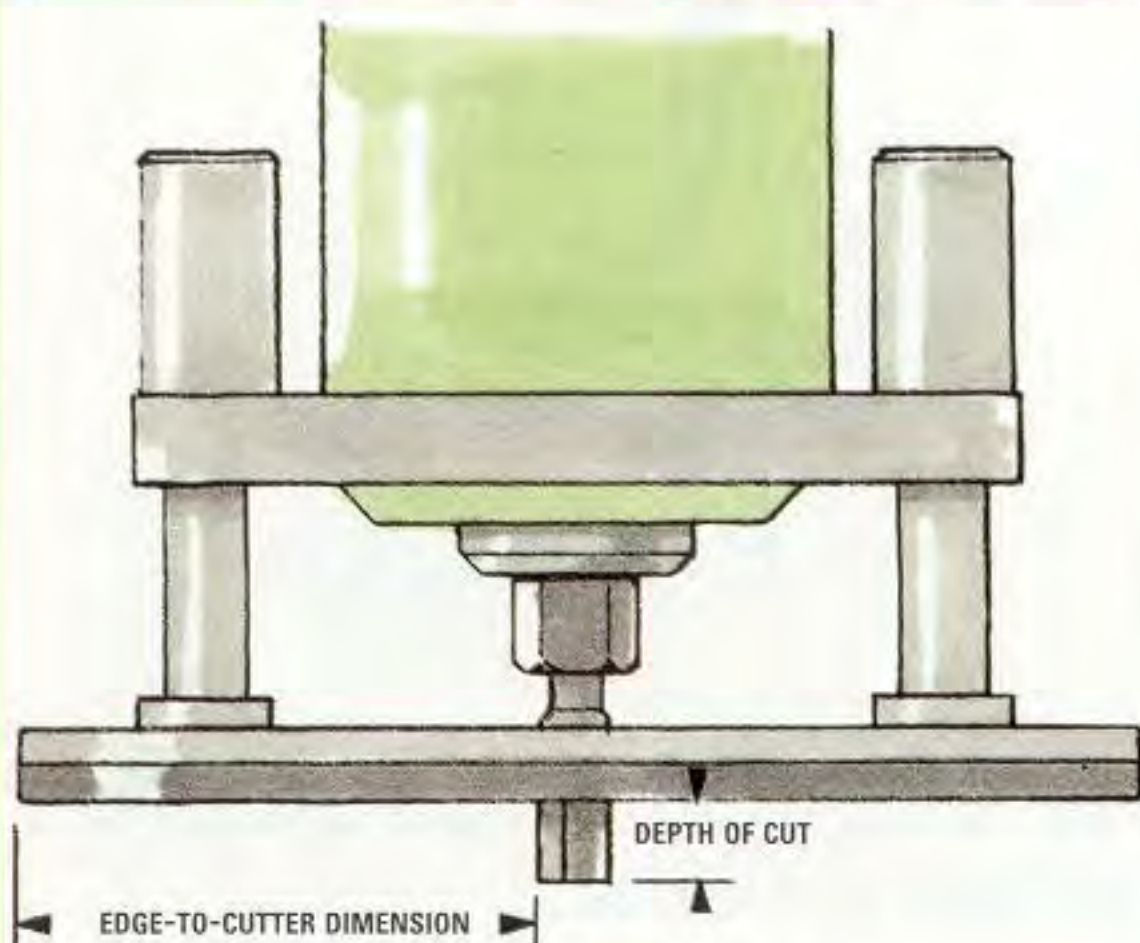
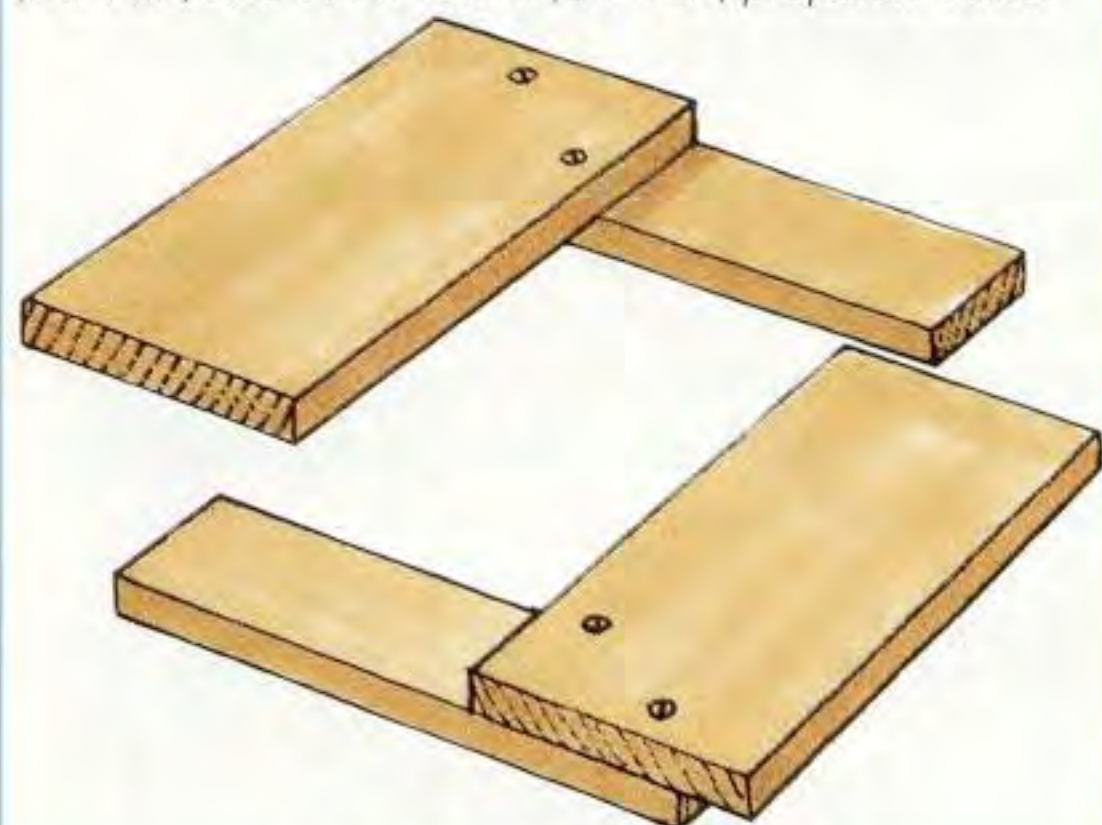
T-HALVING JOINT

MACHINE CUT

A table saw or radial-arm saw is capable of producing accurate, but not particularly well-finished, halving joints. Using a router to cut the joint makes very crisp shoulders and perfectly flat surfaces. If you intend to make a number of joints, use a couple of simple jigs to guide the router.

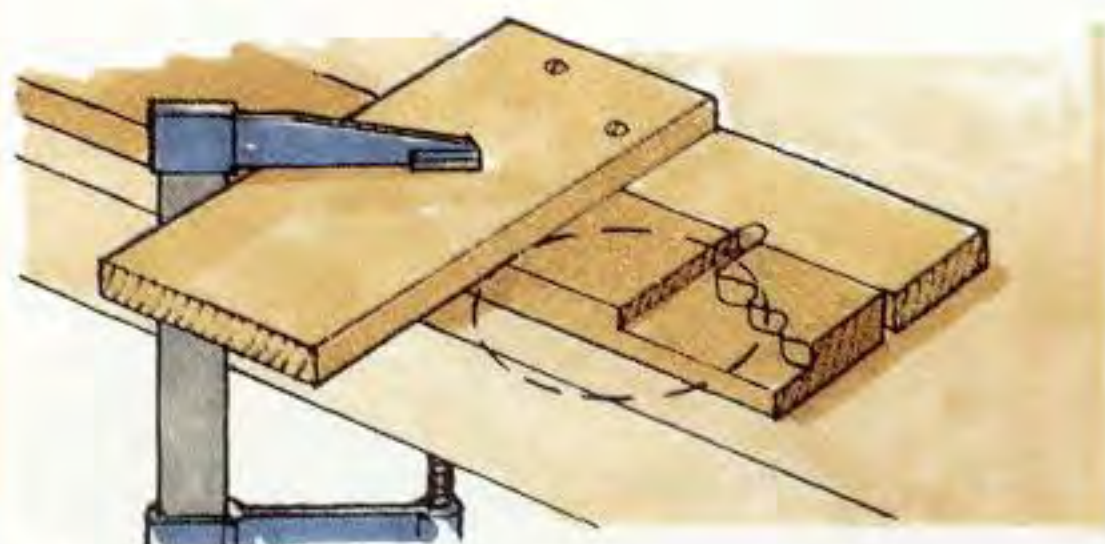
MAKING THE JIGS

Make a pair of identical L-shape jigs by gluing and screwing together 300mm (1ft) lengths of 75 x 18mm (3 x 3/4in) and 150 x 18mm (6 x 3/4in) prepared wood.



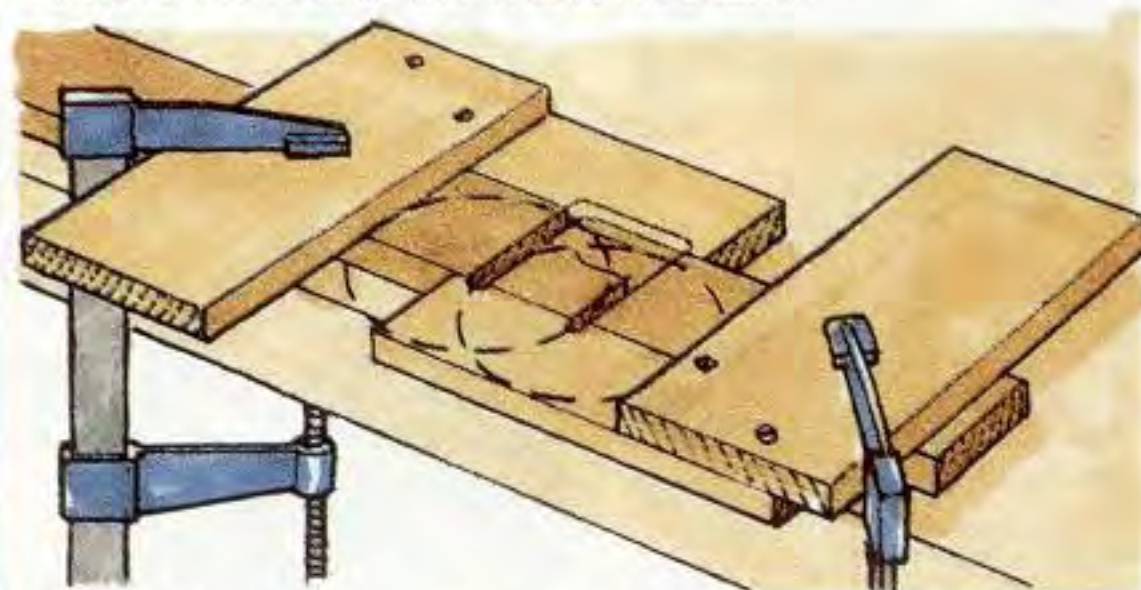
Setting up the router

Set the depth of cut on the router to half the thickness of the workpieces. Measure from the edge of the base to the side of the cutter – use this edge-to-cutter dimension to position the jigs on the work.



1 Marking and cutting the lap

Draw the shoulder line across the work and mark another line, the edge-to-cutter dimension (see below left), from the shoulder line. Align one of the L-shape jigs with this latter line, and clamp both the jig and work to the bench. To cut the lap, run the edge of the router base against the jig to form the shoulder, then remove the rest of the waste freehand.



2 Marking and cutting the recess

Mark two shoulder lines for the recess and clamp both jigs on top of the work, allowing for the edge-to-cutter dimension, as described above. Without altering the depth setting on the router, use the left-hand jig to cut one shoulder, and then move the router to the right-hand jig to cut the second one. Finally, clean out the waste in between.

DOVETAIL HALVING JOINT

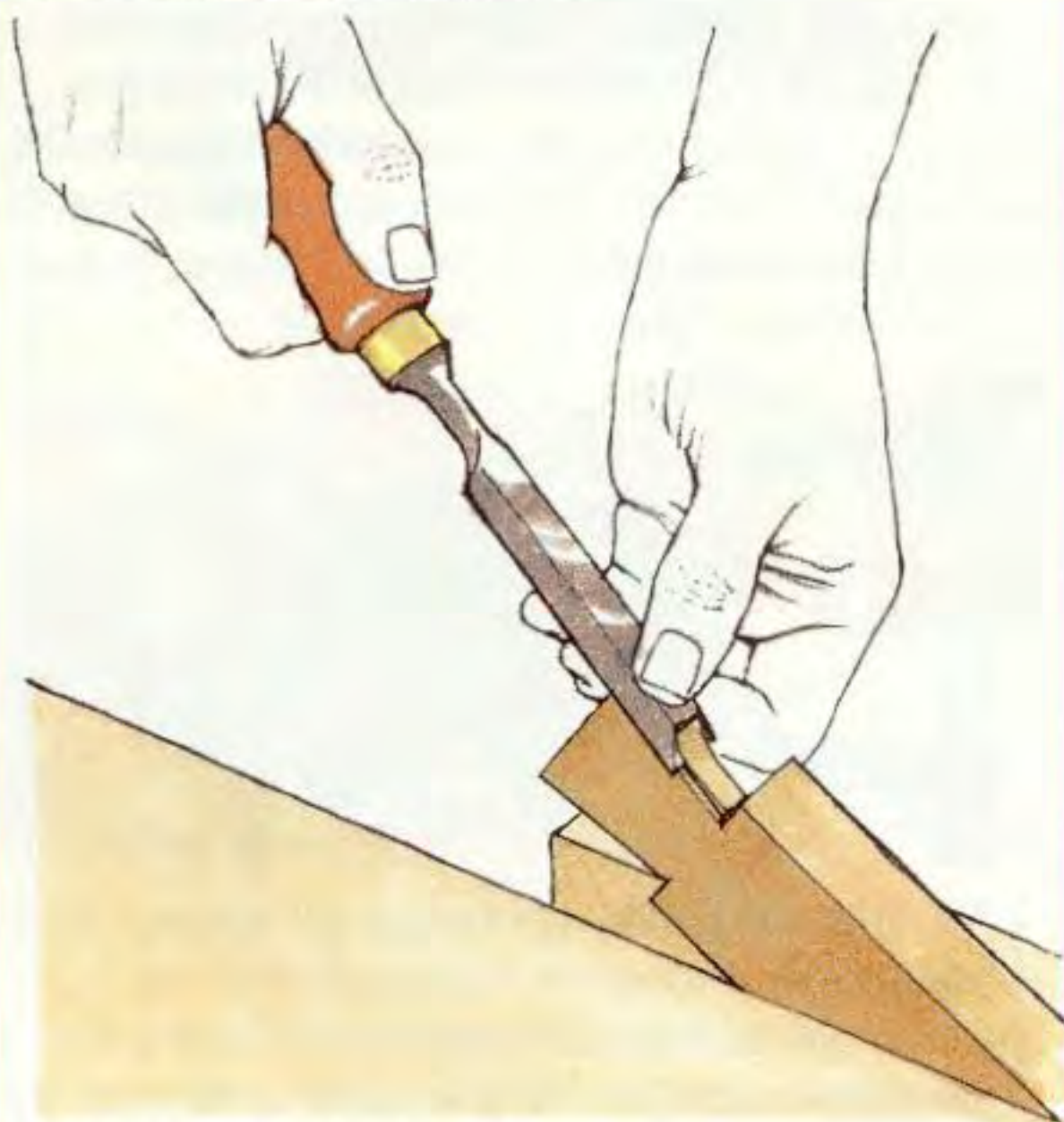
HAND CUT

Incorporate a dovetail to increase the strength of a T-halving joint. It is only marginally more difficult to make than the standard square-shoulder joint.



1 Marking the lap dovetail

Having marked out and cut a lap in the conventional manner (see page 60), use a template and knife to mark the dovetail on the workpiece.



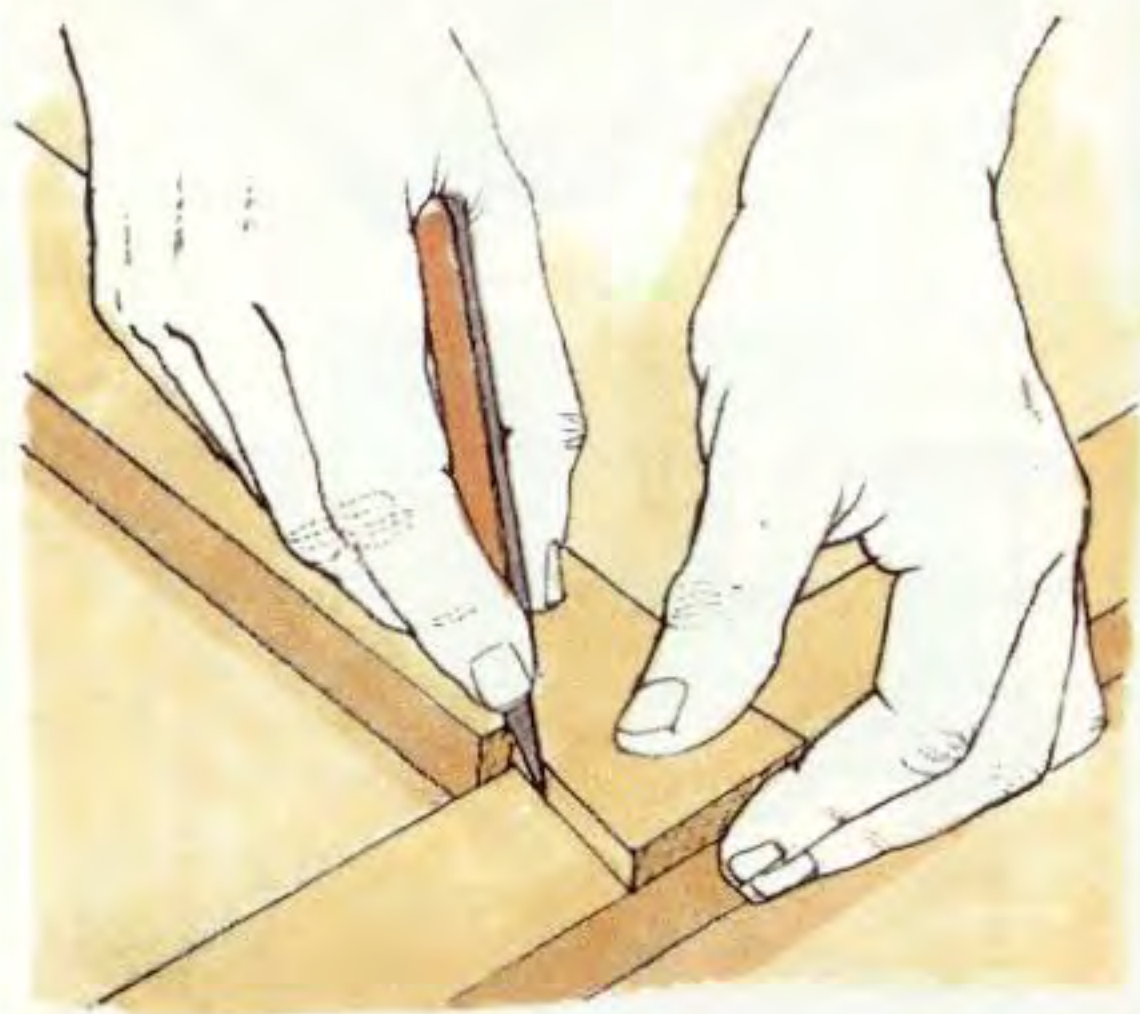
2 Shaping the lap dovetail

Saw the short shoulders on both sides of the lap, then pare away the waste with a chisel to form the sloping sides of the dovetail.



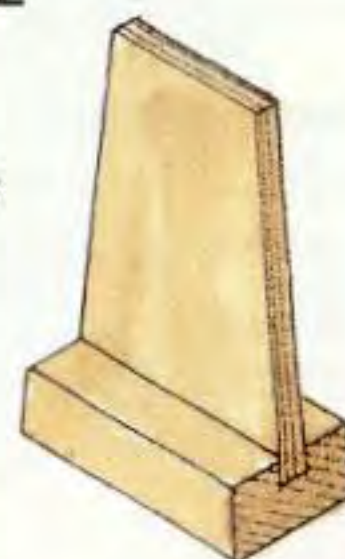
3 Marking and cutting the recess

Using the dovetailed lap as a template, score the shoulders of the recess on the cross member. Mark the depth of the recess with a marking gauge (see page 56), and then remove the waste wood with a tenon saw and chisel.



MAKING A TEMPLATE

Cut a tapered plywood tongue, with one side angled for marking dovetails in softwood and the other for dovetailing hardwoods (see page 82). Glue the tongue into a slot cut in a hardwood stock.

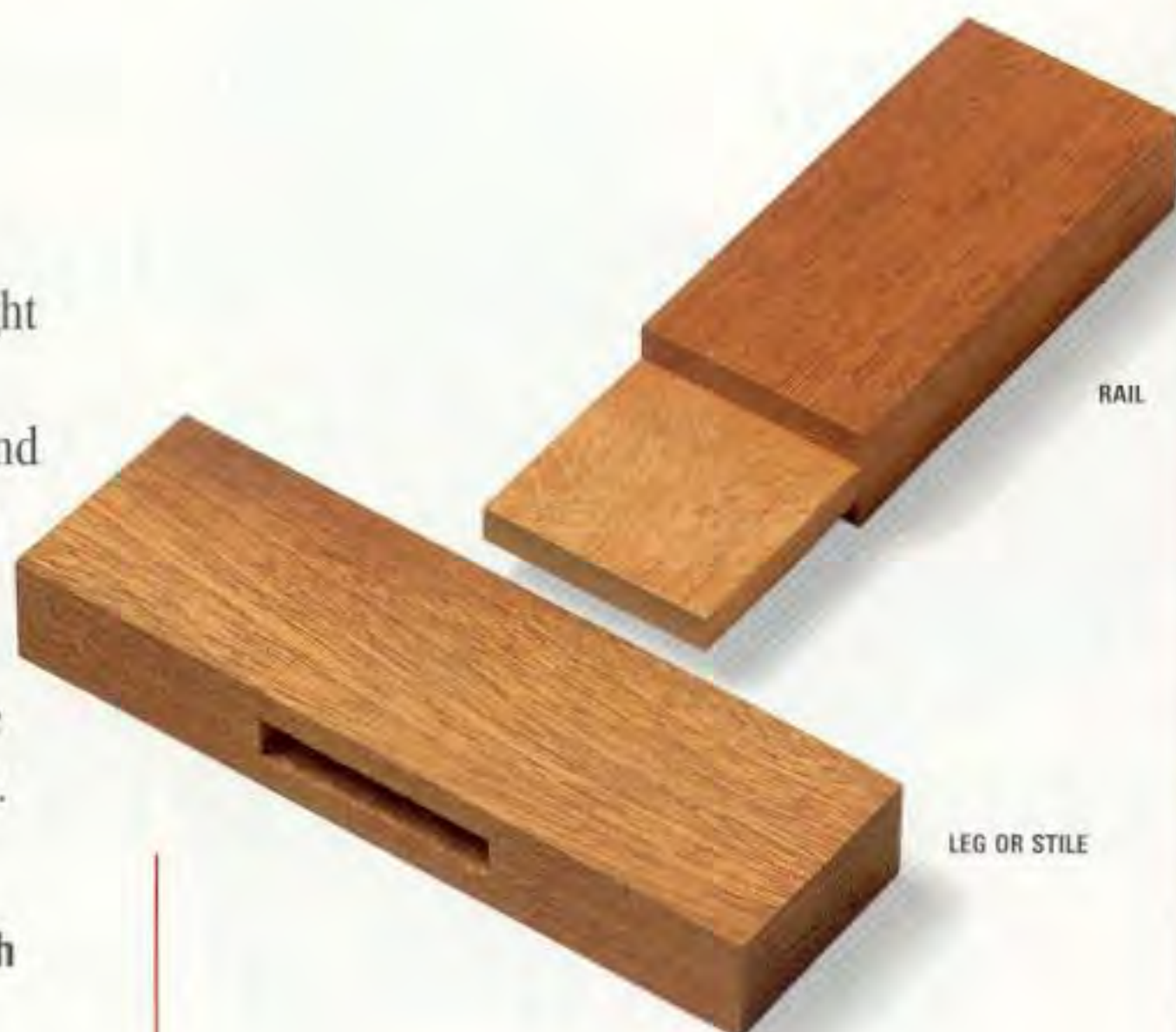


CHAPTER 9 The mortise-and-tenon joint has a venerable history; it has been used for centuries to construct framed cabinets, chairs and tables. In its simplest form, the tenon, a tongue cut on the end of a rail, fits into a slot, the mortise, that is cut into a stile or leg. The basic construction has been developed and refined by generations of joiners and cabinetmakers, creating a variety of strong joints to suit different situations.

THROUGH MORTISE AND TENON

HAND CUT

The through joint, where the tenon passes right through the leg, is used a great deal for constructional frames of all kinds. With the end grain showing, possibly with wooden wedges used to spread the tenon (see page 72), it is an attractive, business-like joint. Always cut the mortise first, since it is easier to make the tenon fit exactly than the other way round.



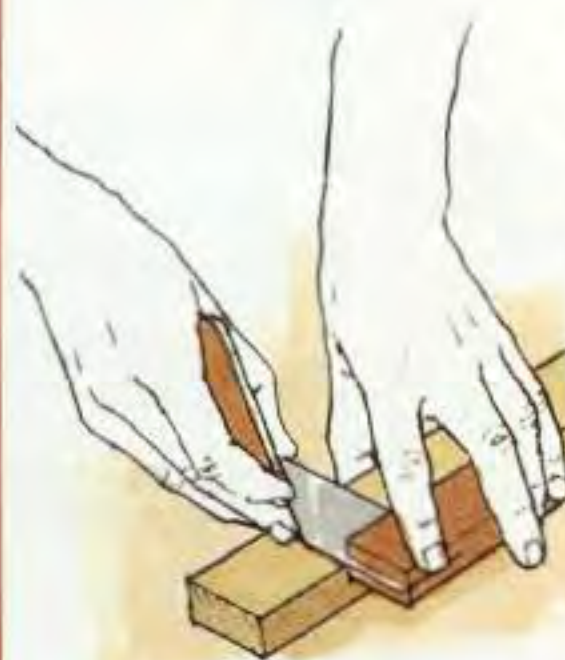
1 Marking the length of the mortise

Mark the position and length of the mortise, using the rail as a template. Square the lines all round with a pencil.



2 Scribing the mortise

Set a mortise gauge to match the width of the mortise chisel to be used, and then scribe the mortise centrally between the squared lines on both of its edges.



3 Marking the tenon shoulders

Mark the shoulders on the rail, allowing for slightly overlong tenons that can be planed flush when the joint is complete. Score the shoulder lines with a marking knife.



4 Scribing the tenon

Without adjusting the settings, use the mortise gauge to scribe the tenon on both edges and across the end of the rail.

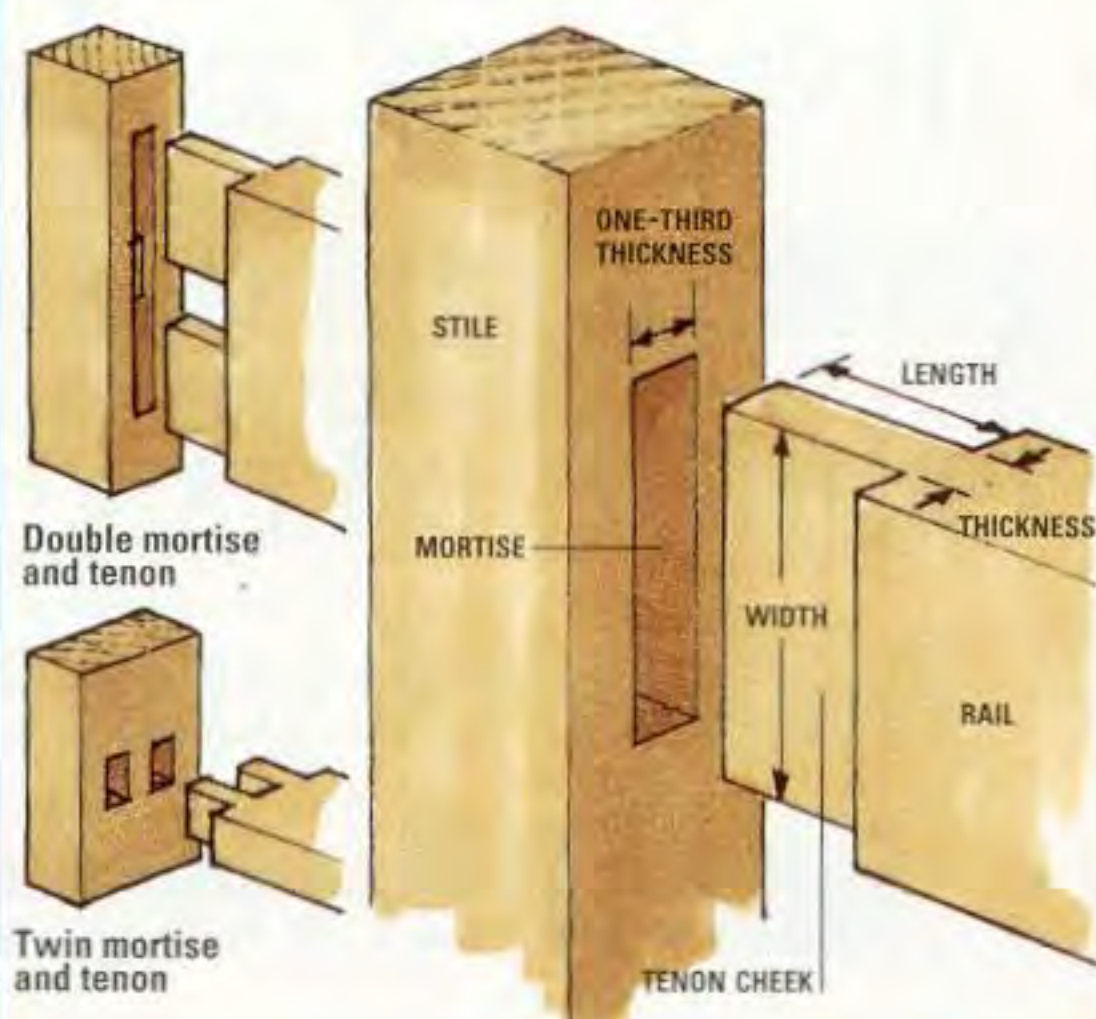
PROPORTIONS OF A MORTISE AND TENON

Cut the tenon for a standard joint to approximately one-third the thickness of the rail, the exact size being determined by the chisel used to cut the mortise.

Tenon thickness can be increased when the leg or mortise member is thicker than the rail.

A tenon normally runs the full width of the rail but, should the rail be unusually wide, it is best to incorporate a pair of tenons, one above the other, to avoid weakening the leg with an excessively long mortise. This type of joint is known as a double mortise and tenon. Twin tenons, cut side by side, are required when a rail is set horizontally.

Make the depth of a stopped mortise about three-quarters the width of the leg or stile.



5 Chopping the mortise

Clamp the work to a bench so that you can stand at one end of the stile. Holding the chisel vertically, drive it 3 to 6mm ($\frac{1}{8}$ to $\frac{1}{4}$ in) into the wood at the centre of the marked mortise. Work backwards in short stages, making similar cuts and ensuring you stop about 2mm ($\frac{1}{16}$ in) from the end of the mortise.



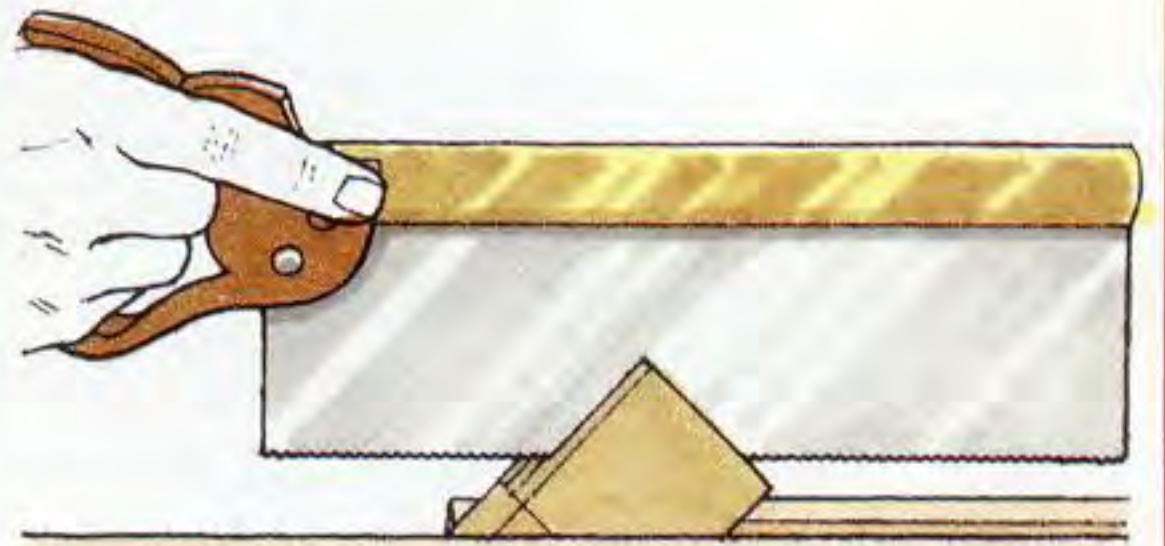
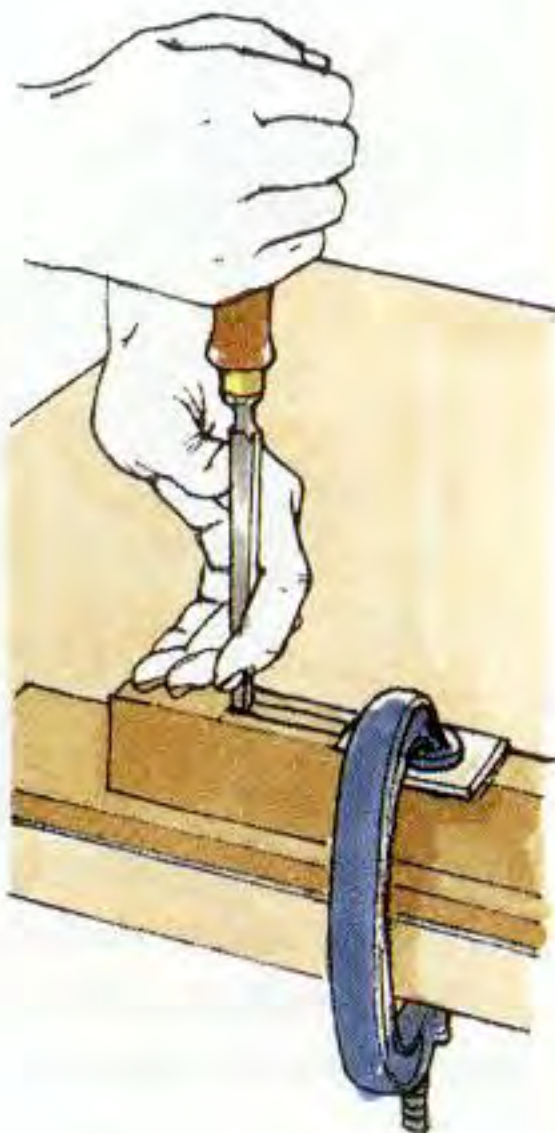
6 Removing the waste

Turn the mortise chisel around and chop the wood in stages towards the other end of the mortise. Lever out the waste with the chisel, then chop out another section of wood until you have cut halfway through the stile.



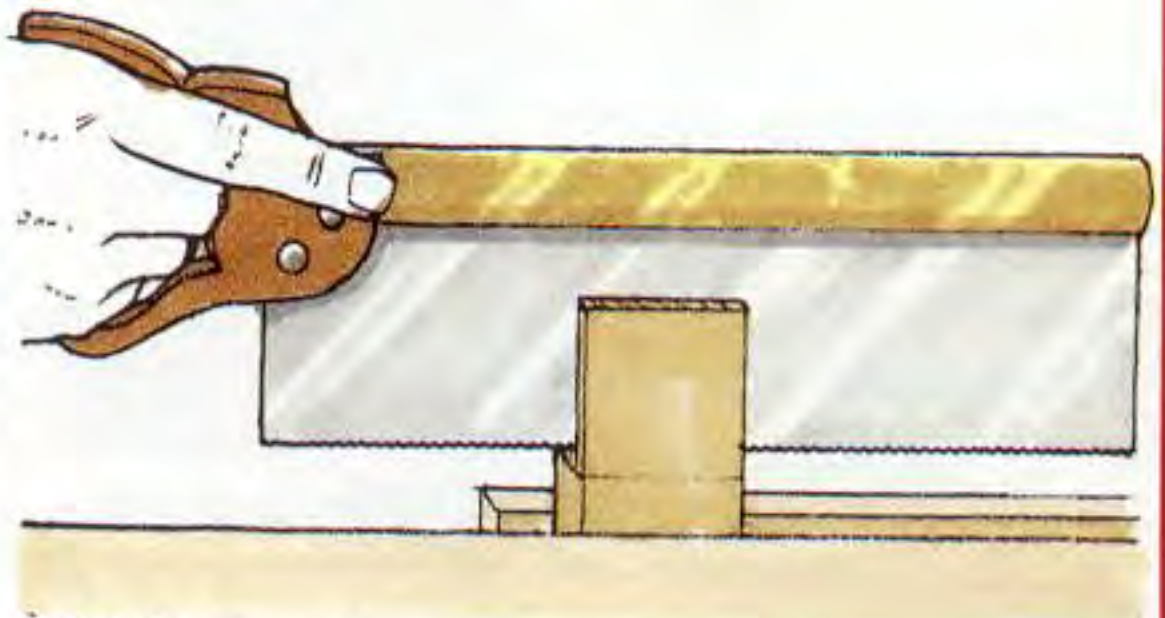
7 Completing the mortise

Pare the ends of the mortise square, then turn the work over and, after shaking out any loose wood chips, clamp the stile down again so that you can chop out the waste from the other side of the joint.



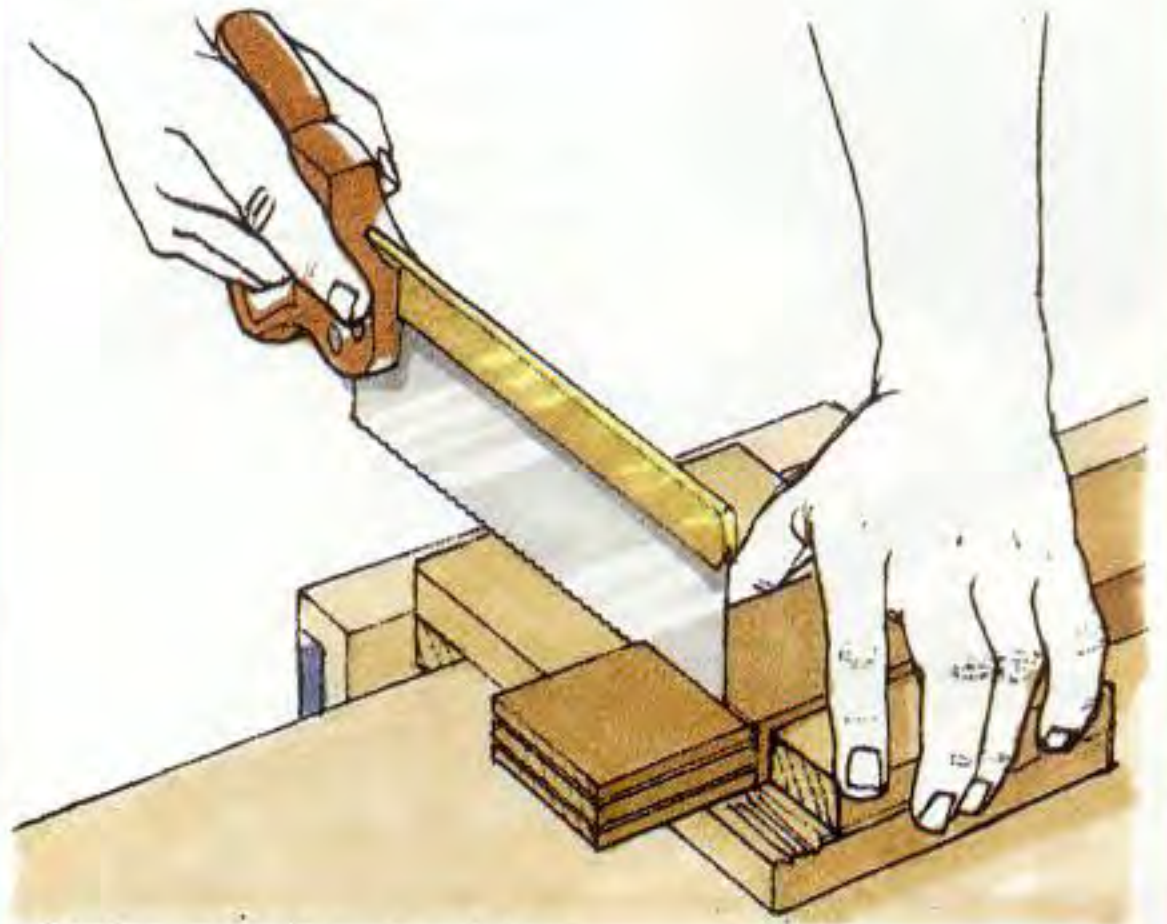
8 Sawing the tenon

Clamp the rail in a vice, set at an angle so that the end grain faces away from you. Saw down to the shoulder on the waste side of each scribed line. Turn the work around and saw down to the shoulder line on the other side of the tenon.



9 Cutting square

Clamp the work upright and saw parallel to the shoulder on both sides of the tenon, taking care not to overrun the marks.



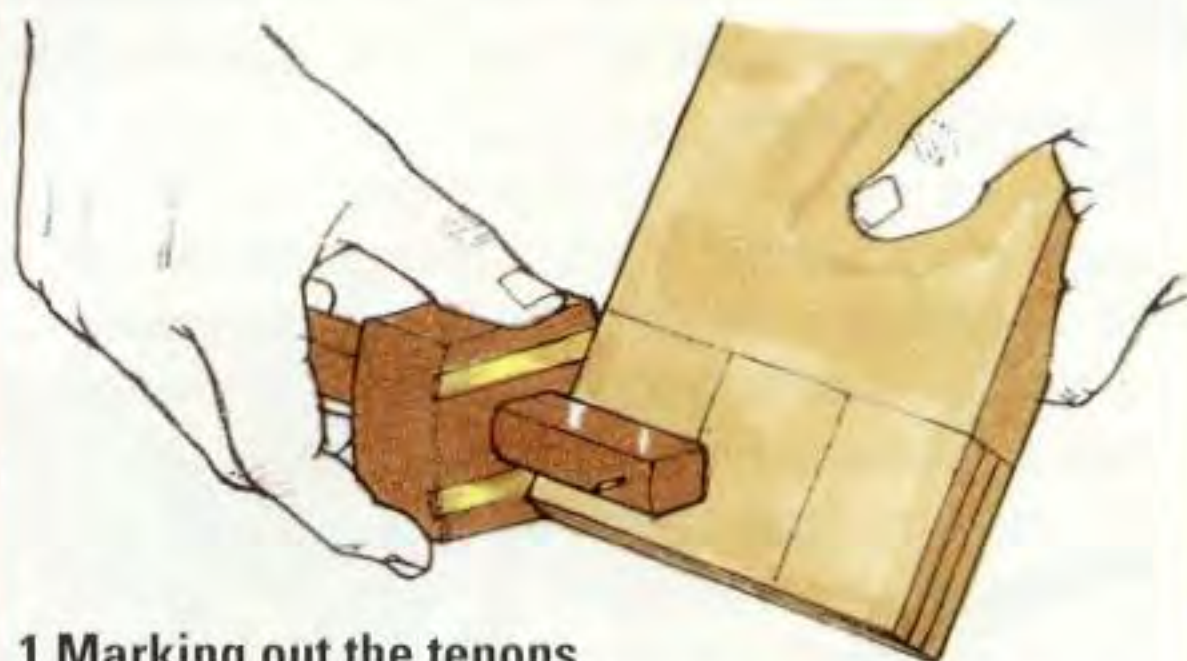
10 Sawing the shoulders

Holding the rail on a bench hook, remove the waste by sawing down the shoulder line on each side of the tenon. If necessary, pare the sides of the tenon with a chisel until it fits the mortise snugly.

DOUBLE MORTISE AND TENON

HAND CUT

A double mortise and tenon is typically used for the lock rail of a large frame-and-panel door. The gap between the tenons should be no more than one-third the width of the rail. To help prevent the rail warping, leave a short stub of wood, known as a haunch (see page 70), between the tenons.



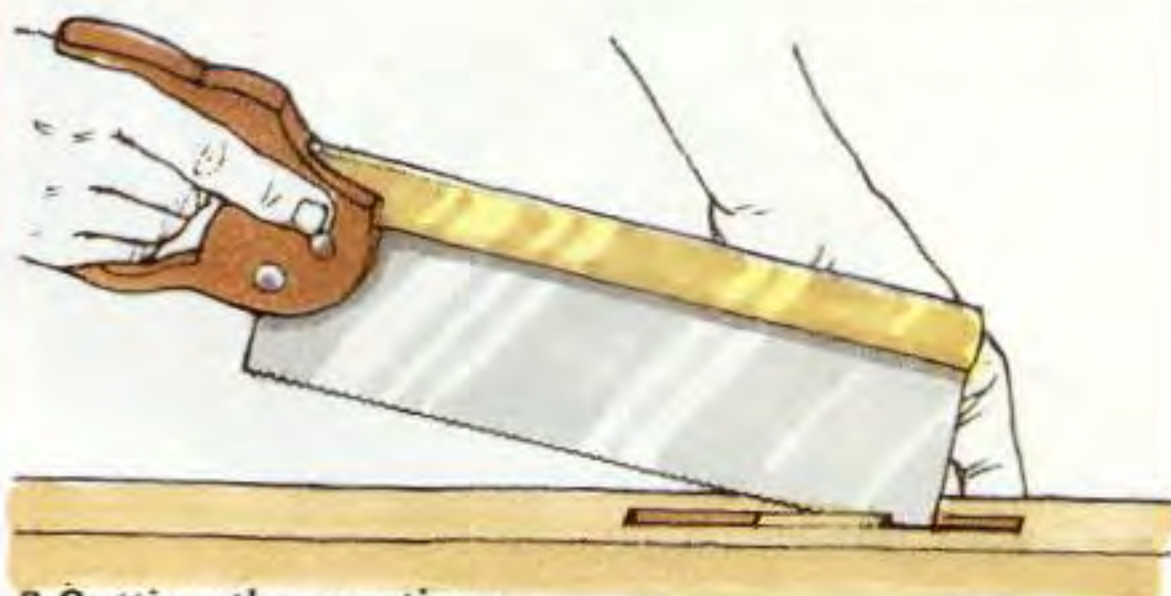
1 Marking out the tenons

Mark the shoulders and scribe the tenons as described for a standard through joint. Set a marking gauge to scribe the inner edge of both tenons on each side of the rail and across the end grain.



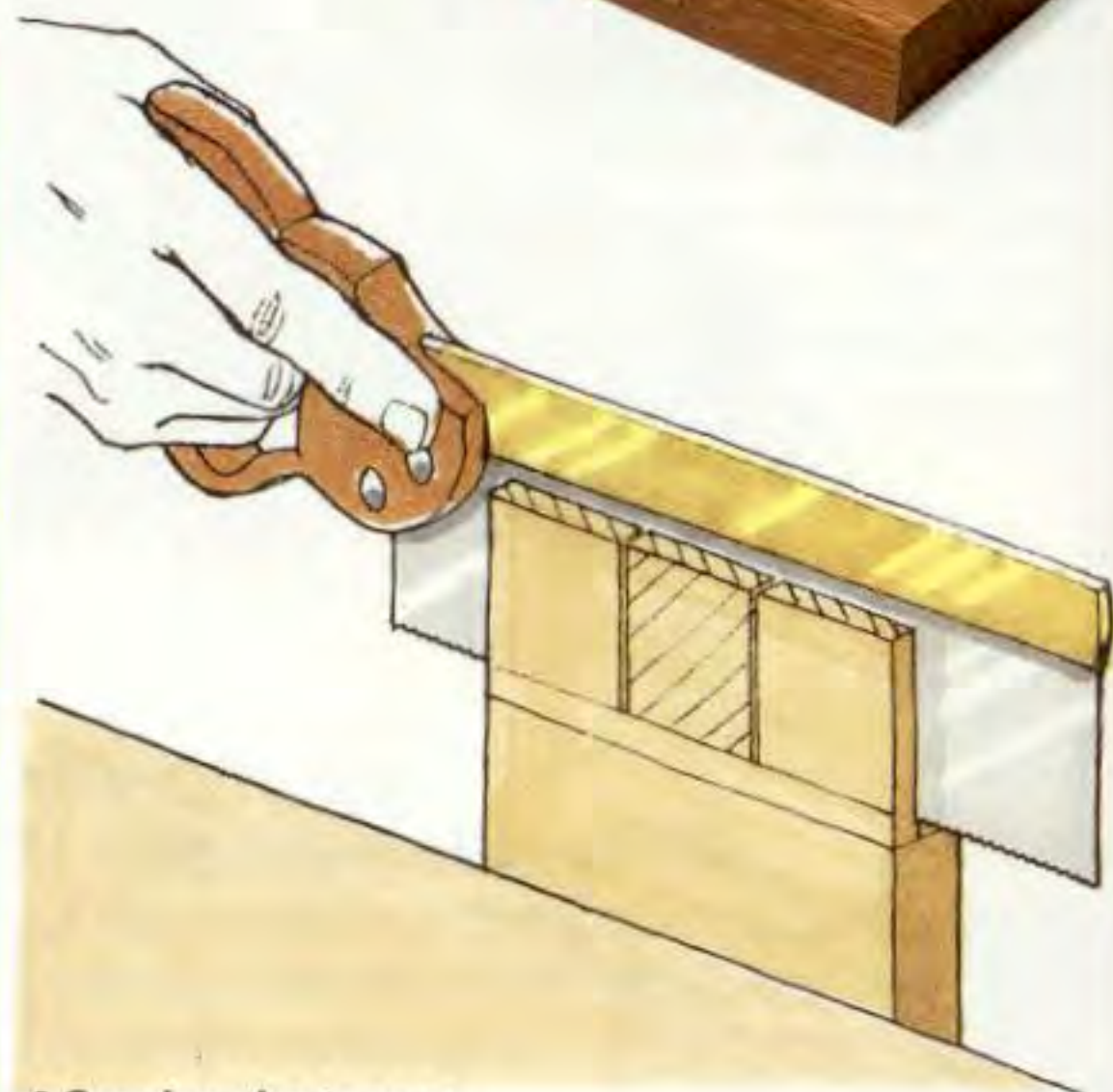
2 Marking the haunch

Using a try square, pencil a line representing the length of the haunch (equal to the thickness of the tenon) on both sides and edges of the rail. Mark the waste with a pencil. Mark out the mortises (see page 64), using the rail as a template.



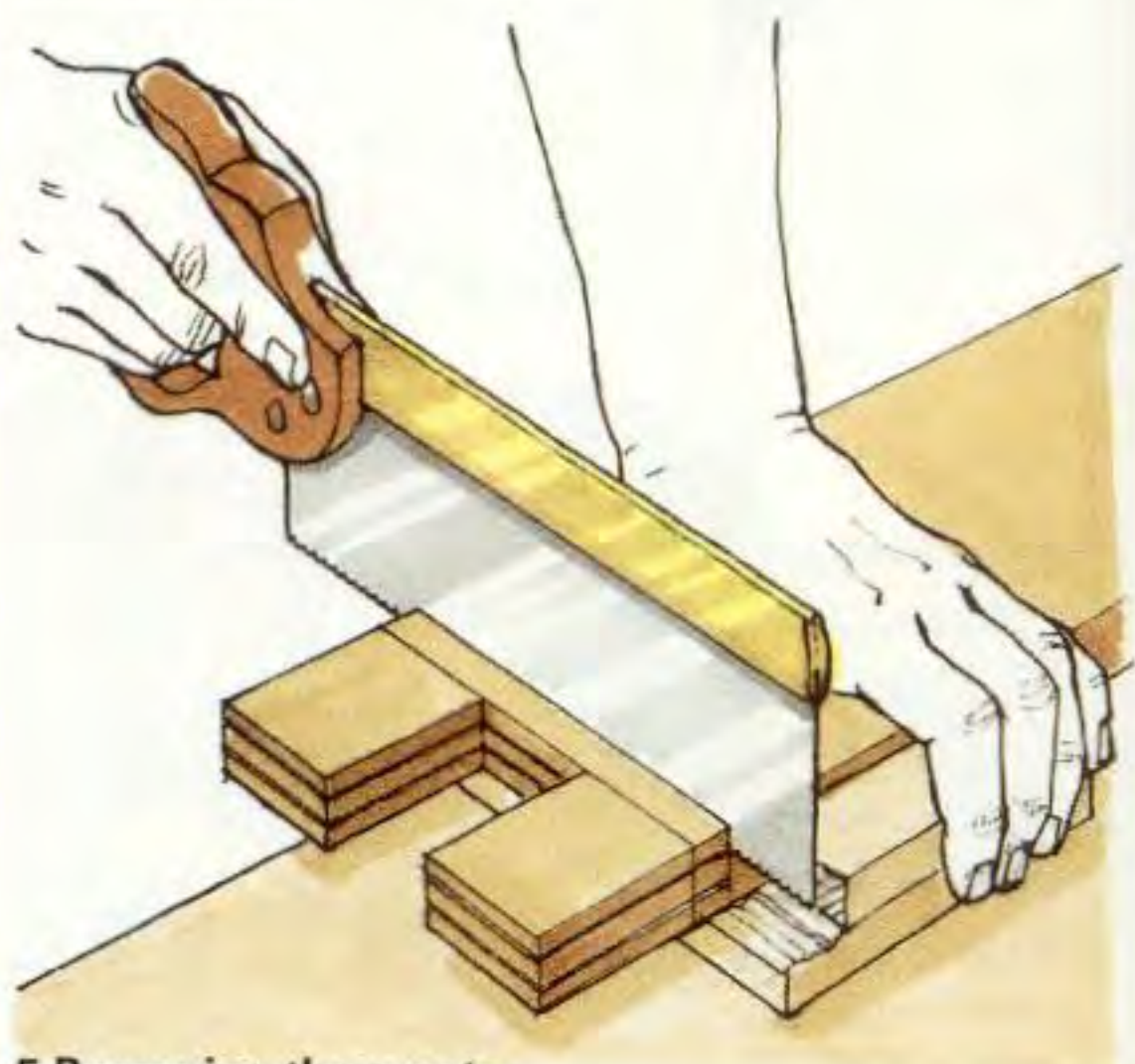
3 Cutting the mortises

Chop out both mortises as described on page 65, then run a saw blade alongside the haunch lines gauged between them. Chisel out the waste between the saw cuts, down to the level of the haunch.



4 Sawing the tenons

Clamp the rail upright and, standing at the side of the rail, first saw down the inner edge of each tenon, stopping at the haunch line. Change your position to saw alongside both tenons, all the way down to the shoulder lines.



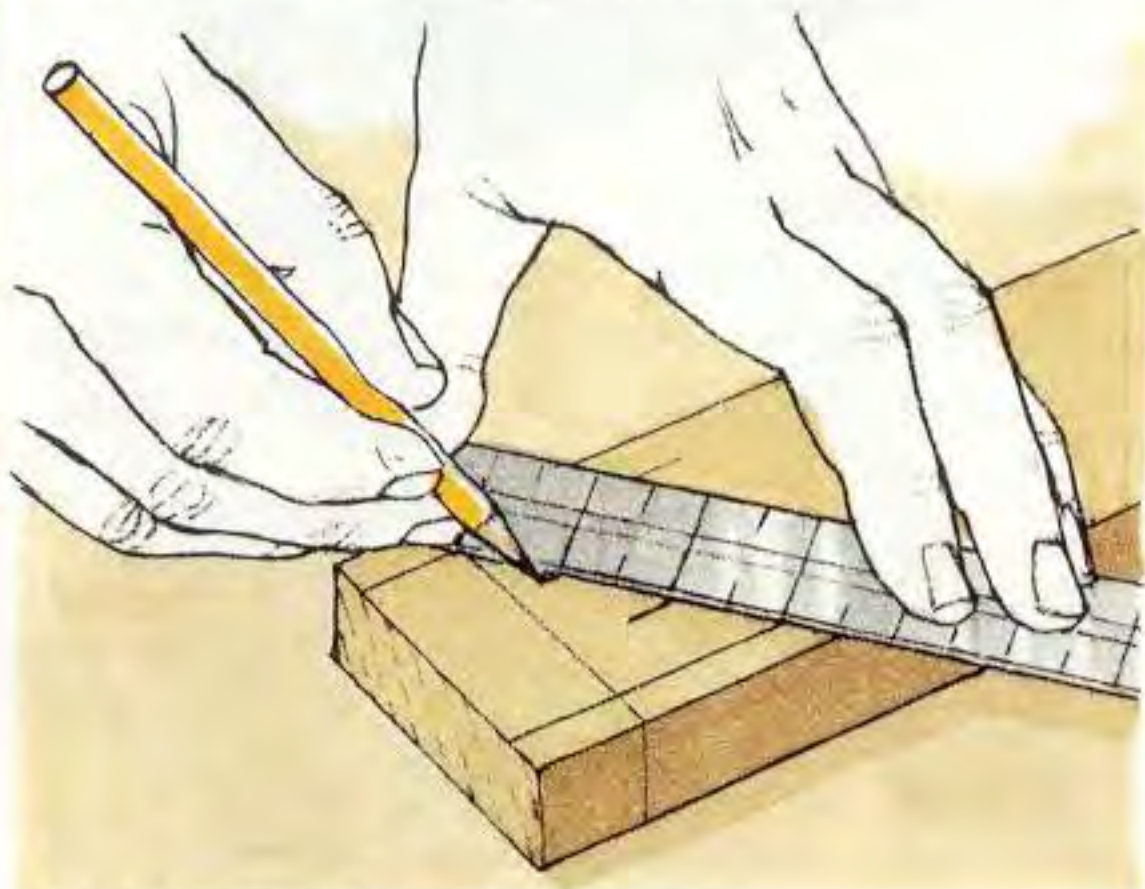
5 Removing the waste

Cut out the wood from between the tenons, using a coping saw, then saw the shoulder on each side of the joint to remove what is left of the waste.

TWIN MORTISE AND TENON

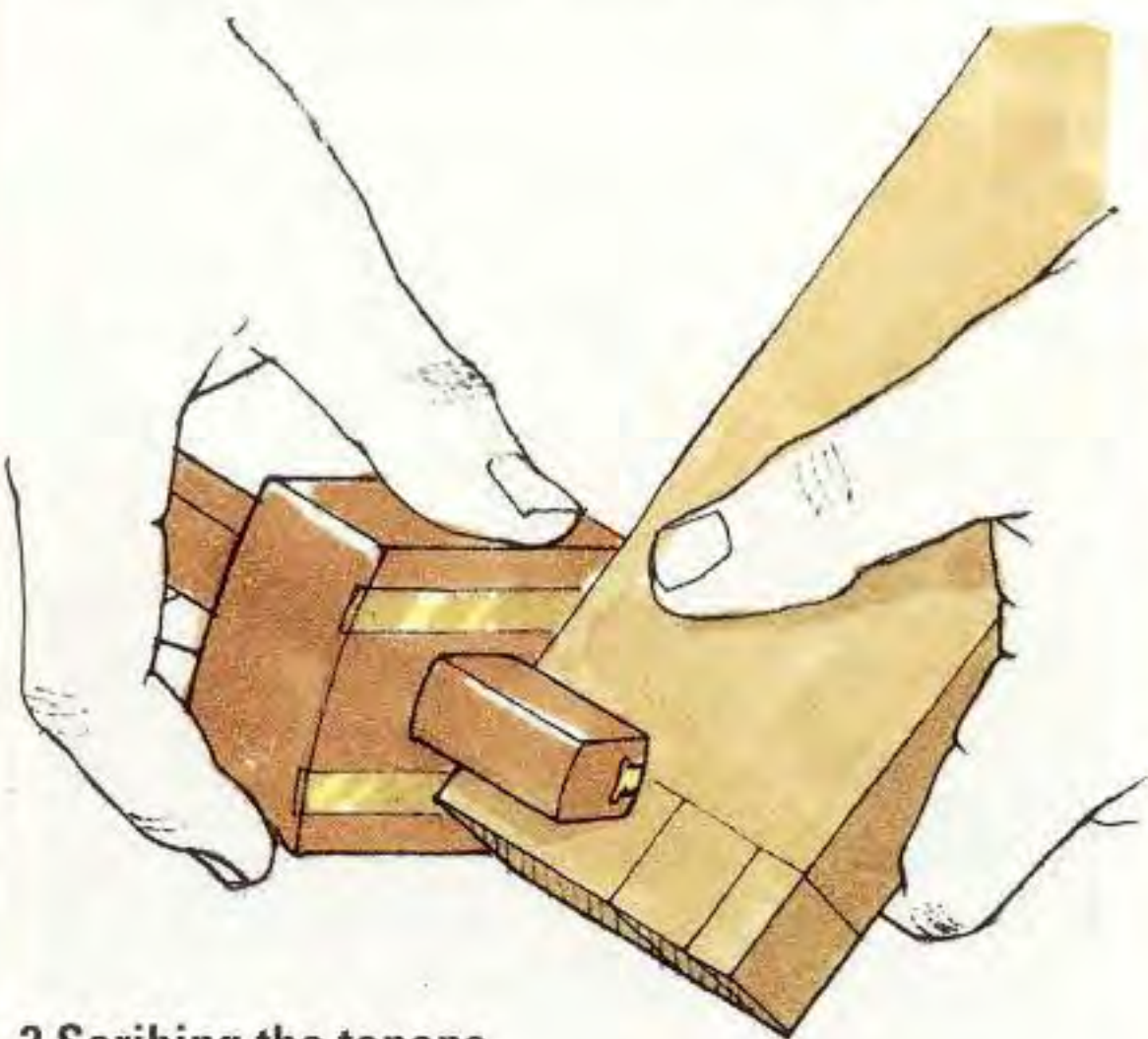
HAND CUT

The twin mortise and tenon is used when a rail, turned on its side, is jointed into the face of a leg rather than its edge. It is also commonly used for drawer-rail construction. Depending on the section of the rail, there may be a pair of tenons cut to standard proportions, or two relatively thick pin tenons (see page 68). As a rule, make each tenon as thick as the gap between them.



1 Marking out tenon thickness

Having squared the shoulder lines all round, make a pencil mark not less than 6mm (1/4in) from each edge, then divide the space between into three, to give a pair of tenons and the gap between them. Modify the thickness of the tenons to match a suitable chisel.



2 Scribing the tenons

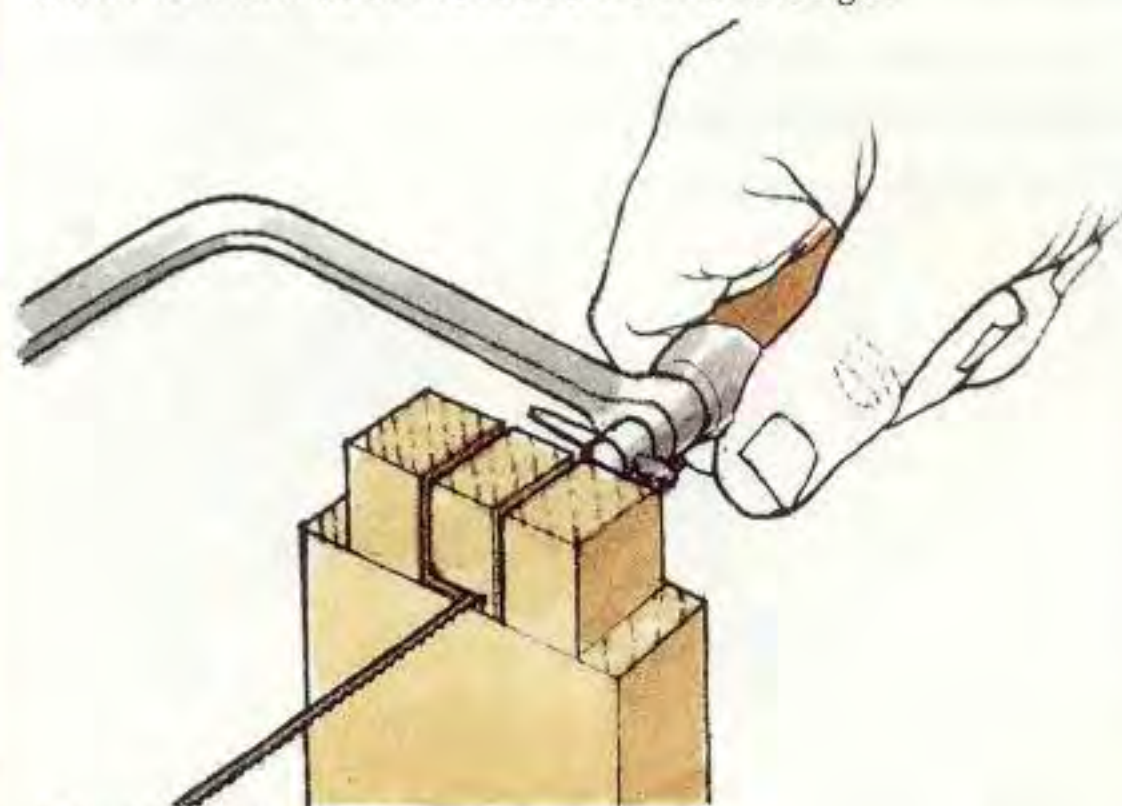
Set a mortise gauge to the above dimensions, and scribe the tenons on both faces and across the end of the rail, working from both edges.

MORTISE-AND-TENON JOINTS



3 Marking out the mortises

Square two lines across the work to mark the top and bottom of the mortises, then scribe lines between them to mark the sides of the mortises, using the marking gauge. If the mortises are to be cut into a wider rail or panel, leave the pin settings alone but adjust the tool's stock to mark both mortises from one edge.



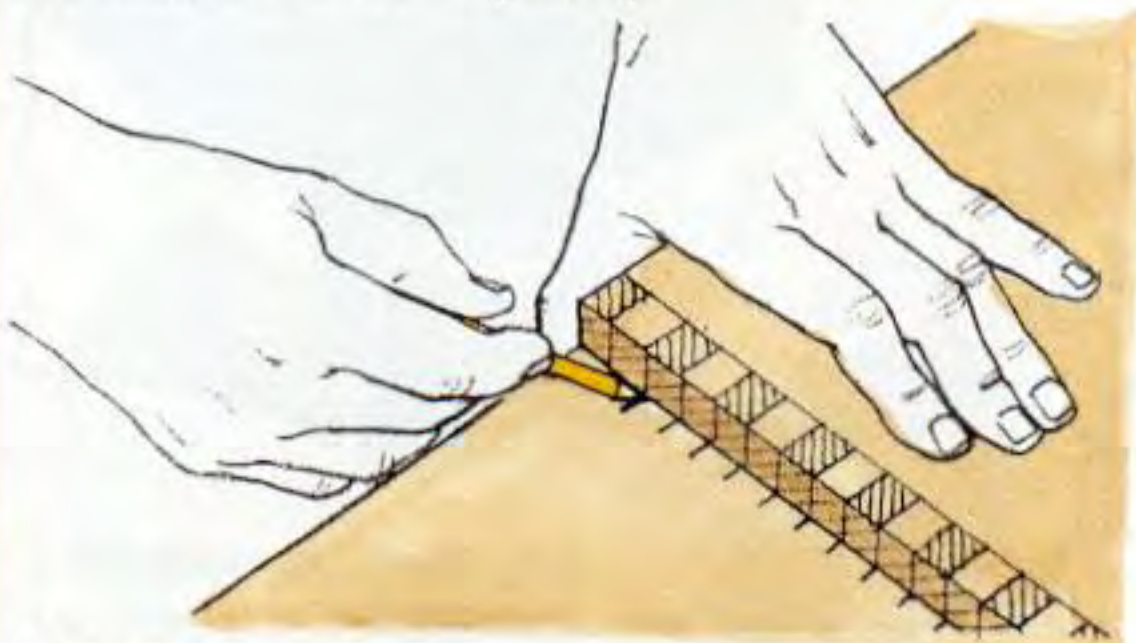
4 Cutting the joint

Chop out the mortises as described on page 65. Saw down beside each tenon, following the scribed lines, then cut off the waste wood from both edges of the rail by sawing along the shoulder lines. Remove the waste from between the tenons with a coping saw and chisel (see also page 68).

PINNED MORTISE AND TENON

HAND CUT

A pinned version of the joint comprises a row of evenly spaced, stubby tenons (pins) for fitting wide, fixed shelves or partitions into a cabinet. When the tenons pass right through the panel, they are usually held firmly in place with hardwood wedges set into sawcuts made across the end grain of each pin. For decorative reasons, the wedges are sometimes set diagonally.



1 Marking out the joint

Mark out the shelf as described for a twin mortise and tenon (see page 67), dividing the shoulder line with a row of evenly spaced pins. Modify the size of the pins to match your chisel. Mark the positions of the mortises, using the shelf as a template.

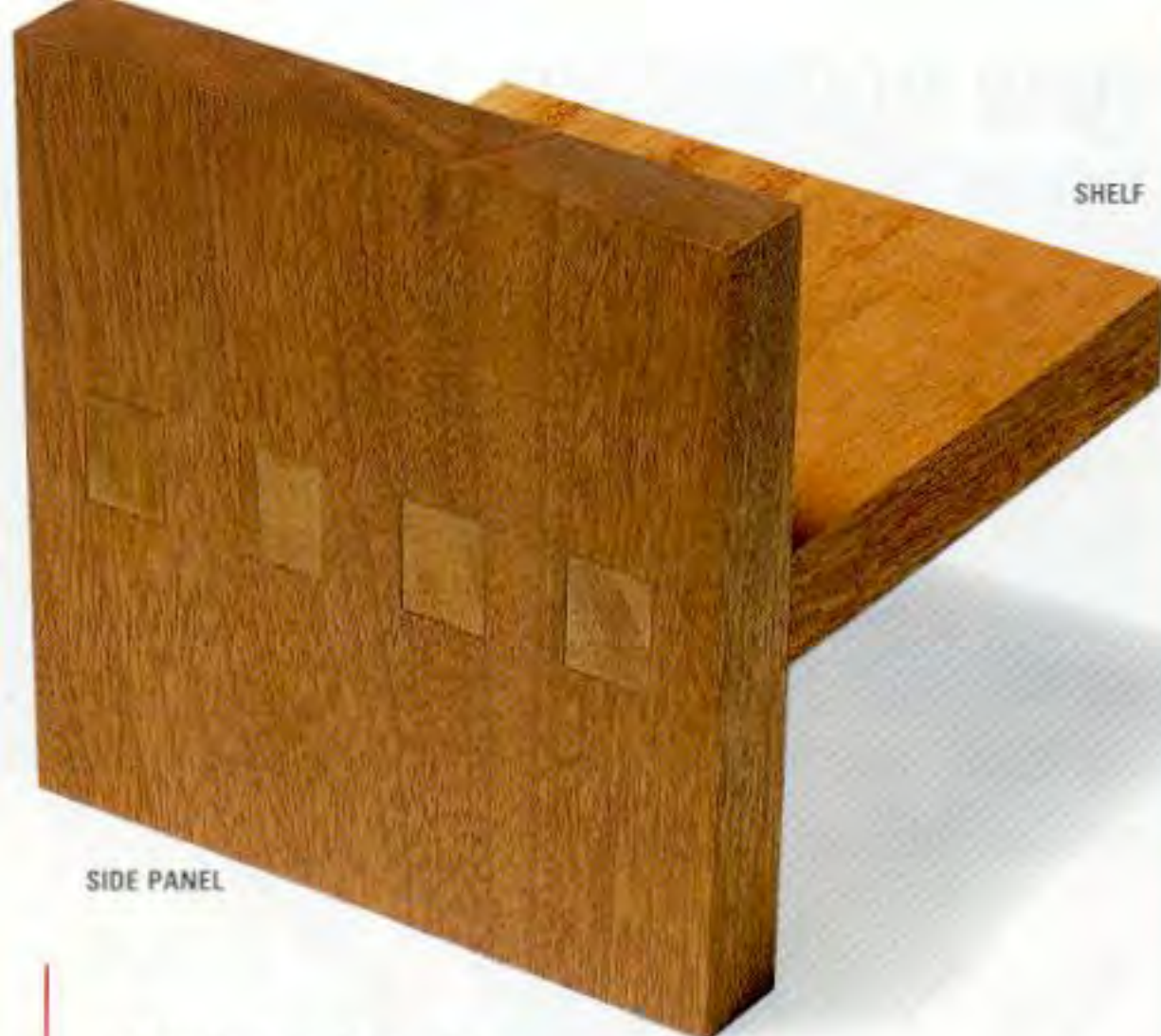
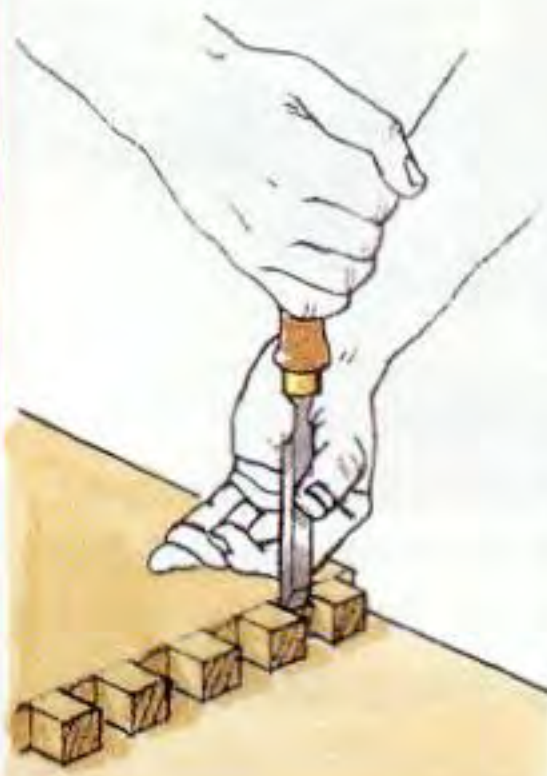
2 Cutting the mortises

Chop out the through mortises (see page 65), working from both sides of the panel.



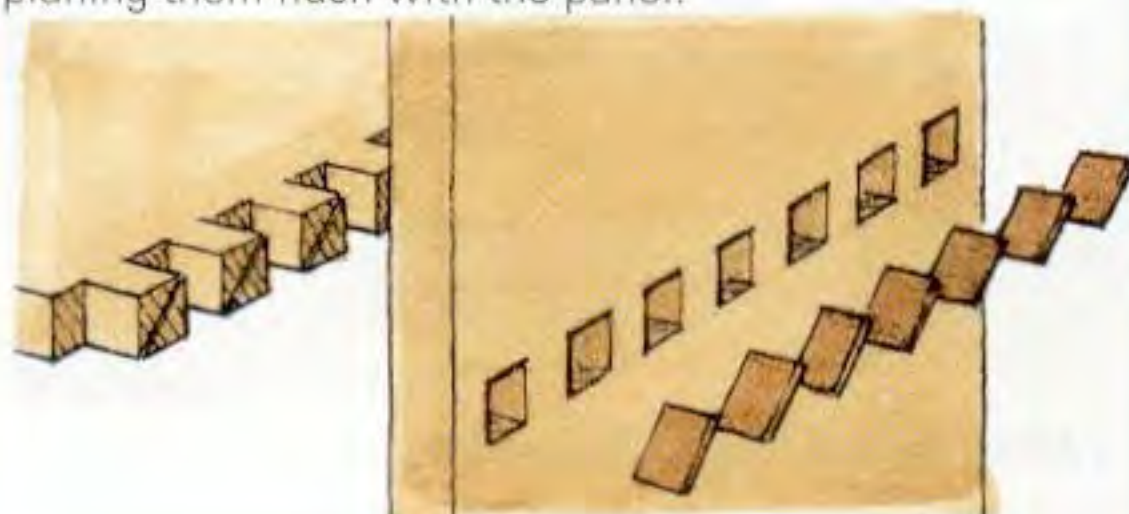
3 Cutting the pins

Saw down the sides of the pins with a tenon saw, then remove the waste from between them with a coping saw. Trim the shoulders with a chisel.



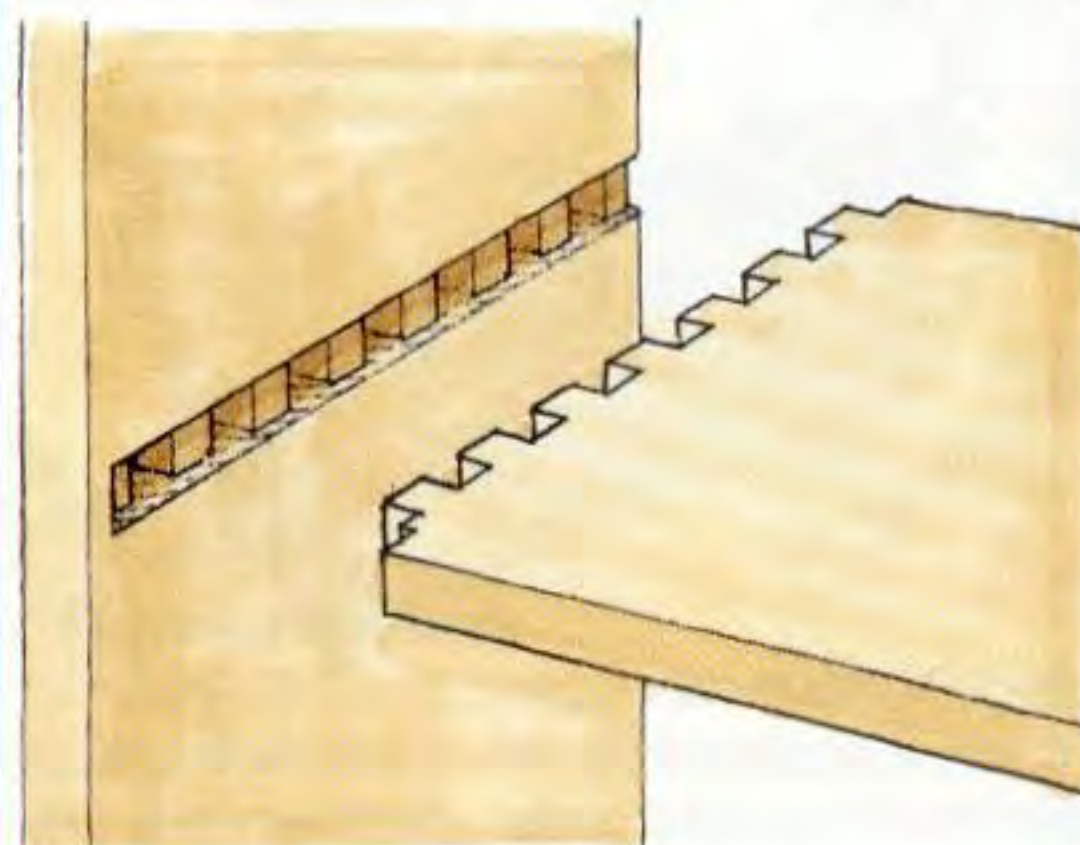
4 Wedging the pins

Make a diagonal saw cut across the end of each pin, down to the shoulder line. Having glued and assembled the joint, drive in glued wedges and leave to set before planing them flush with the panel.



STOPPED-HOUSING VERSION

Make an even stronger version of this joint by incorporating a stopped housing that holds the pinned end of the shelf. This joint is normally made with stopped pins. Cut the housing first. Allow for the depth of the housing when marking the shoulder line for the pins on the end of the shelf. When you have cut them, saw a notch out of the front edge of the shelf to accommodate the stopped end of the housing.



STOPPED MORTISE AND TENON

HAND CUT

The majority of tables and chairs are made with stopped mortise-and-tenon joints, with no obvious signs of the joint on the outside of the leg. It is a good-looking joint that is no more difficult to make than a through tenon, once you have learned how to accurately gauge the depth of the mortise.



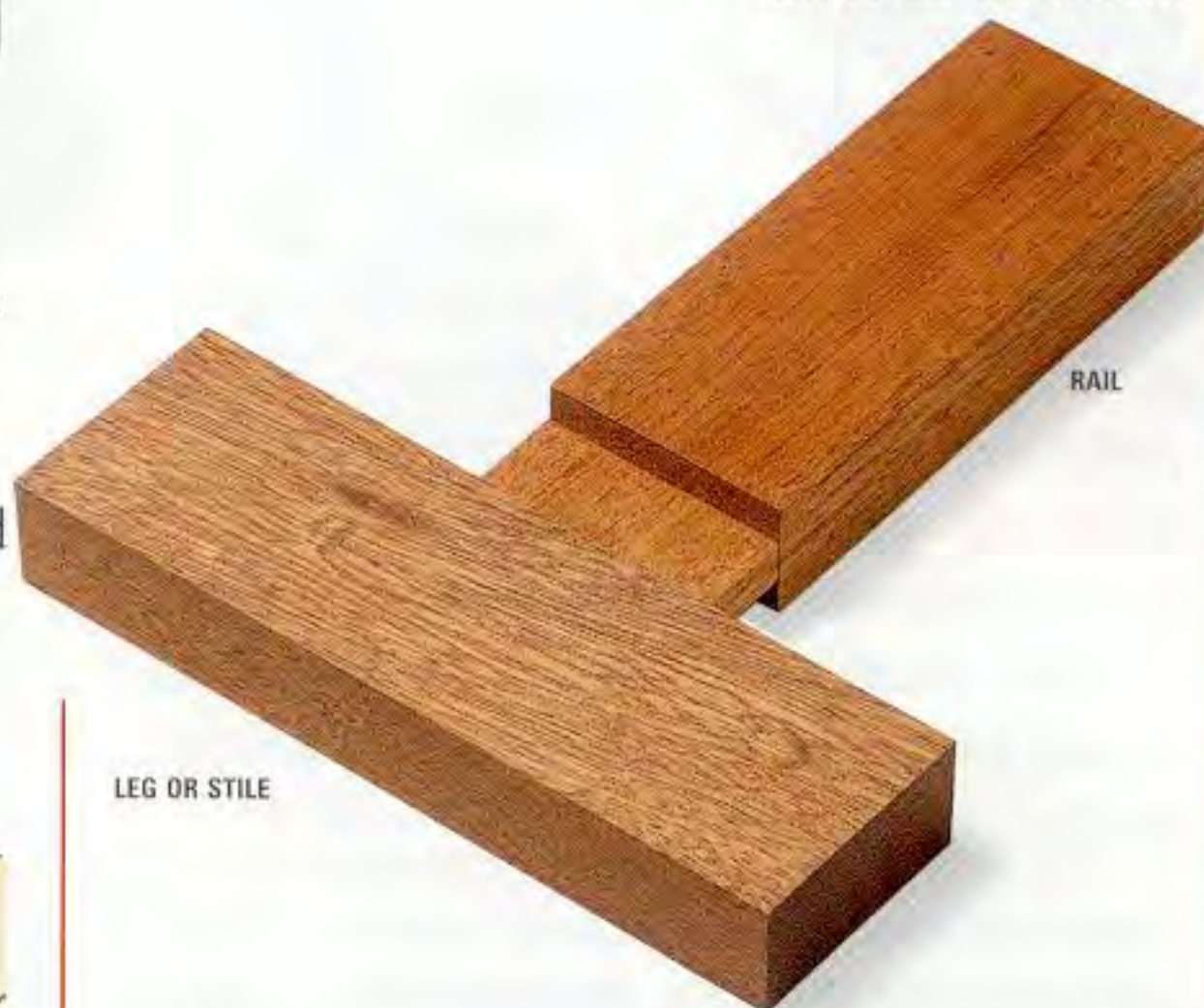
1 Marking out the tenon

Score the shoulder line all round the rail (see page 64 for proportions), and scribe the thickness of the tenon with a mortise gauge.



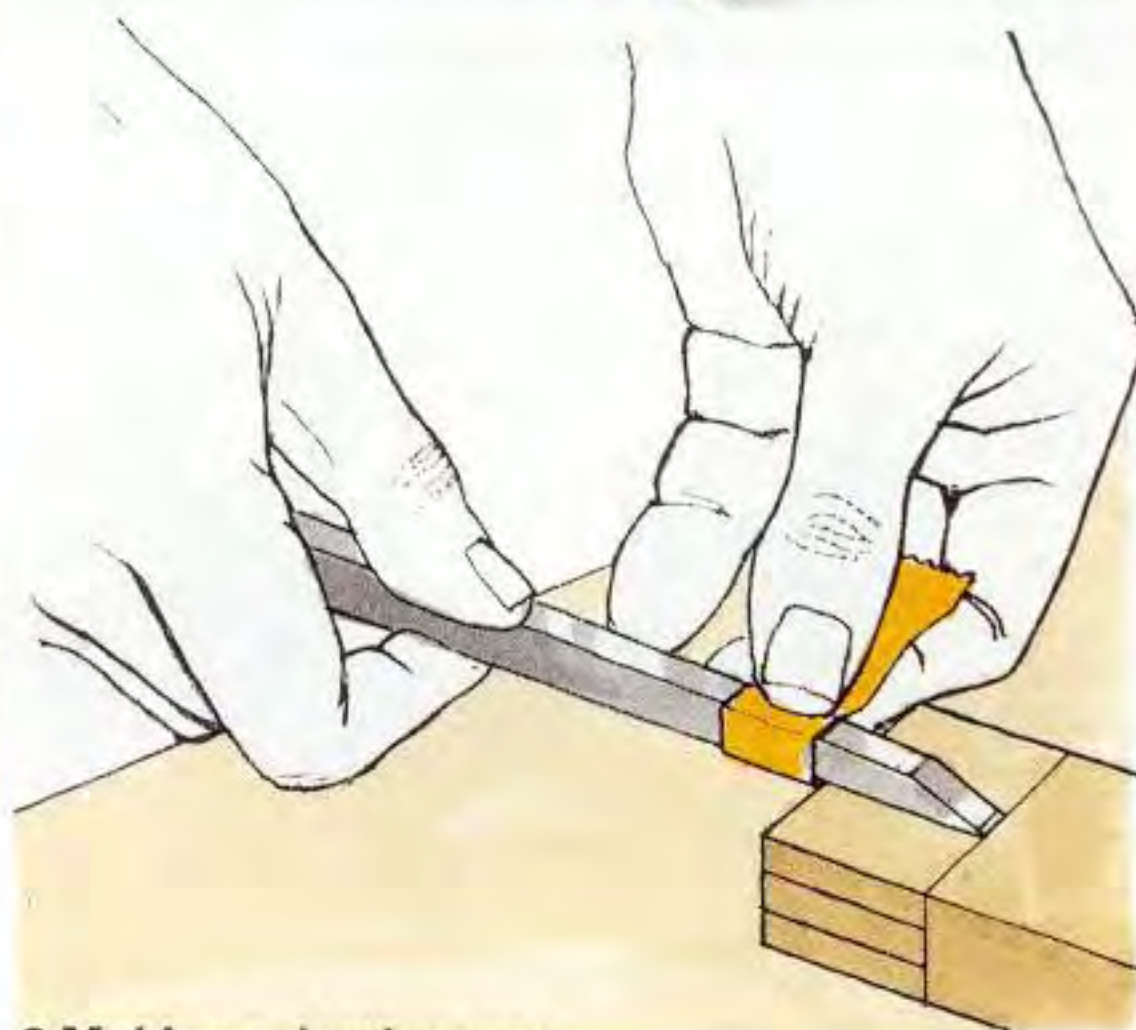
2 Marking out the mortise

Use the rail as a guide for marking out the mortise position on the leg or stile. Square the lines across the edge of the work, and use the same gauge to scribe the mortise between them.



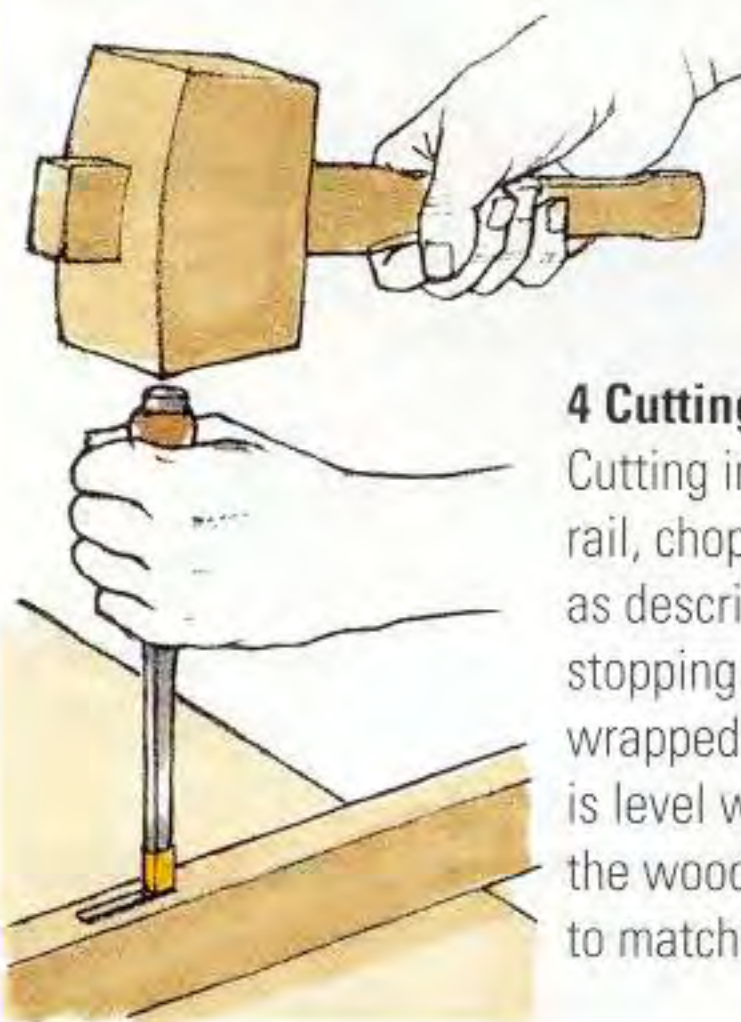
LEG OR STILE

RAIL



3 Making a depth gauge

To gauge the depth of the mortise, lay the blade of the chisel on the marked rail, with its cutting edge aligned with the shoulder line. Wrap adhesive tape around the blade at a point just beyond the end of the rail.



4 Cutting the joint

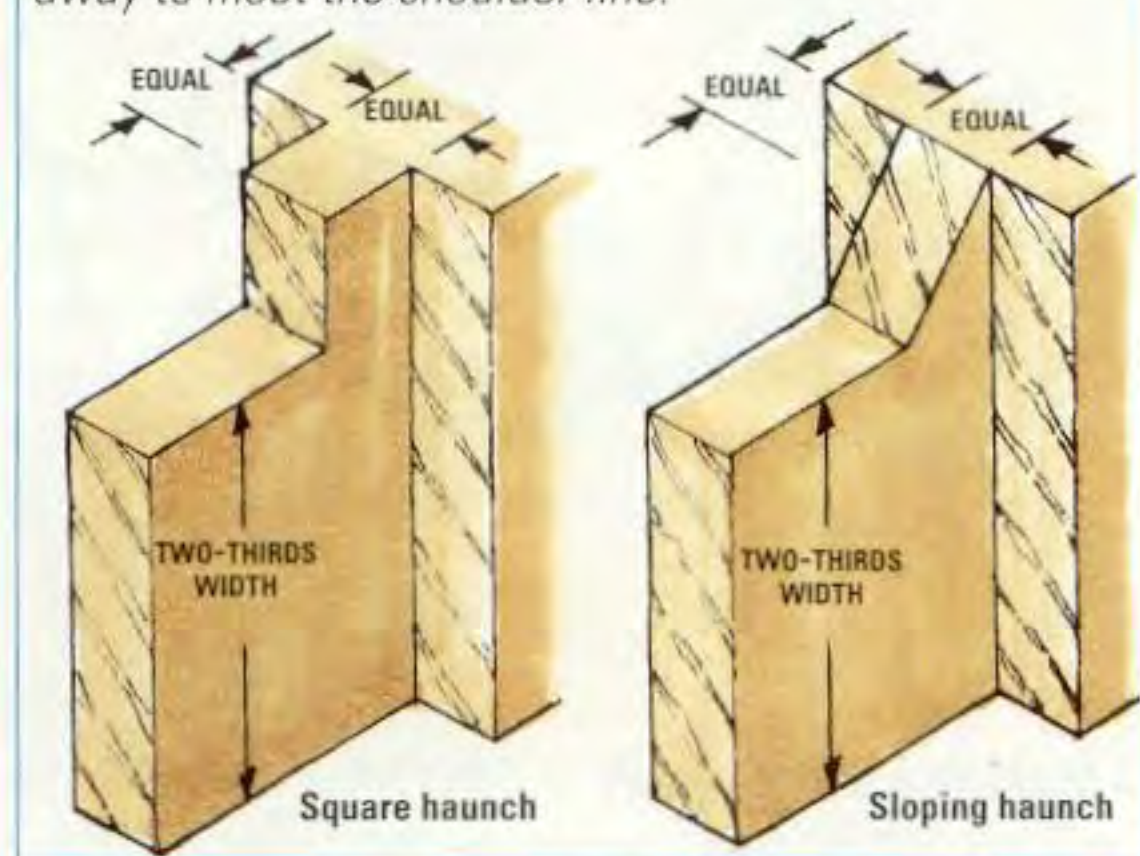
Cutting into one edge of the rail, chop out the mortise as described on page 65, stopping when the tape wrapped around the blade is level with the surface of the wood. Saw the tenon to match.

HAUNCHED MORTISE AND TENON HAND CUT

In order to include a strong joint at the corner of a frame, it is essential to offset the tenon slightly, to prevent it breaking through the end grain of the leg or stile. To support the top edge of the rail, a small integral tongue, known as a haunch, fits into a shallow groove cut just above the mortise. Cut a sloping haunch if you want it to be invisible when the joint is assembled.

PROPORTIONS OF A HAUNCHED TENON

Make the tenon two-thirds the width of the rail; the haunch itself should be as long as it is thick. Make a sloping haunch to the same proportions, but pare it away to meet the shoulder line.



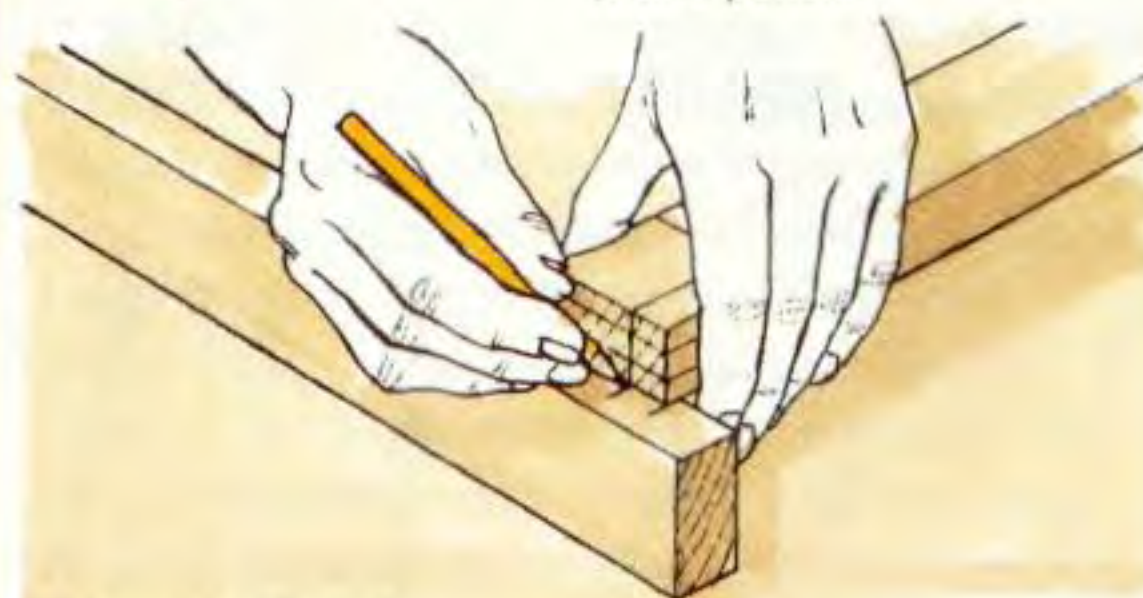
1 Marking out the tenon

Having marked the shoulders and scribed the tenon thickness on the rail (see page 64), use a marking gauge to scribe the top edge of the tenon on both sides and across the end grain.



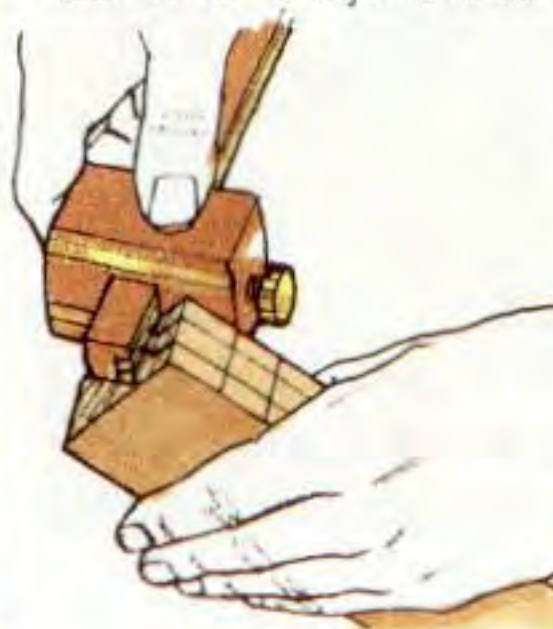
2 Marking the haunch

Mark the length of the haunch across the top and down the sides of the rail, and then hatch the waste with a pencil.



3 Transferring the measurements

Using the rail as a template, mark the position of the mortise on the stile. At this stage, let the end of the stile project by about 18mm ($\frac{3}{4}$ in) to prevent splitting. This extension, known as the horn, is cut off and planed flush when the joint is complete.



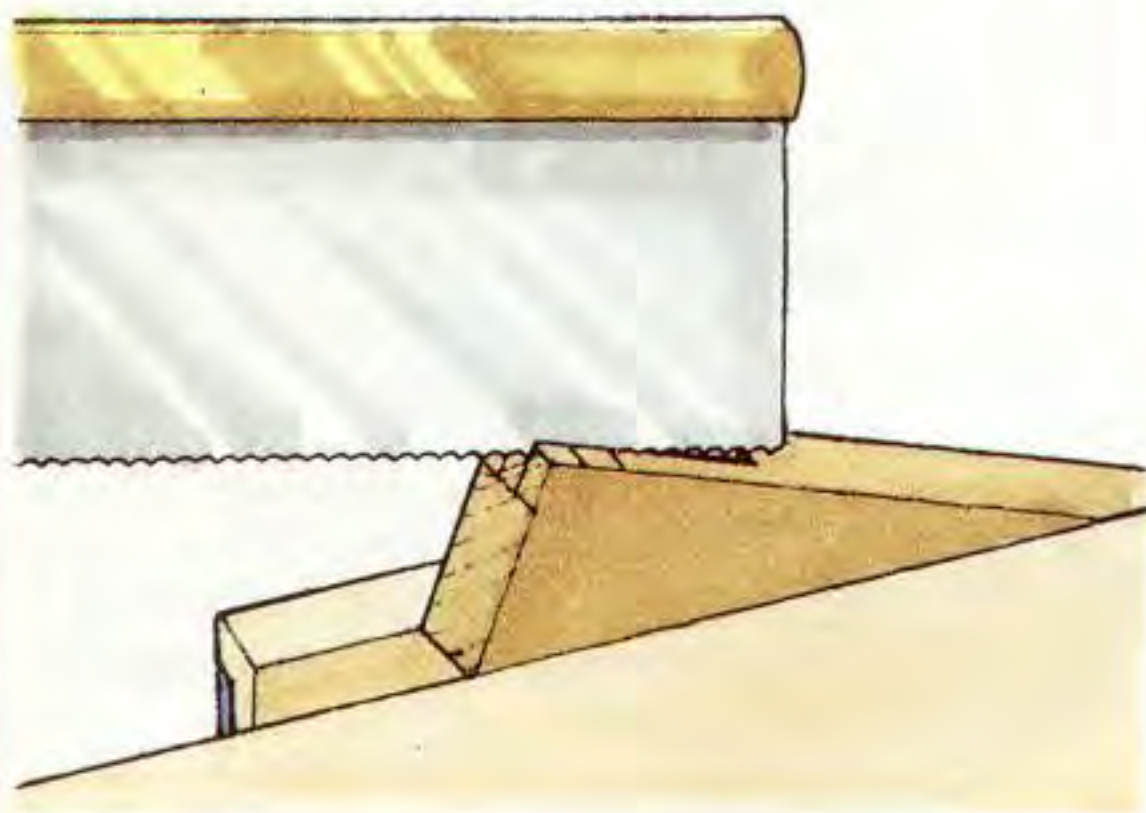
4 Scribing the mortise

Scribe the mortise up to the end of the stile, and then continue the lines a short way onto the end grain; this marks the end of the haunch groove.



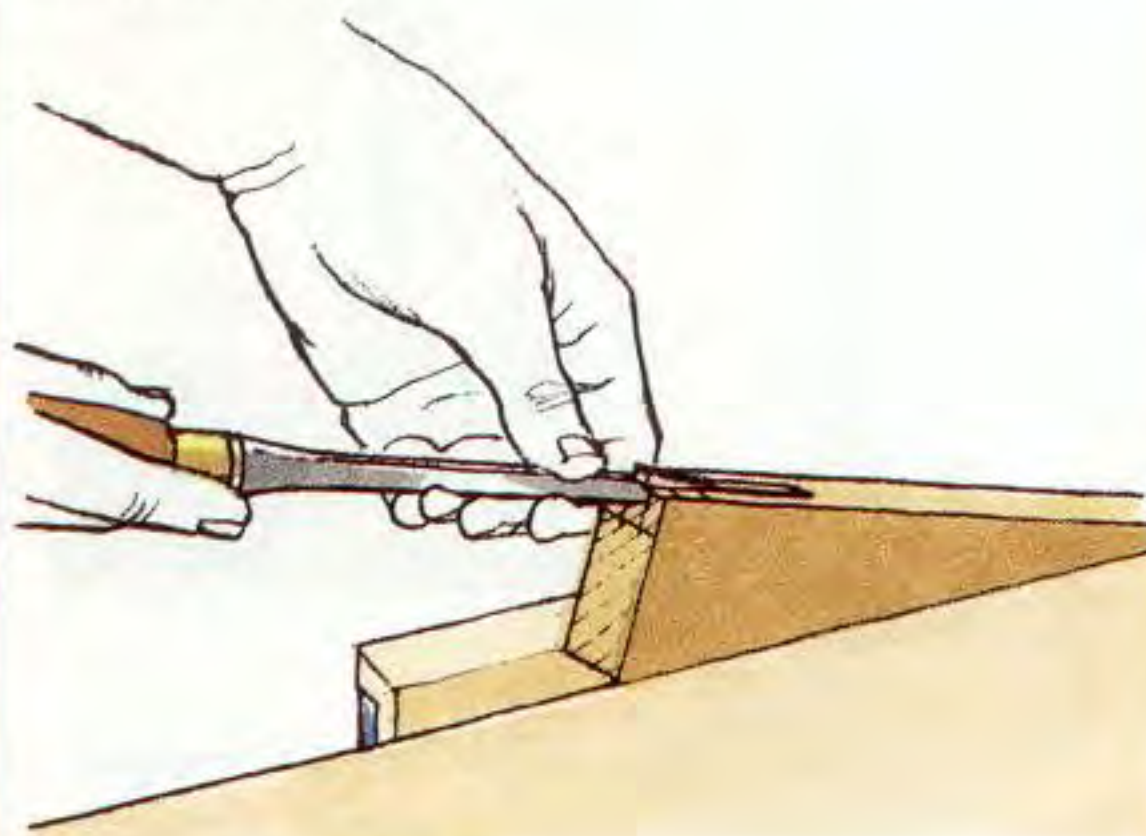
5 Marking the depth of the groove

Scribe a short line on the end of the stile to mark the depth of the haunch groove.



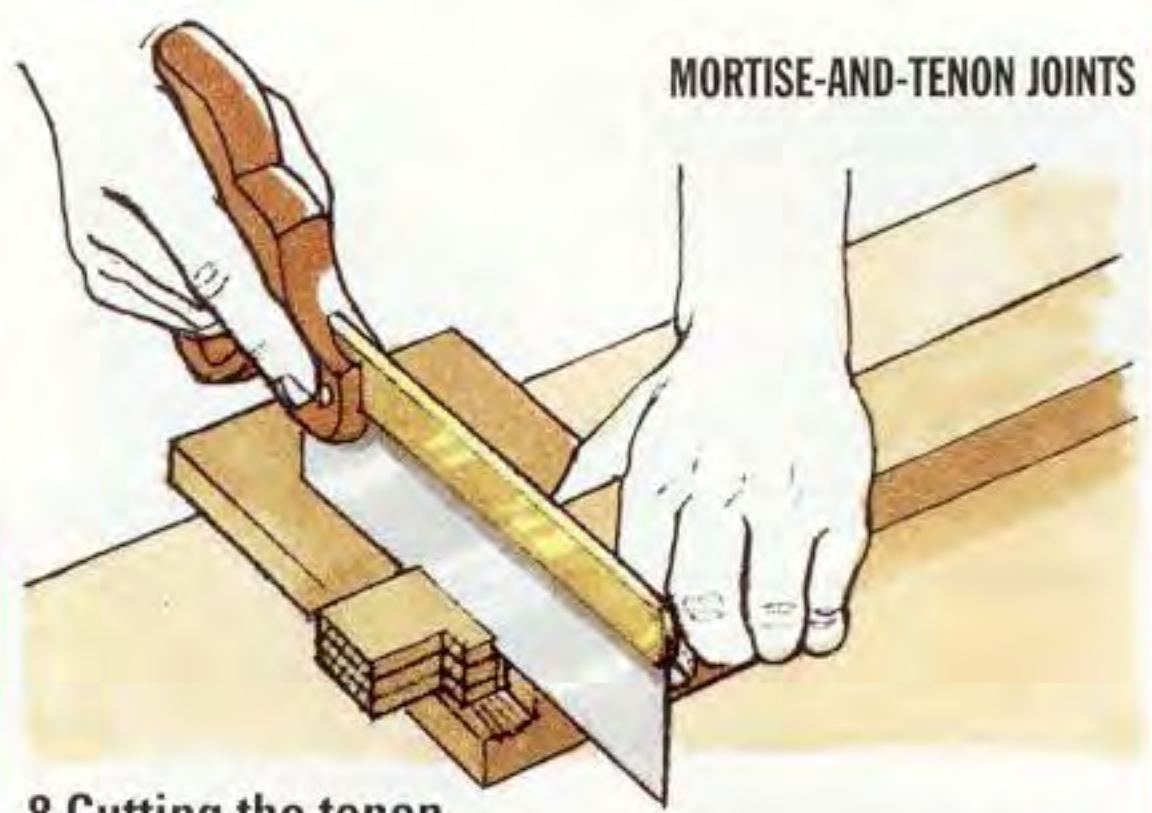
6 Cutting the mortise

Having cut the mortise (see page 65), extend the sides by sawing along the gauged lines, down to the bottom of the haunch groove.



7 Paring the groove

Use a chisel to pare away the waste, leaving the bottom of the groove square.



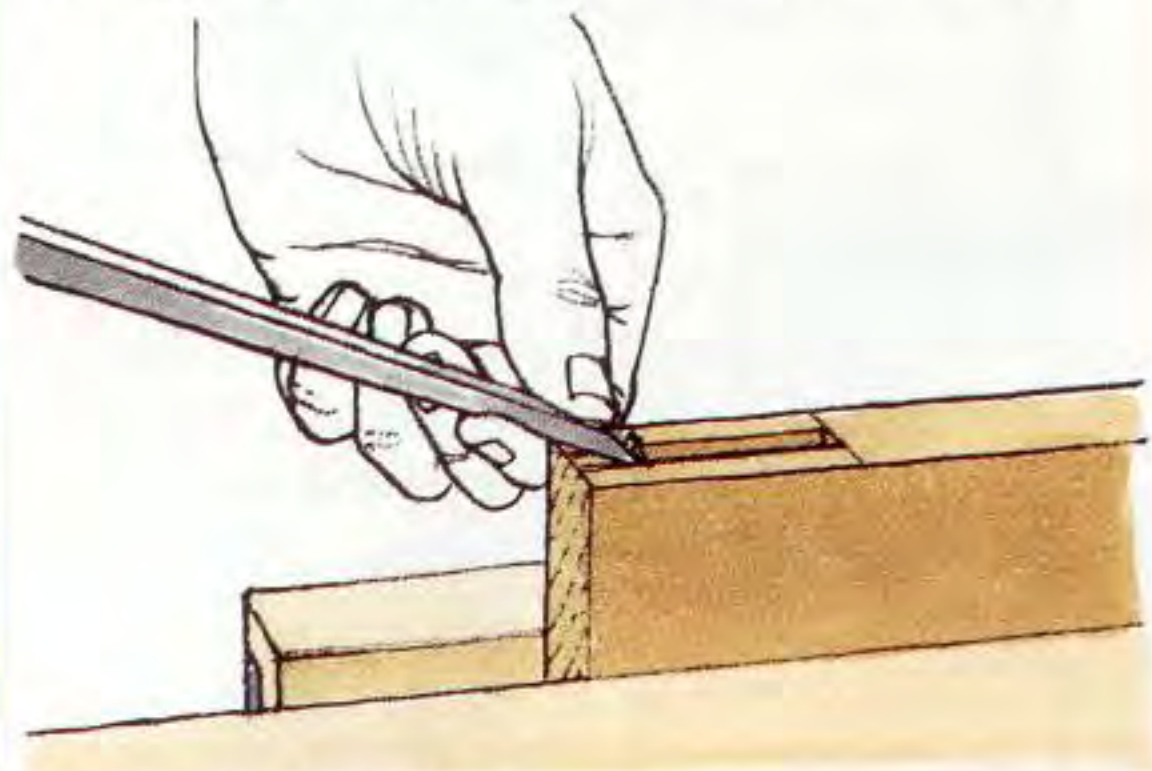
8 Cutting the tenon

After sawing the sides of the tenon (see page 65), clamp the work upright in a vice and saw beside the line marking the top edge of the tenon, down to the haunch. Reposition the work and saw down the end of the haunch, forming a notch at the top corner of the joint. Finally, saw along the shoulders to remove waste from both sides of the tenon.



1 Making a sloping haunch

Mark out the tenon, including the haunch (see opposite), then score the sloping sides of the haunch with a marking knife. Saw down this line, after first cutting along the top edge of the tenon (see above).



2 Trimming the mortise

When marking out the mortise, continue the gauged lines up to the top of the stile, but not over the end. Having chopped out the mortise, saw the sides of the haunch groove at an angle, taking care not to overrun, then pare the slope with a chisel.

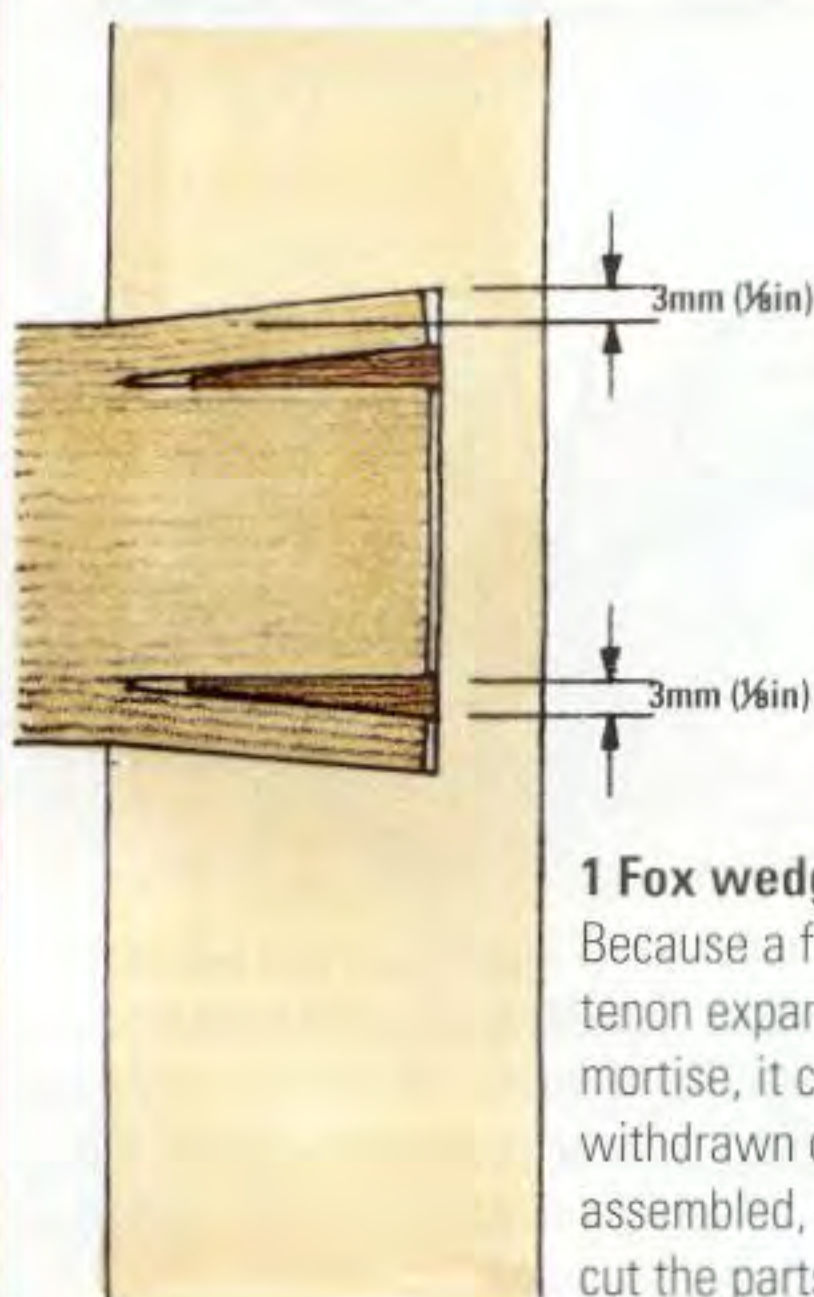
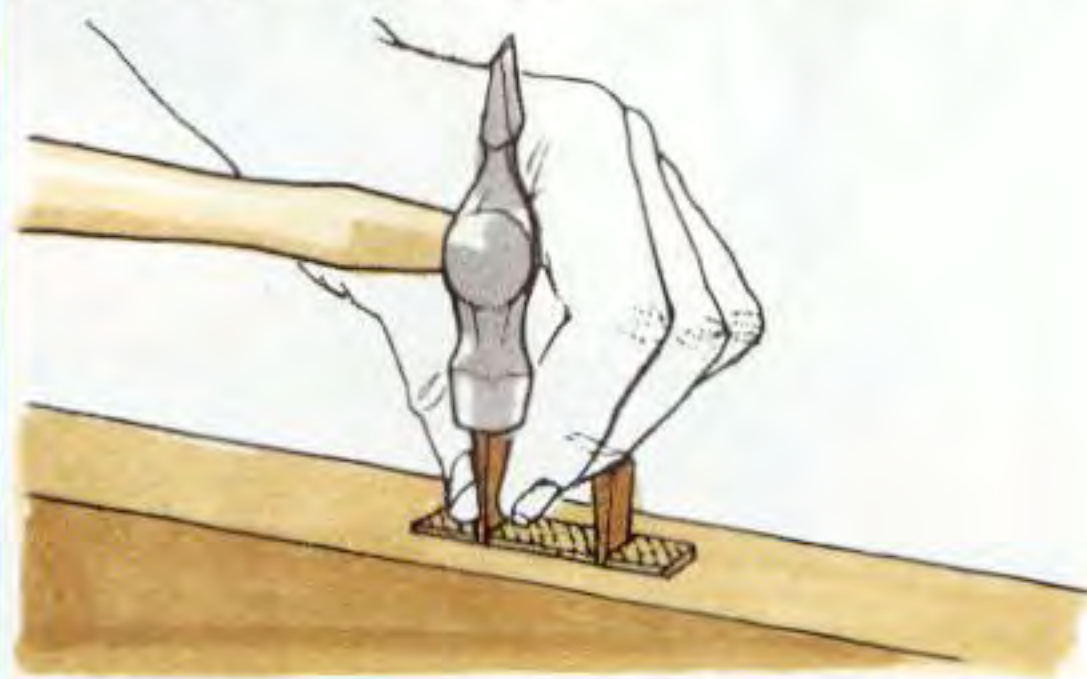
WEDGED MORTISE AND TENON

HAND CUT

A well-made mortise and tenon is normally strong enough to hold the joint together using glue alone. However, if a joint has to resist more than average leverage, expand the tenon dovetail-fashion with hardwood wedges. You can wedge both through and stopped tenons – when hidden, they are known as fox wedges.

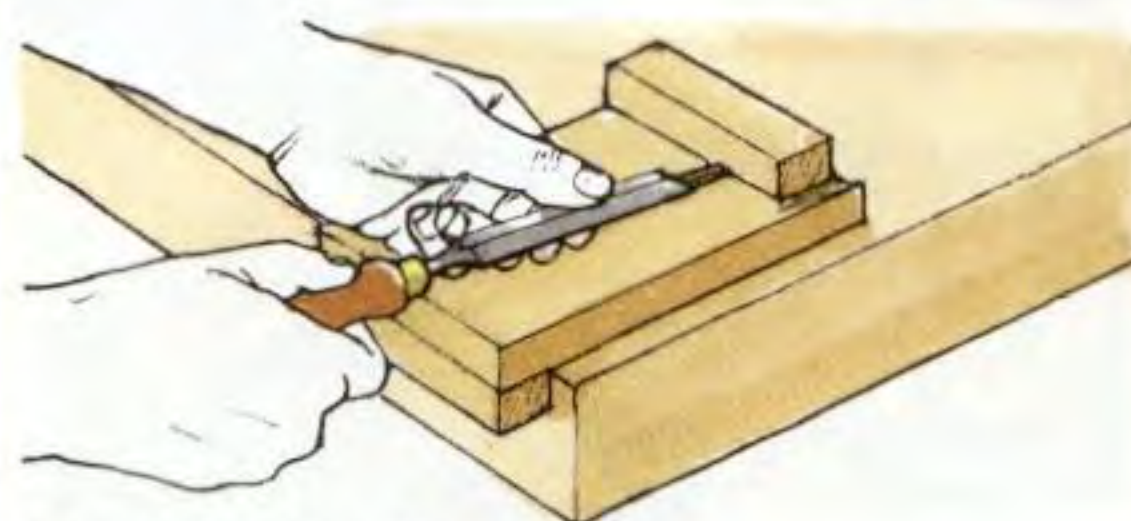
WEDGING THROUGH TENONS

Cut a shallow slope at each end of the mortise to allow room for the tenon to expand. Make two saw cuts down the length of the tenon, stopping just short of the shoulders. Glue and assemble the joint, then drive in the glued wedges, tapping them alternately to spread the tenon evenly. When the adhesive sets, plane end grain and wedges flush.



1 Fox wedging

Because a fox-wedged tenon expands inside the mortise, it cannot be withdrawn once the joint is assembled, so take care to cut the parts accurately.

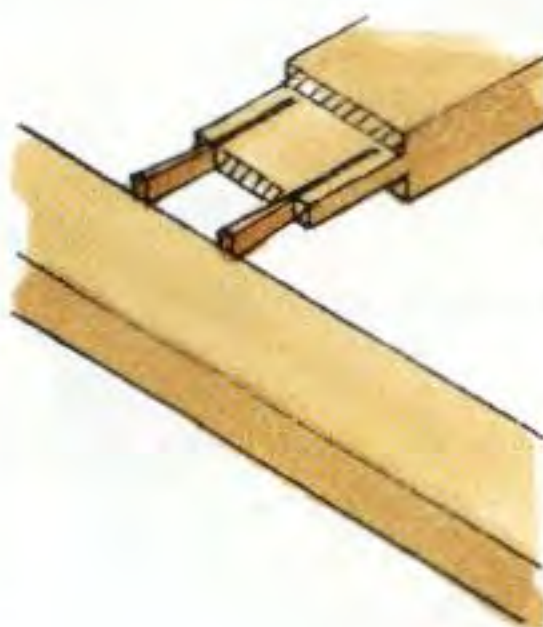


2 Cutting the wedges

Make two wedges about three-quarters the length of the tenon, and about 3mm (1/8in) thick at the wide point.

3 Shaping the mortise

Undercut each end of the mortise with a chisel, paring away about 3mm (1/8in) of the wood at the bottom of the joint.



4 Inserting the wedges

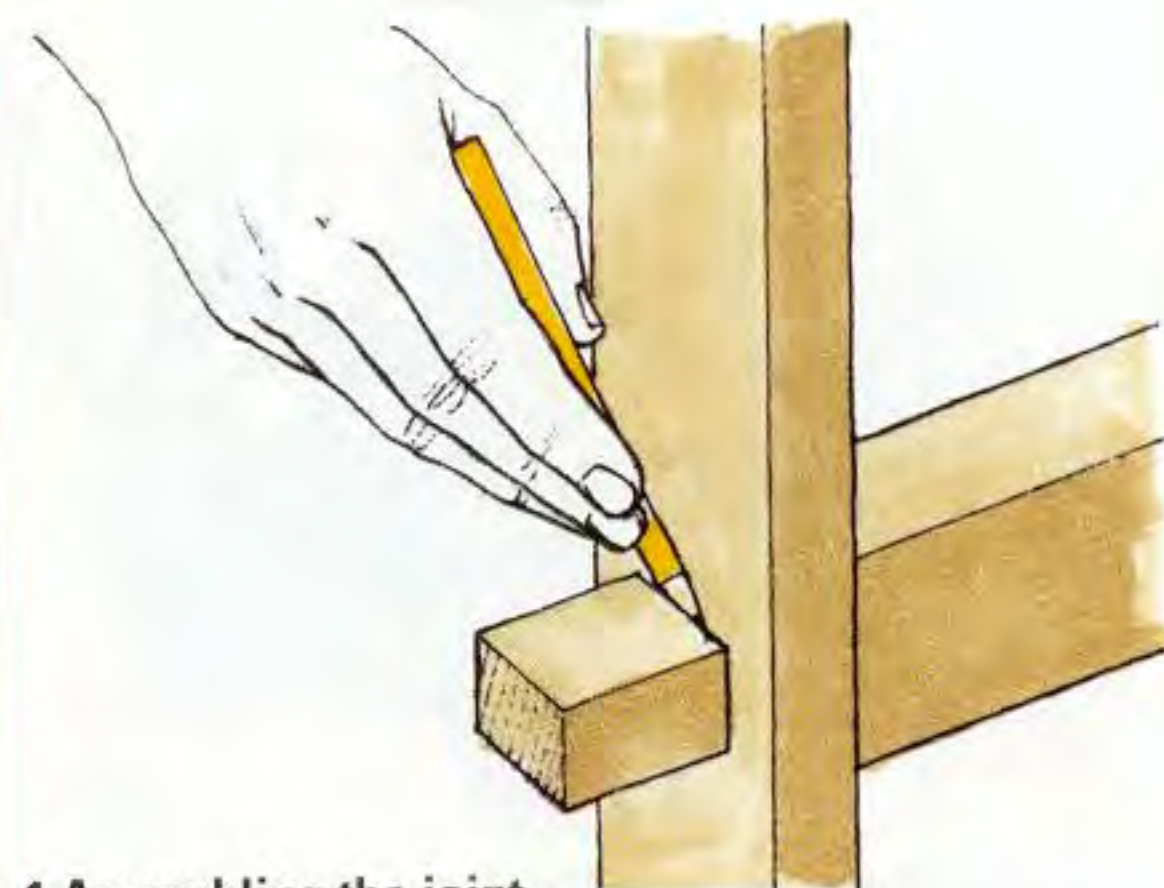
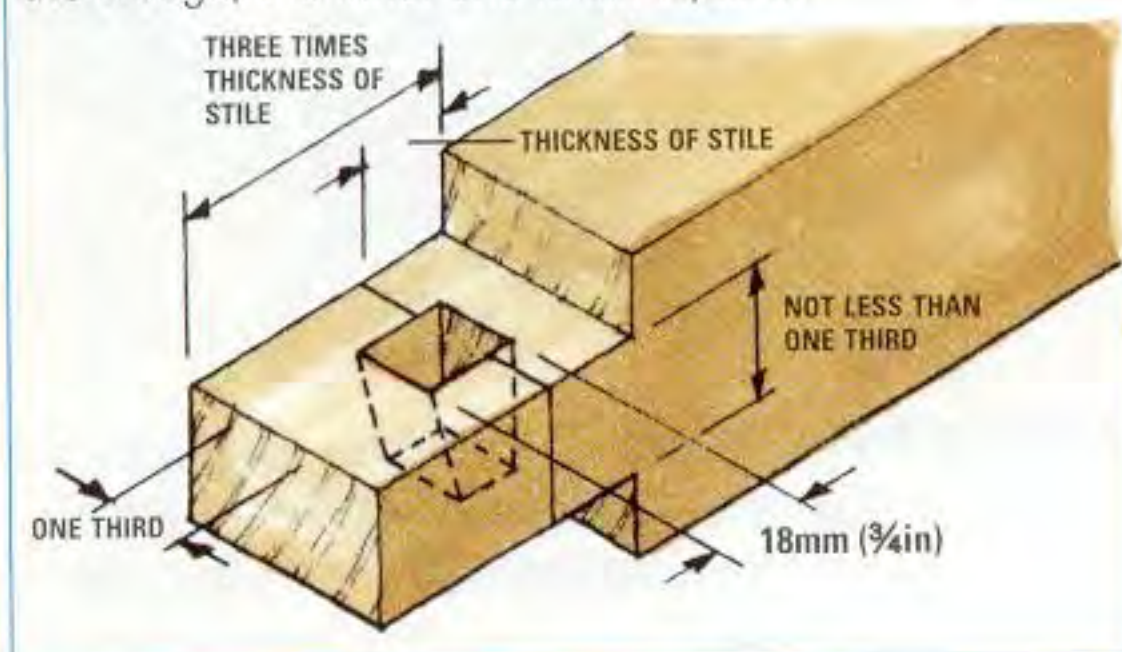
Dip the wedges in glue and brush some more into the joint. Push the wedges into the saw cuts before assembling the joint and clamping it.

LOOSE-WEDGED MORTISE AND TENON HAND CUT

A loose-wedged joint must be constructed with generous shoulders and a stout tenon that will resist splitting. The wedge is normally set vertically to prevent it working loose. Since the joint is designed to be broken down, no glue is used, and it relies on the clamping force of the wedge to provide rigidity.

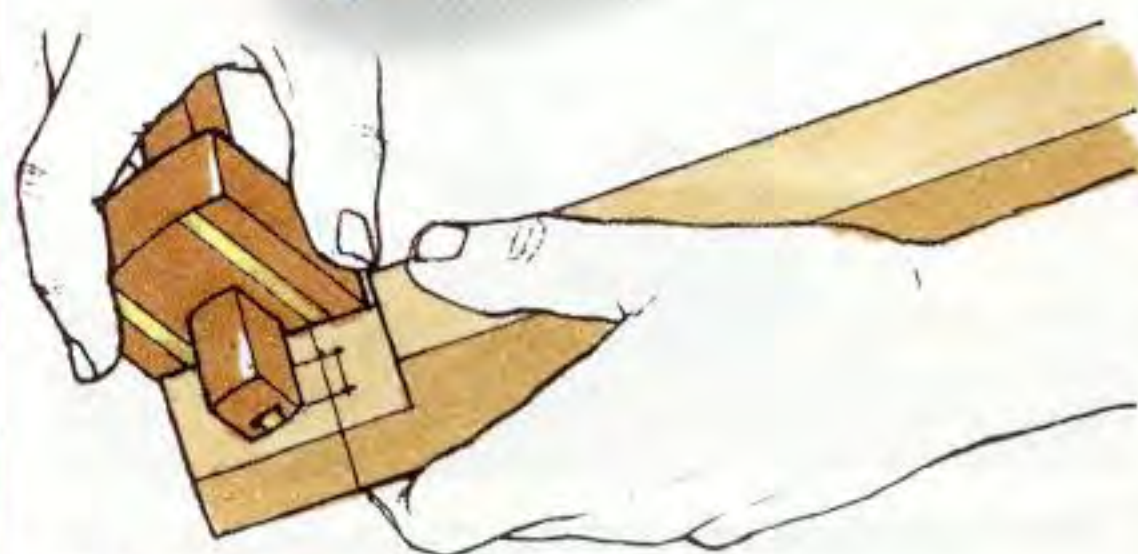
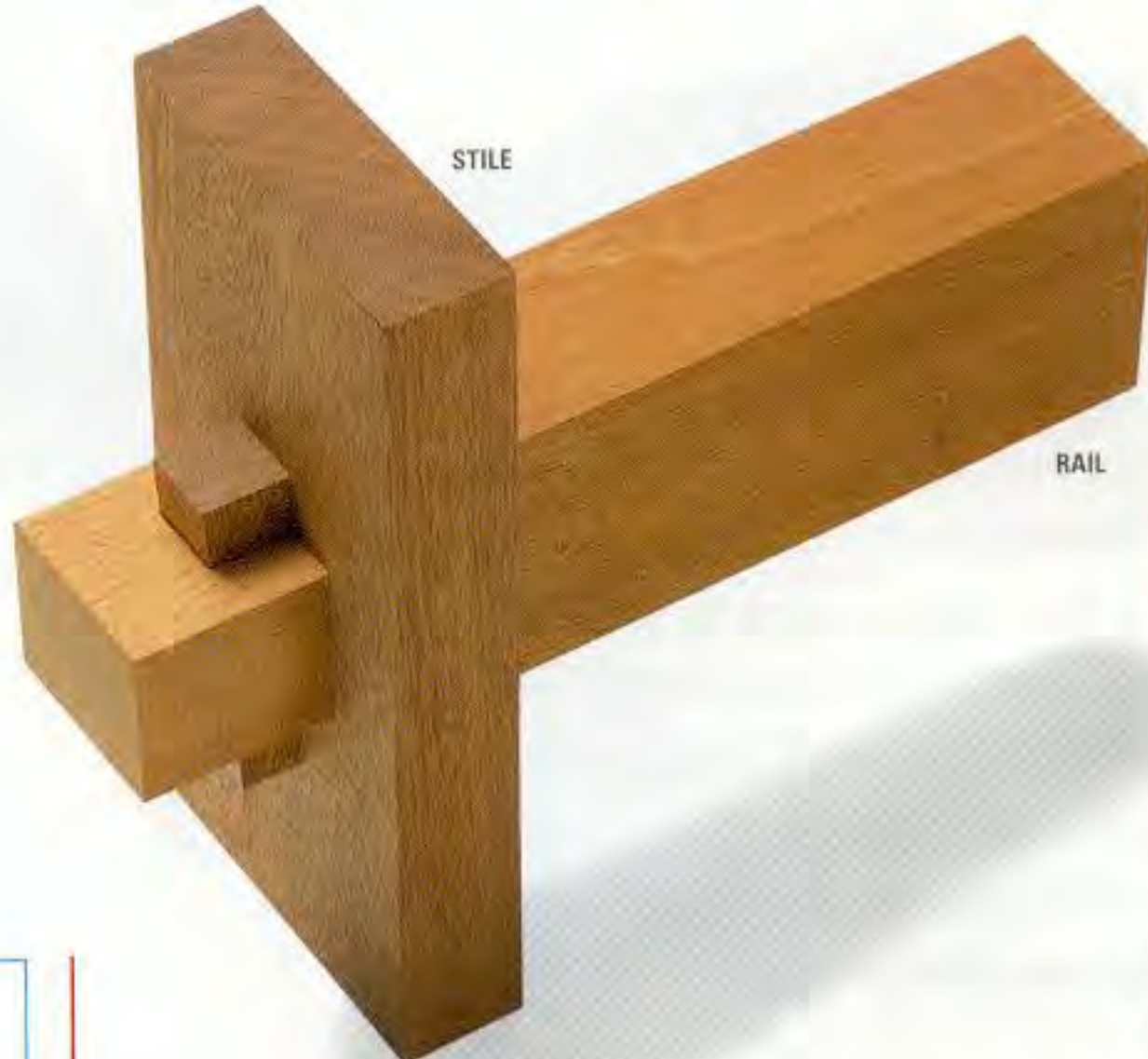
PROPORTIONS OF A LOOSE-WEDGED JOINT

The total length of the tenon should be at least three times the thickness of the stile, and it should be not less than one-third the width of the rail. The mortise for the loose wedge should be approximately 18mm (3/4in) long and about one-third of the tenon in width. The outer end of this mortise slopes to accommodate the wedge; the inner end is cut square.



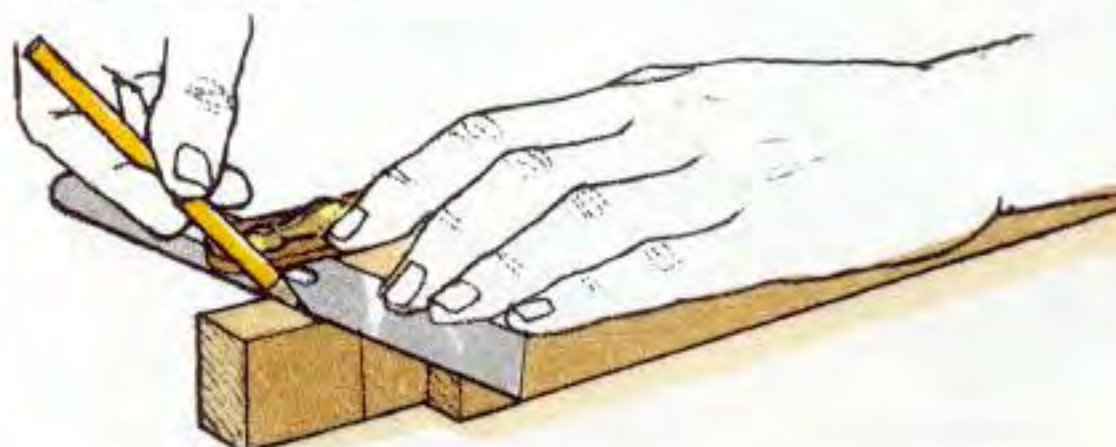
1 Assembling the joint

Cut the mortise and tenon as described on pages 64-5, but make them a sliding fit. Assemble the joint and mark the thickness of the stile on the projecting tenon.



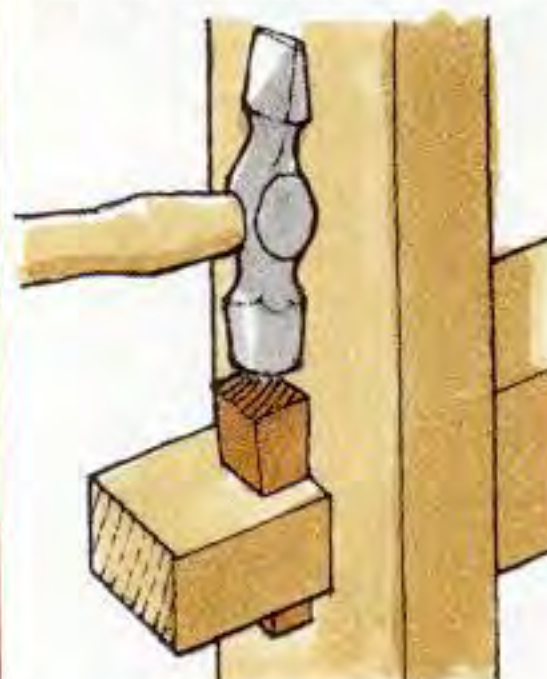
2 Marking the wedge mortise

Take the joint apart and mark the mortise for the loose wedge on the top edge of the tenon. Set the inner end of the mortise about 3mm (1/8in) inside the line marking the thickness of the stile.



3 Marking the sloping end

Set a sliding bevel to an angle of 1:6. From the line marking the outer end of the wedge mortise, draw another line on the side of the tenon, using the bevel. Square this line across the bottom of the tenon, then scribe the sides of the wedge mortise up to the line.



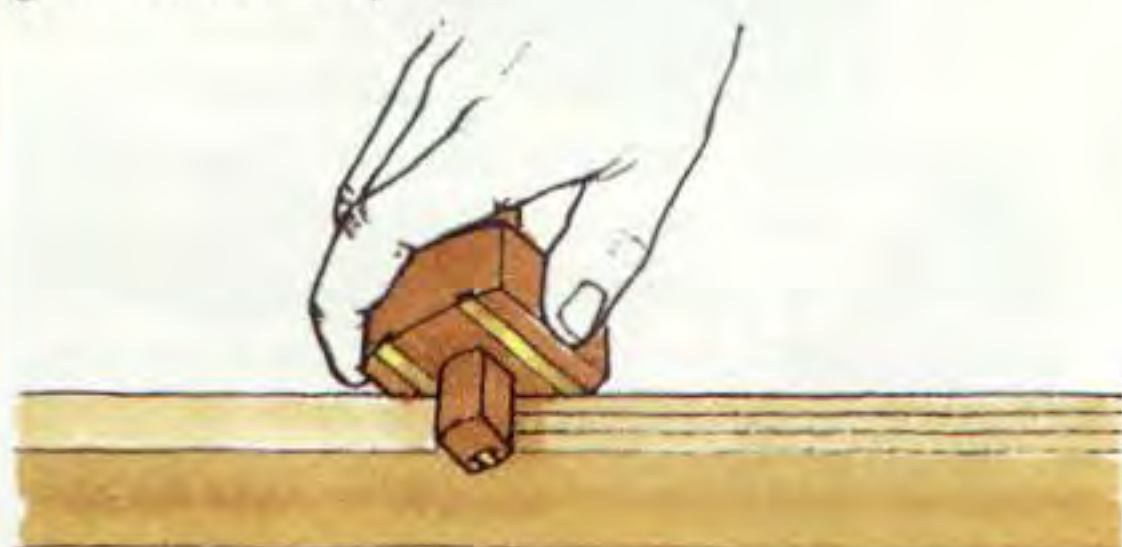
4 Completing the joint

Cut the wedge mortise, paring the sloping end with a chisel. Assemble the joint and tap in the wedge to draw the shoulders up tight.

GROOVED-FRAME MORTISE AND TENON

HAND CUT

The frame of a traditional panelled door is grooved on the inside to accommodate the panel. When haunched mortise-and-tenon joints are used at the corners, align the grooves with the mortises and make them both the same width. In addition, match the depth of the groove to the length of the haunch, so that the one neatly fills the other at the end of the stile. It is usually easier to cut the groove after the joints.



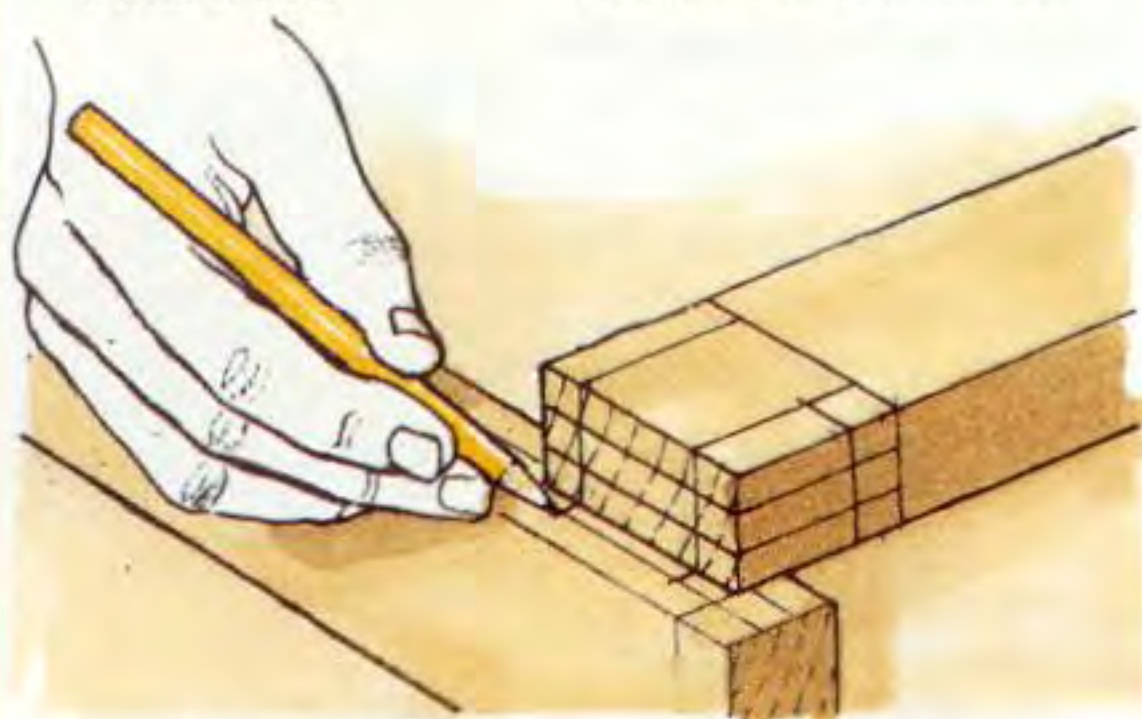
1 Scribing the panel grooves

Use a mortise gauge to scribe grooves on the inside of the rails and stiles.



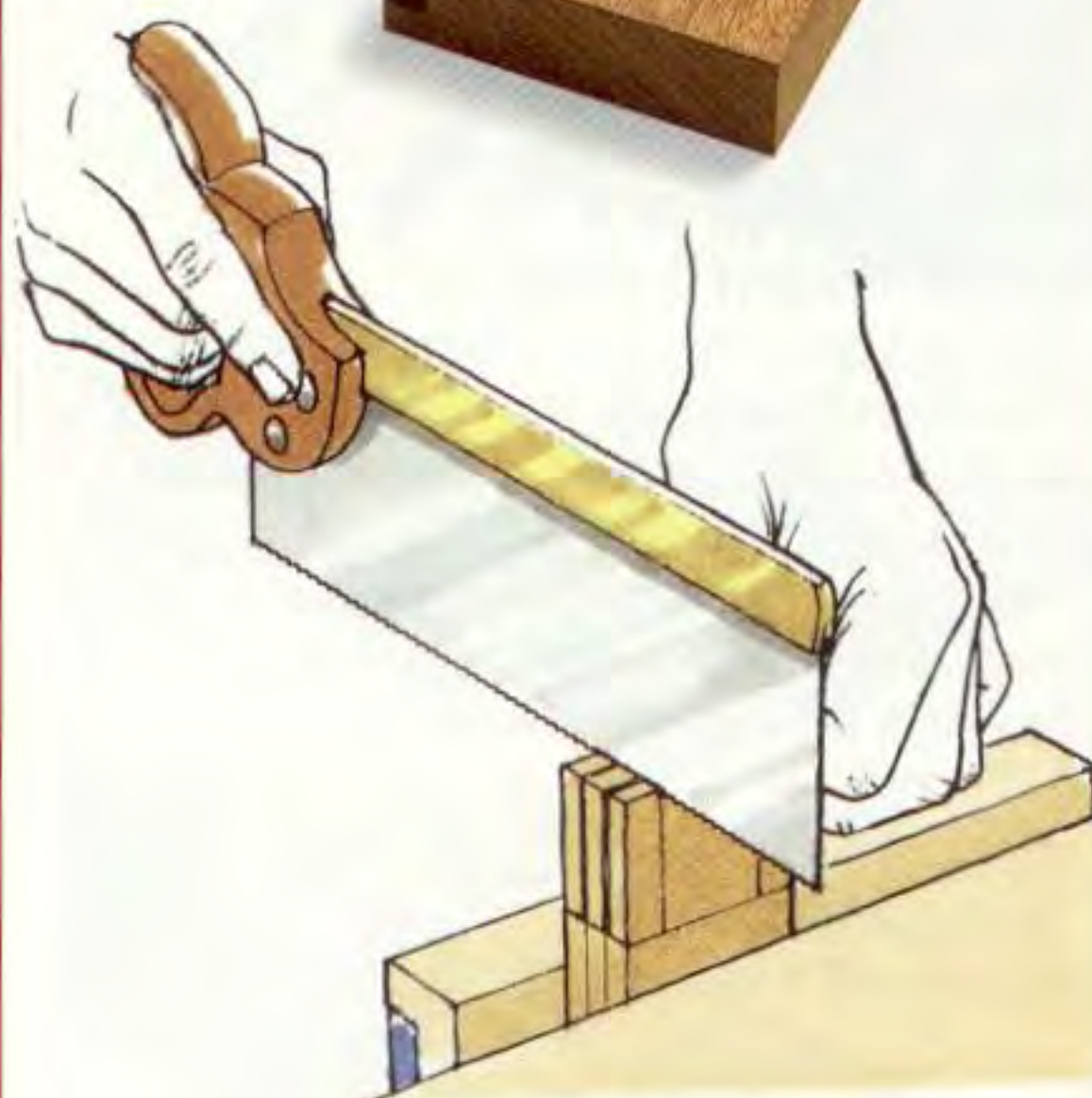
2 Marking out the tenon

Mark out the tenon (see page 70) then, with a marking gauge set to the depth of the groove, scribe the bottom edge of the tenon on both sides and across the end of the rail.



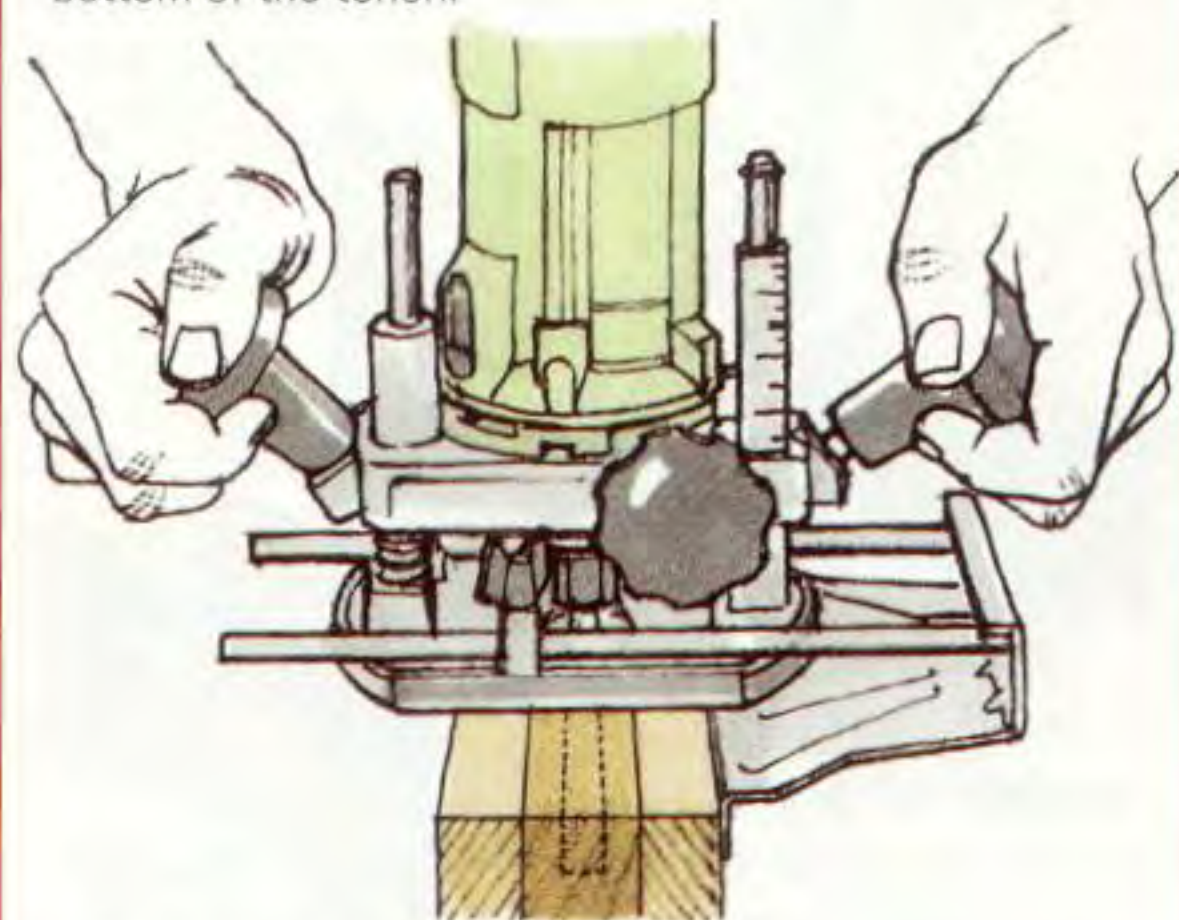
3 Transferring the measurements

Using the rail as a template, mark the position of the mortise on the stile. Cut a simple stopped mortise on these marks; cutting the panel groove at a later stage also makes room for the haunch.



4 Cutting the tenon

Cut the tenon as described on page 71, but make a second saw cut across the end of the rail to form the bottom of the tenon.



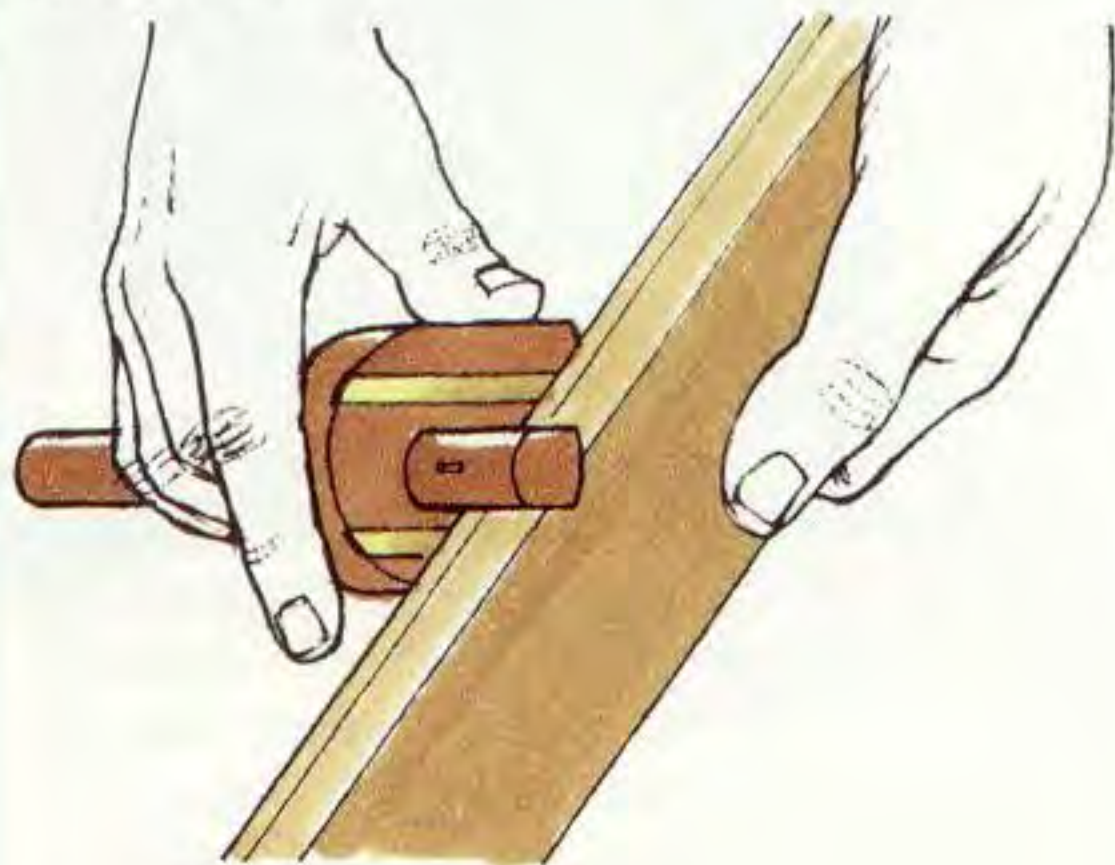
5 Cutting the panel grooves

Plane or router the grooves on the inside of the rails and stiles, then make and fit the panel before gluing and assembling the frame.

RABBETED-FRAME MORTISE AND TENON

HAND CUT

When making a glazed door for a cabinet, cut a rabbet on the inside of the rails and stiles to take the glass. Each corner of the frame can be joined with a haunched mortise and tenon, but it is necessary to stagger the shoulders in order to close off the rabbet at the end of the stile. It is probably easier to cut the rabbets after the joints. When the doorframe is complete, lay the glass in the rabbets and hold it in place with putty or a wooden bead.



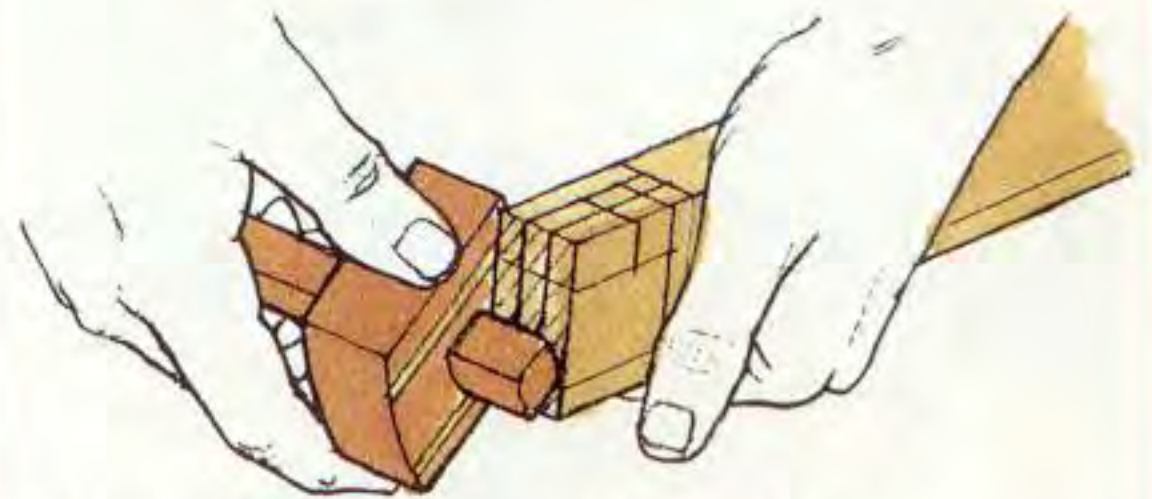
1 Scribing the rabbets

Set a marking gauge to one-third the thickness of the workpieces, and scribe the depth of the rabbet on the inner edge of the rails and stiles. Reset the gauge to about 6mm (1/4in) and scribe the rabbet width.



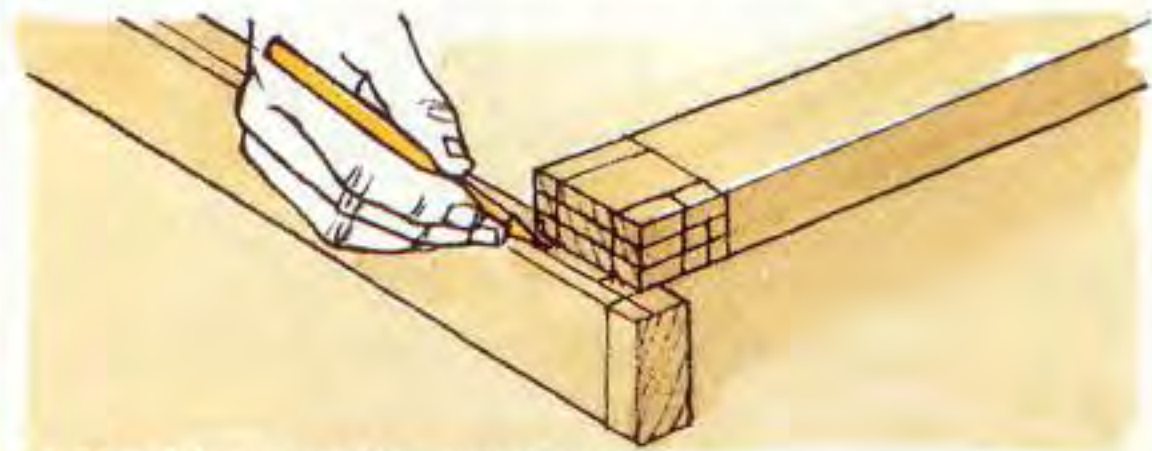
2 Marking the long shoulder

Referring to the proportions given for a standard haunched mortise and tenon (see page 70), score the long shoulder across the outer face of the rail. Using a pencil, square this line across both edges.



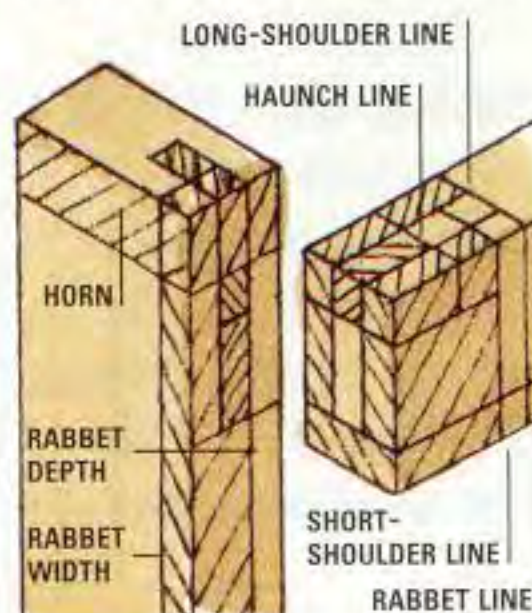
3 Marking the short shoulder and tenon

Mark the short shoulder across the inner face; it should be as far from the long-shoulder line as the width of the rabbet – about 6mm (1/4in). Square the line across both edges. Mark out the haunch, then scribe the thickness of the tenon with a mortise gauge. Use a marking gauge to scribe the bottom of the tenon.



4 Marking out the mortise

Transfer the dimension from the rail to mark the position of the mortise on the stile. Gauge the thickness of the mortise. Use the same tool to mark the length of the haunch, measured from the long-shoulder line, onto the end of the stile. Hatch waste wood with a pencil.



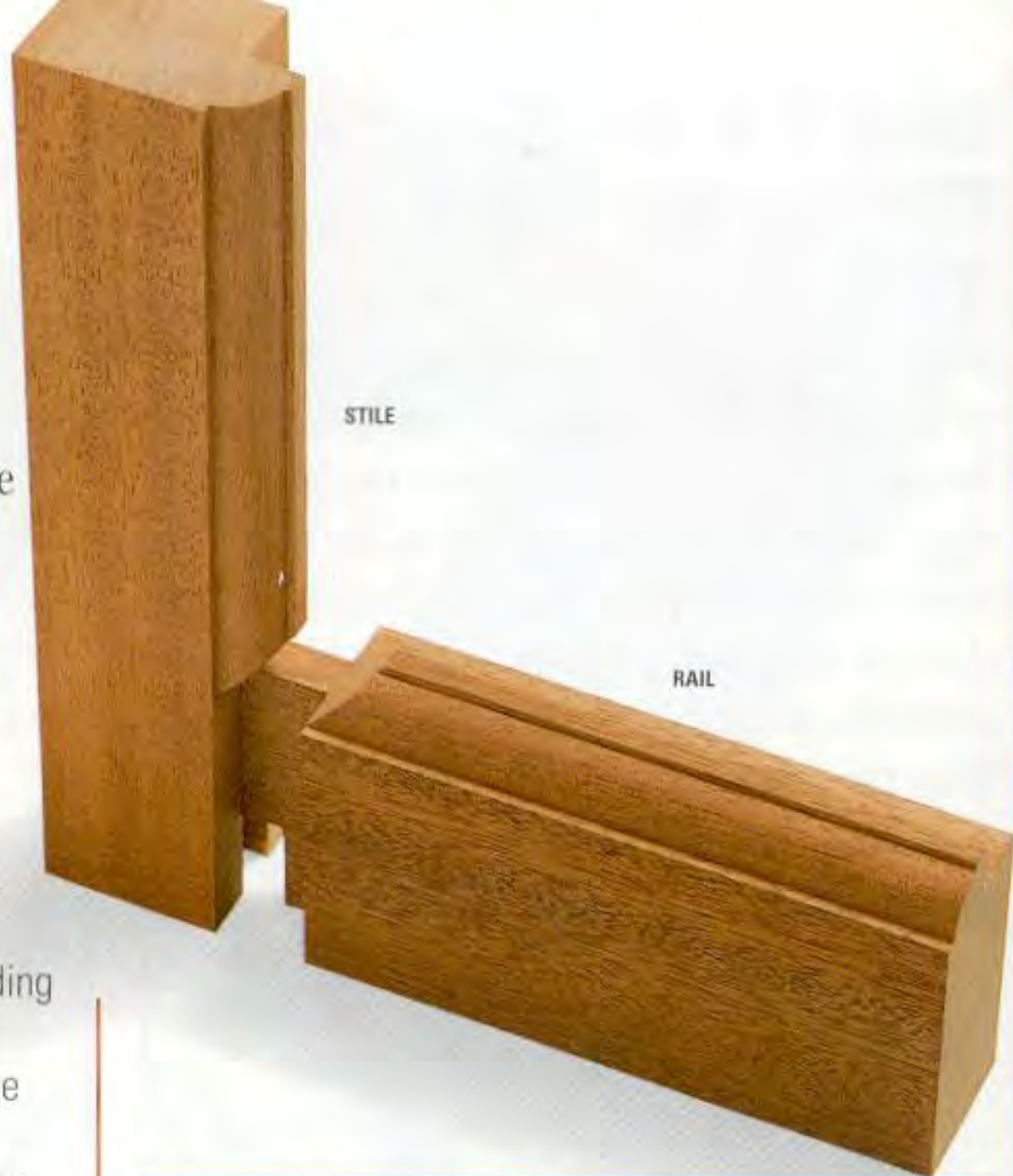
5 Cutting the joints and rabbets

After cutting the joints, plane or router the rabbets on the inside of the rails and stiles. Finally, pare out the haunch waste from each joint (see page 71).

MOULDED-FRAME MORTISE AND TENON

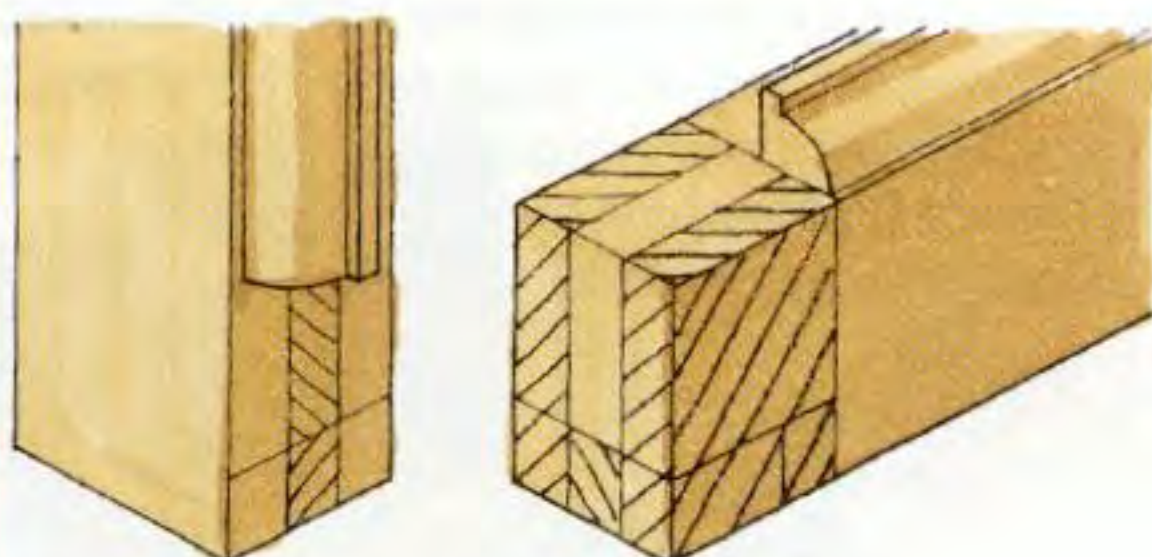
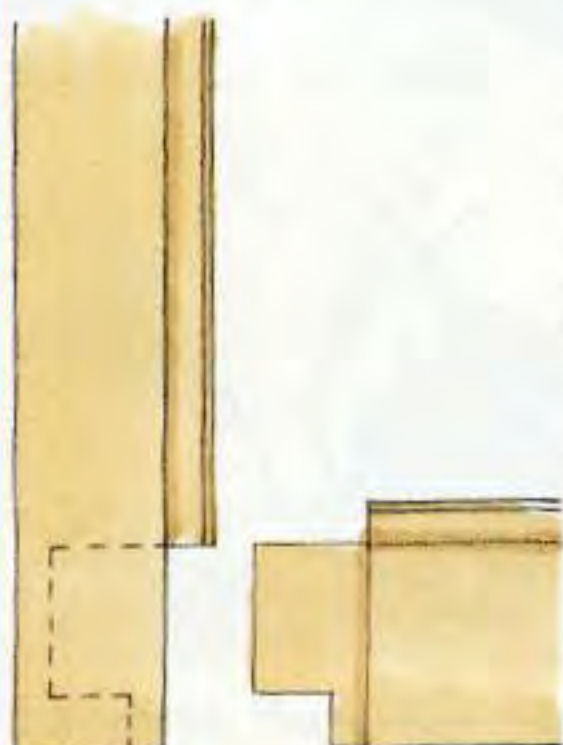
HAND CUT

When a rabbeted frame is also moulded, it is necessary to mitre the moulding ends after the mortise and tenons have been cut. A possible alternative method is to scribe one end of the moulding to cover the other; the scribing is relatively difficult, but it is better for disguising gaps if the joint should shrink.



1 Trimming mouldings

Before marking out the joint, cut away the moulding down to the level of the rabbet, leaving a flat edge on the stile equal to the width of the tenon plus the haunch. Similarly, trim the moulding off the rail, back to the shoulder line.



2 Marking out and cutting the joint

Mark out a haunched mortise and tenon, and cut both halves of the joint (see page 70-1).

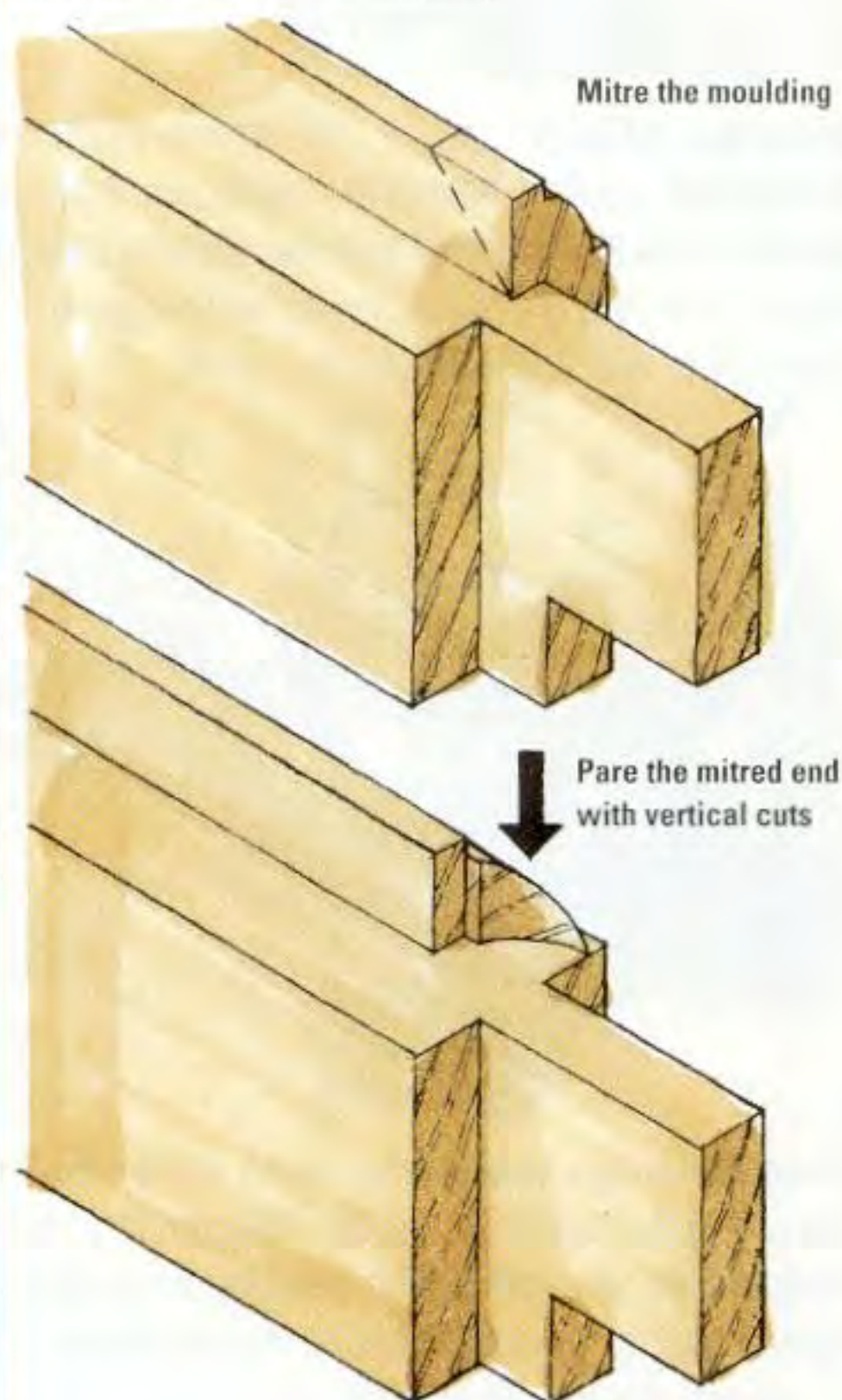


3 Mitring the moulding

Trim the ends of the moulded sections to 45 degrees. Clamp a guide block over the moulding to keep the chisel blade at the required angle.

SCRIBING THE MOULDING

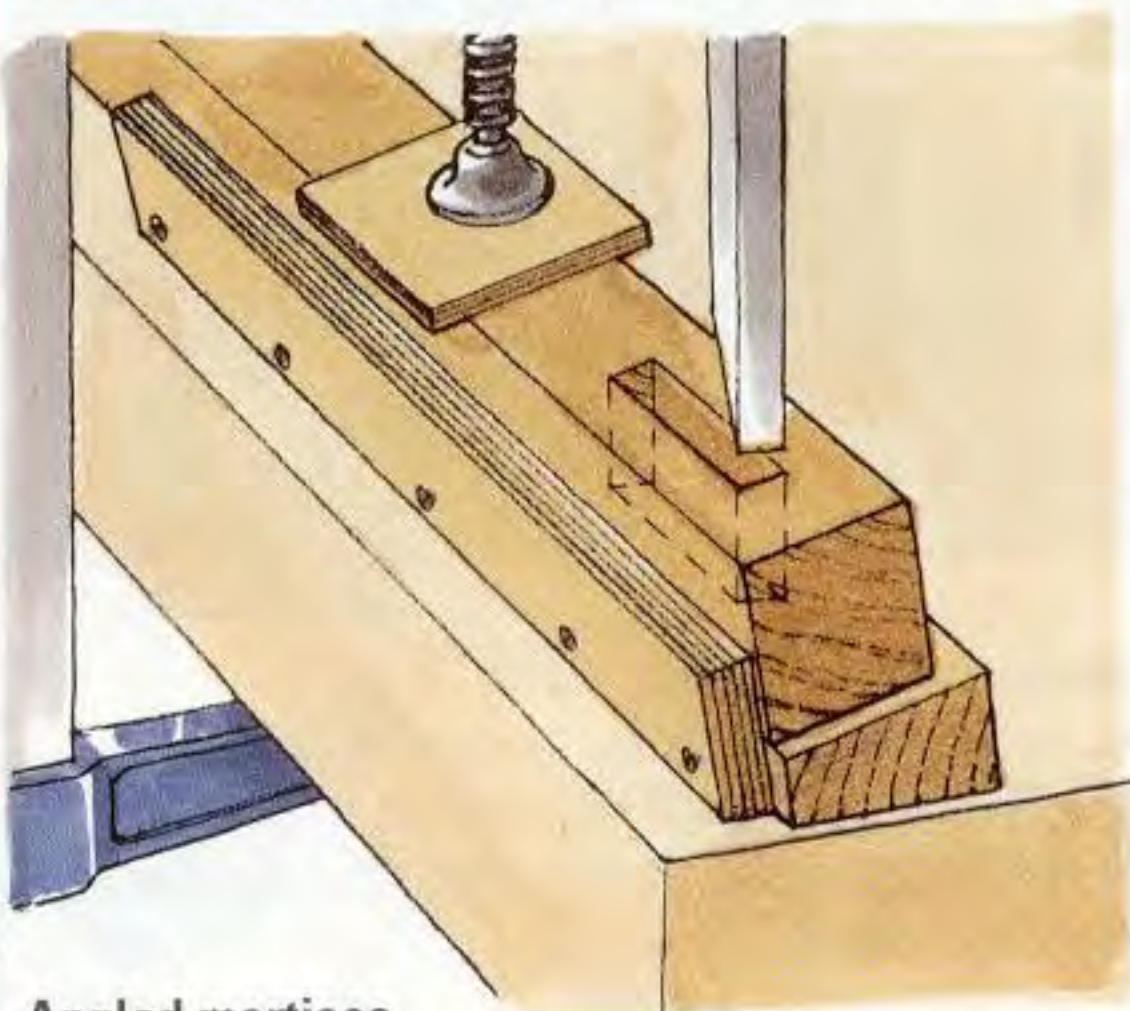
Leave the stile moulding cut square as described in stage 1 (see left). Mitre the end of the rail moulding, then, using a gouge and straight chisel, pare away the wood on the inside of the mitre until it fits around the contour of the stile moulding.



CORNER MORTISE AND TENON

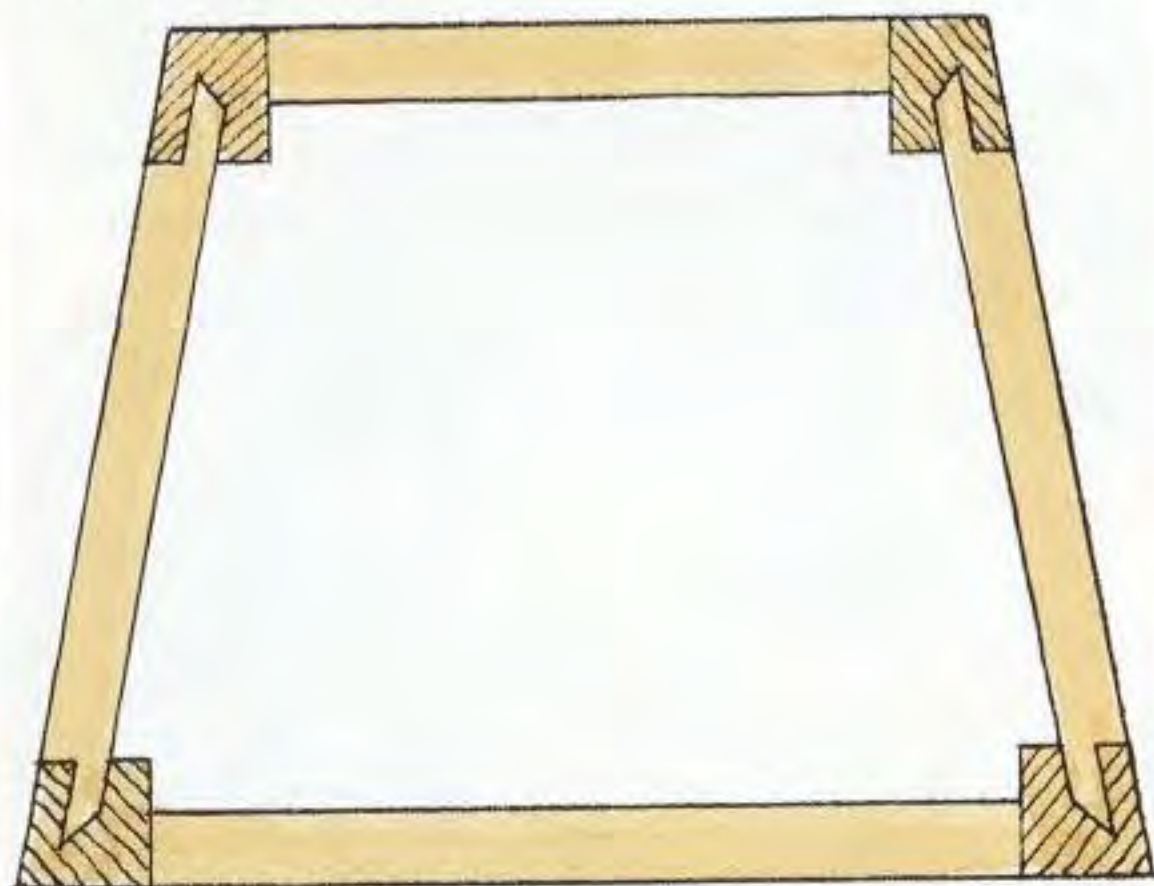
HAND CUT

On the majority of tables, two rails are joined to a single leg at each corner. The joints are cut as previously described, except that the ends of the tenons are mitred where they meet inside the leg. To make tapered chair frames, however, either the side-rail mortises must be cut at an angle, or the tenons are skewed to fit square-cut mortises.



Angled mortises

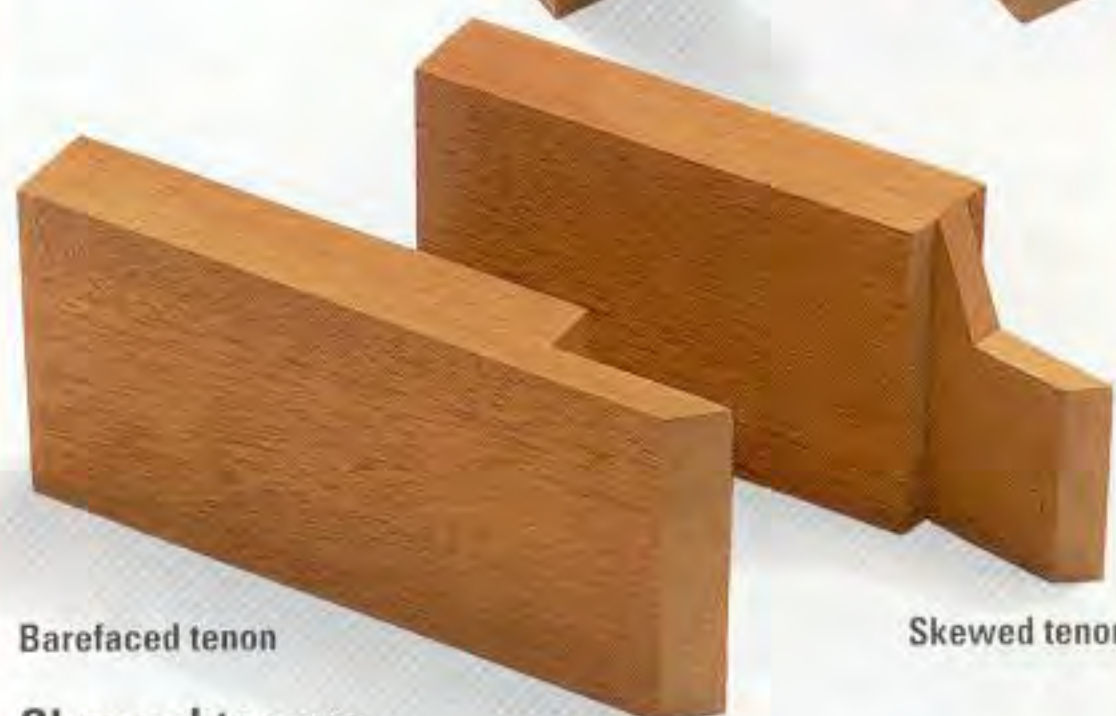
A stronger joint results if you keep the tenons in line with the rails. Mark out each joint in the usual way, but mark the shoulders at an angle to fit the face of the leg. You may find it easier to cut the mortise if you make a simple jig that holds the leg at the required angle, so that you can keep your chisel blade or drill vertical when cutting the joint.



Using barefaced tenons

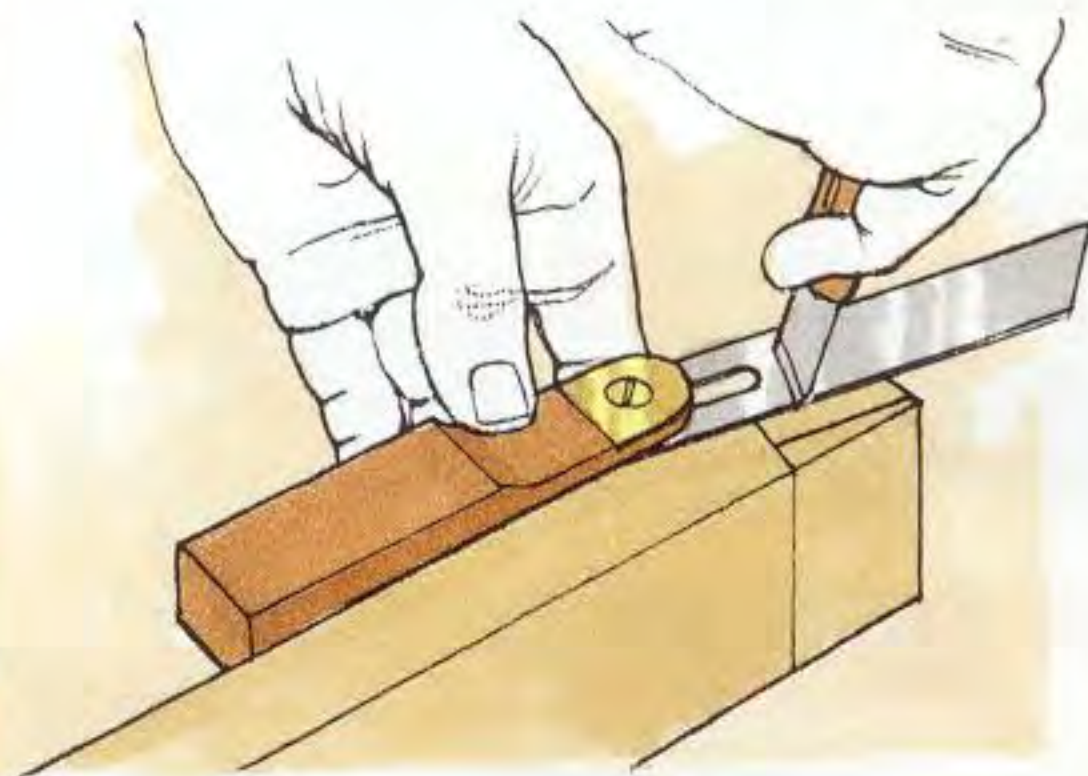
Design a frame with barefaced tenons if you want the rails to lie flush with the legs.

MORTISE-AND-TENON JOINTS



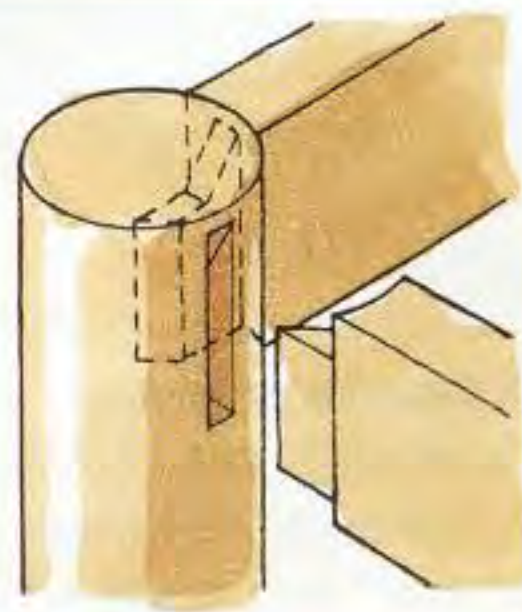
Skewed tenons

Since it is easier to cut square mortises, it may be more convenient to skew the tenons. However, the inevitable short grain makes for relatively weak joints, so keep the angle to a minimum. It is impossible to mark skewed tenons with a mortise gauge, so use a sliding bevel and marking knife instead.



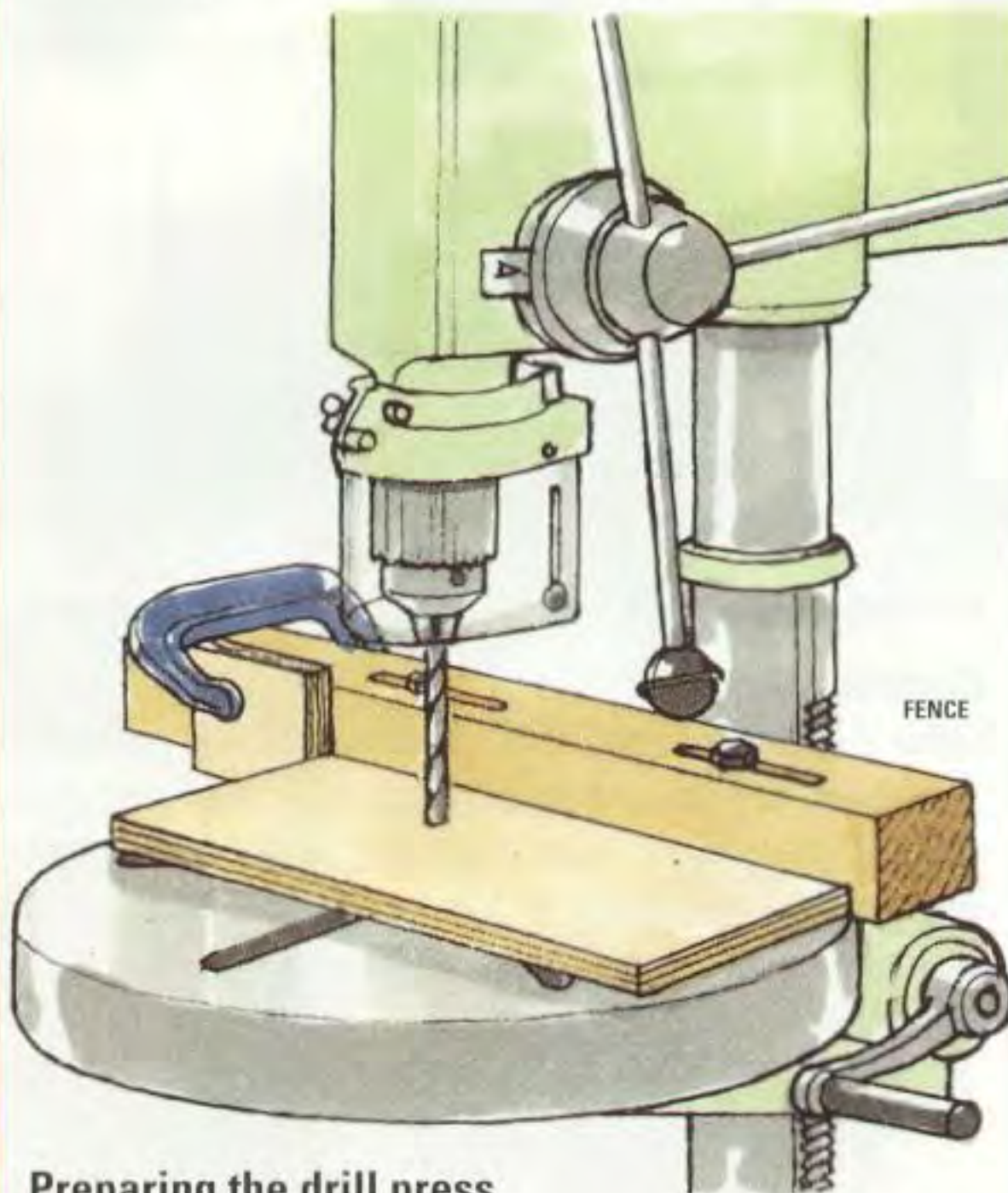
CORNER JOINTS FOR ROUND LEGS

It is easier to cut the mortises before you turn a round leg. Having cut the tenons, trim the shoulders with a gouge to fit the curve.



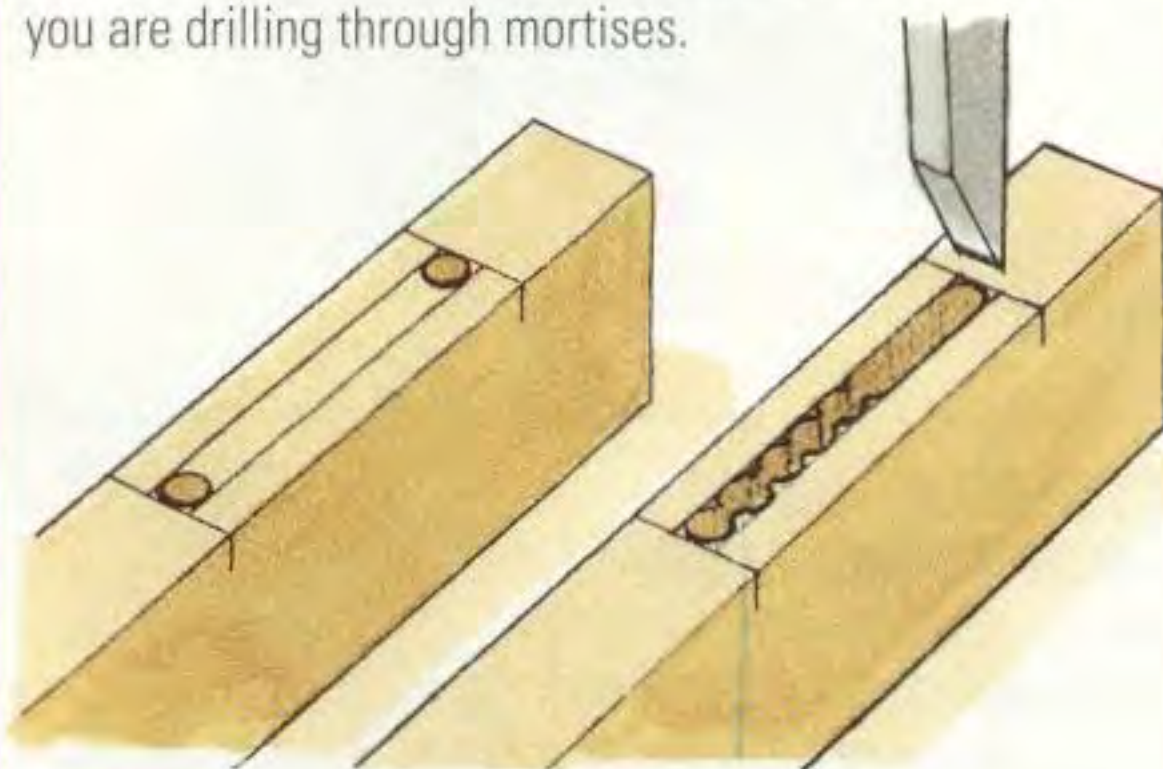
MACHINE-CUT MORTISES

If you plan to cut a number of joints, it is well worth setting up a machine tool to make your production easier and faster. A drill press (or a power drill in a bench stand) can be used to remove most of the waste before finishing the job by hand, or – better still – you can fit a special mortising attachment to the drill press.



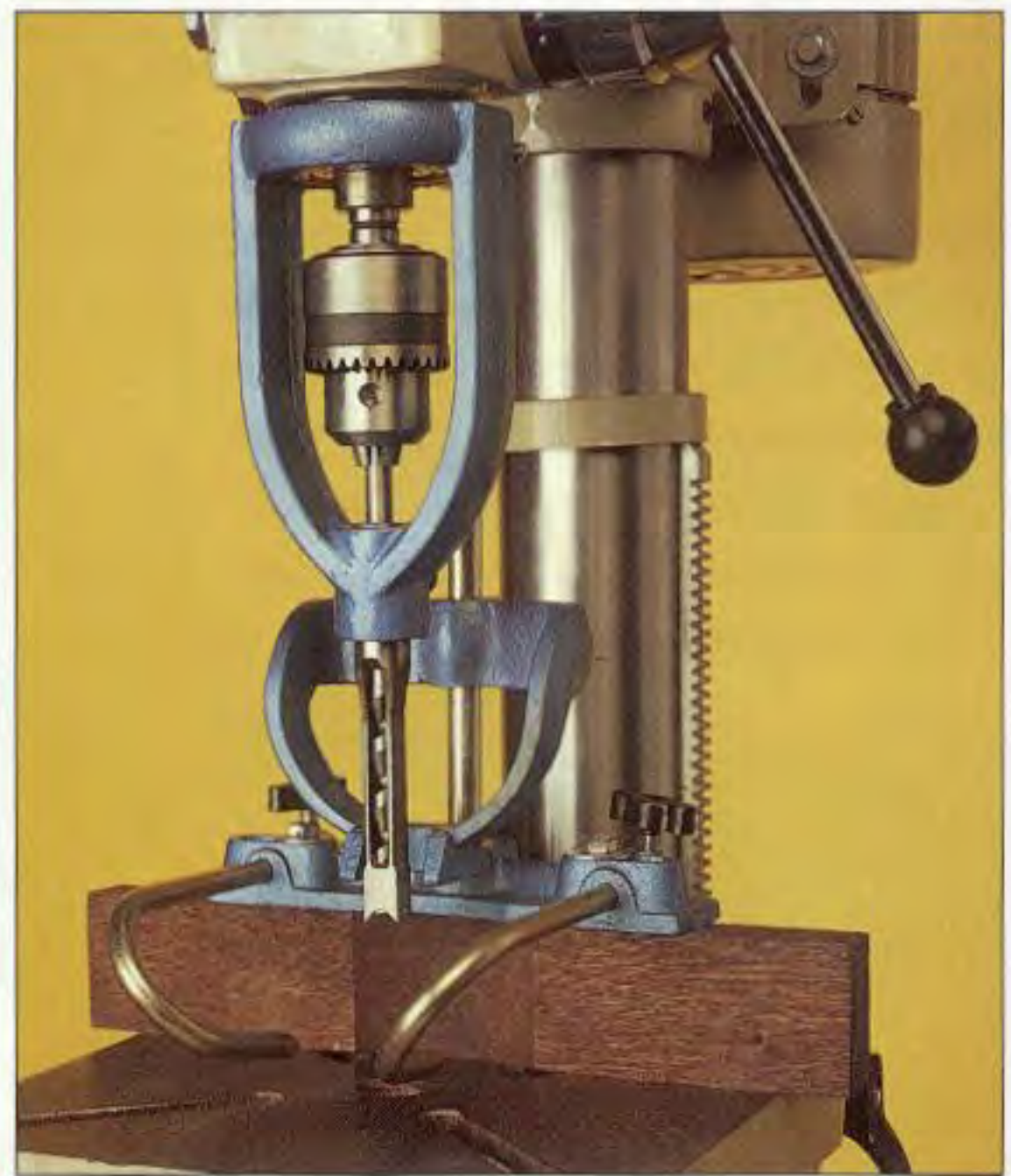
Preparing the drill press

Clamp a wooden fence to the base of the drill press, and adjust it to centre the point of the drill bit on the mortise. Set the tool's depth stop to drill to the base of a stopped mortise. Place a board beneath the work if you are drilling through mortises.



Cutting the mortise

Drill a hole at each end of the mortise, then connect them with a row of slightly overlapping holes. Pare the sides and ends square with chisels.



Using a mortising attachment

Adapt a drill press by fitting a mortising attachment, comprising an auger drill that removes the waste, coupled with a square hollow chisel which shapes the mortise at the same time.



1 Cutting the ends square

Start the mortise by cutting a square hole at each end. Plunge the chisel firmly but don't force it, especially when working hardwoods.

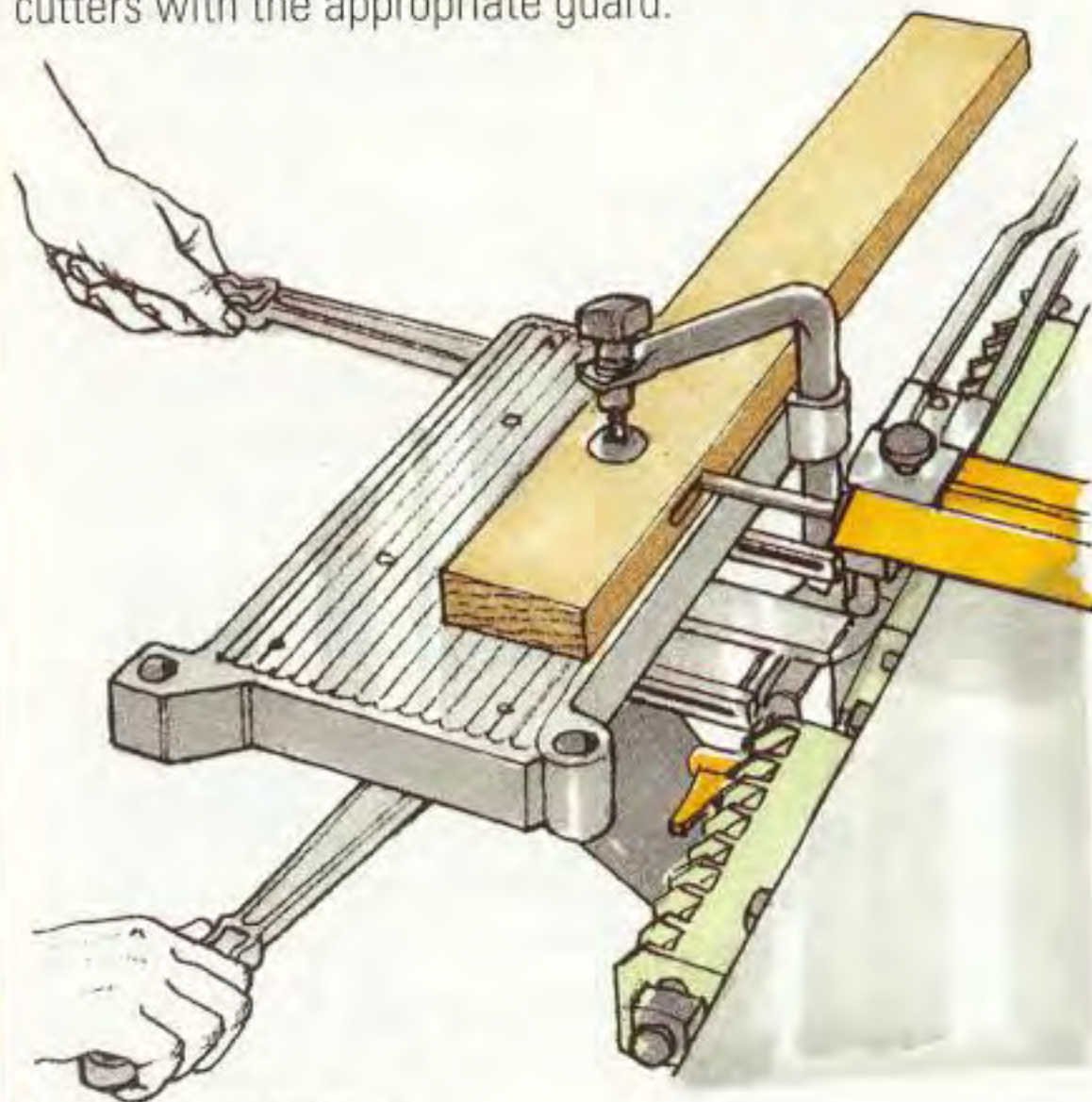


2 Removing the waste

Remove the waste between the holes in stages. Work steadily at an even pace, to avoid any overheating of the auger bit.

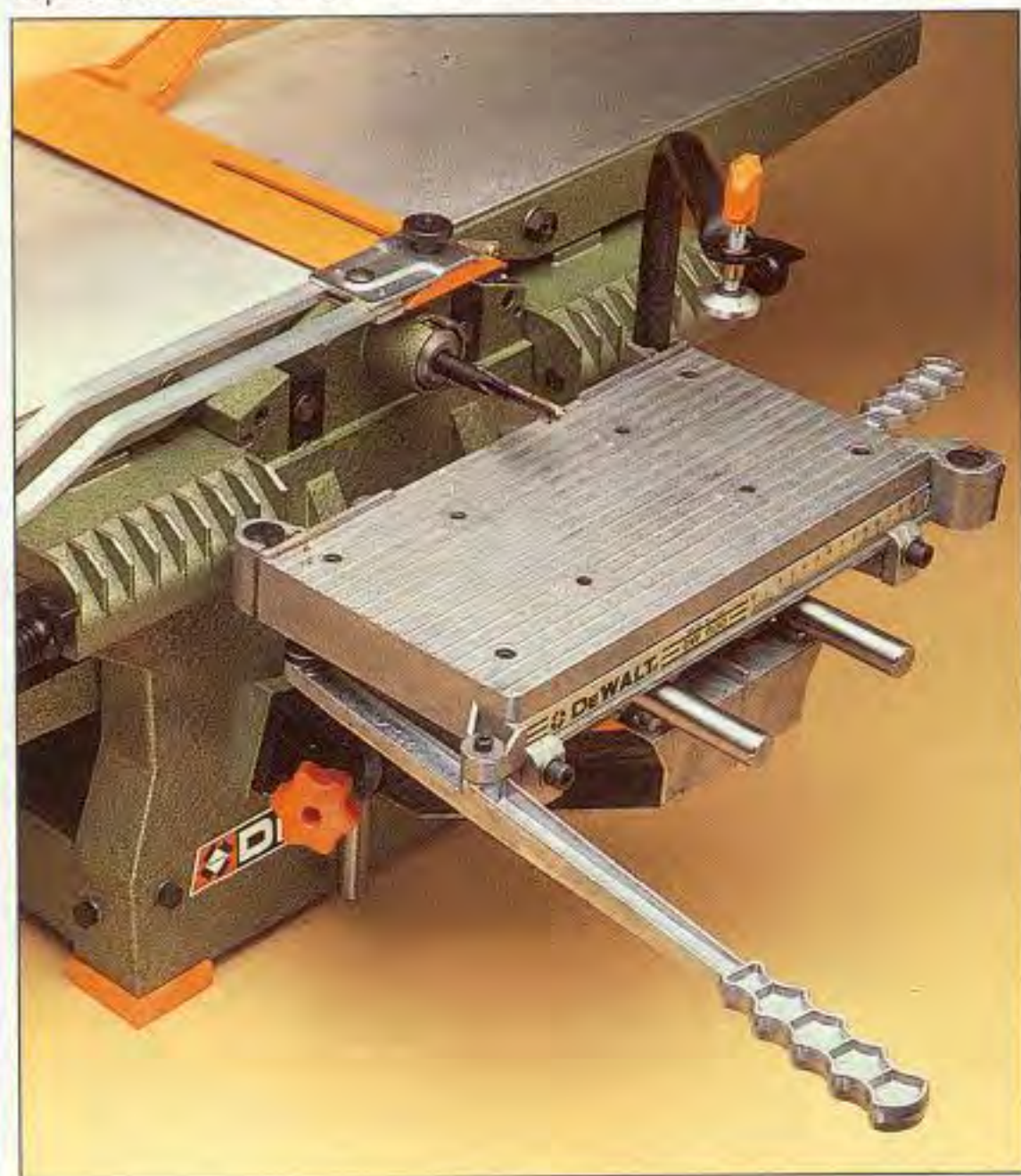
Using a slot mortiser

It is possible to adapt a planer-thicknessener to machine mortises by fitting a milling chuck to the end of the tool's cutter block. The workpiece is moved relative to the stationary cutter by means of a special mortising table that is adjustable in height. When using this type of attachment, it is imperative to cover the planer cutters with the appropriate guard.



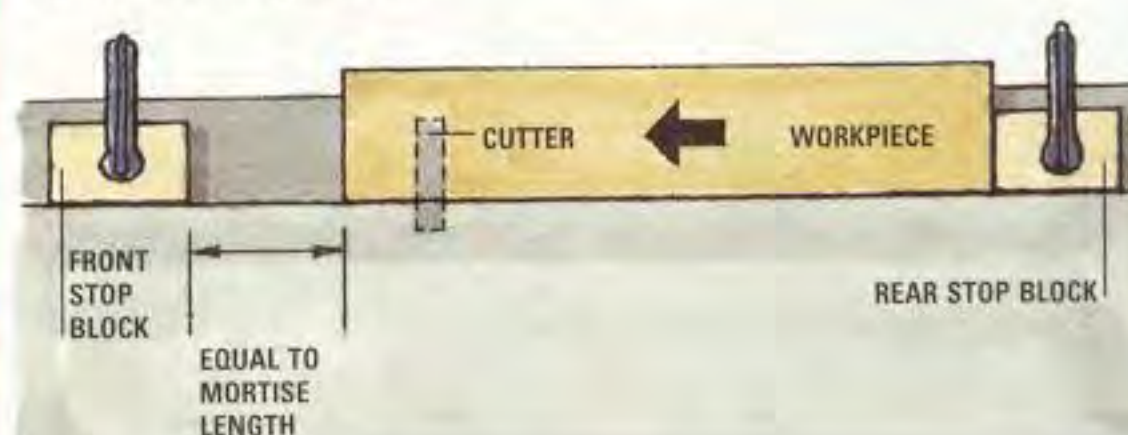
Cutting a mortise

Avoid the risk of breaking the cutter by machining a mortise in stages, and never plunge deeper than the cutter's diameter during any one pass. Since the machined mortise has rounded ends, either chop them square with a chisel or file the corners off the tenon.



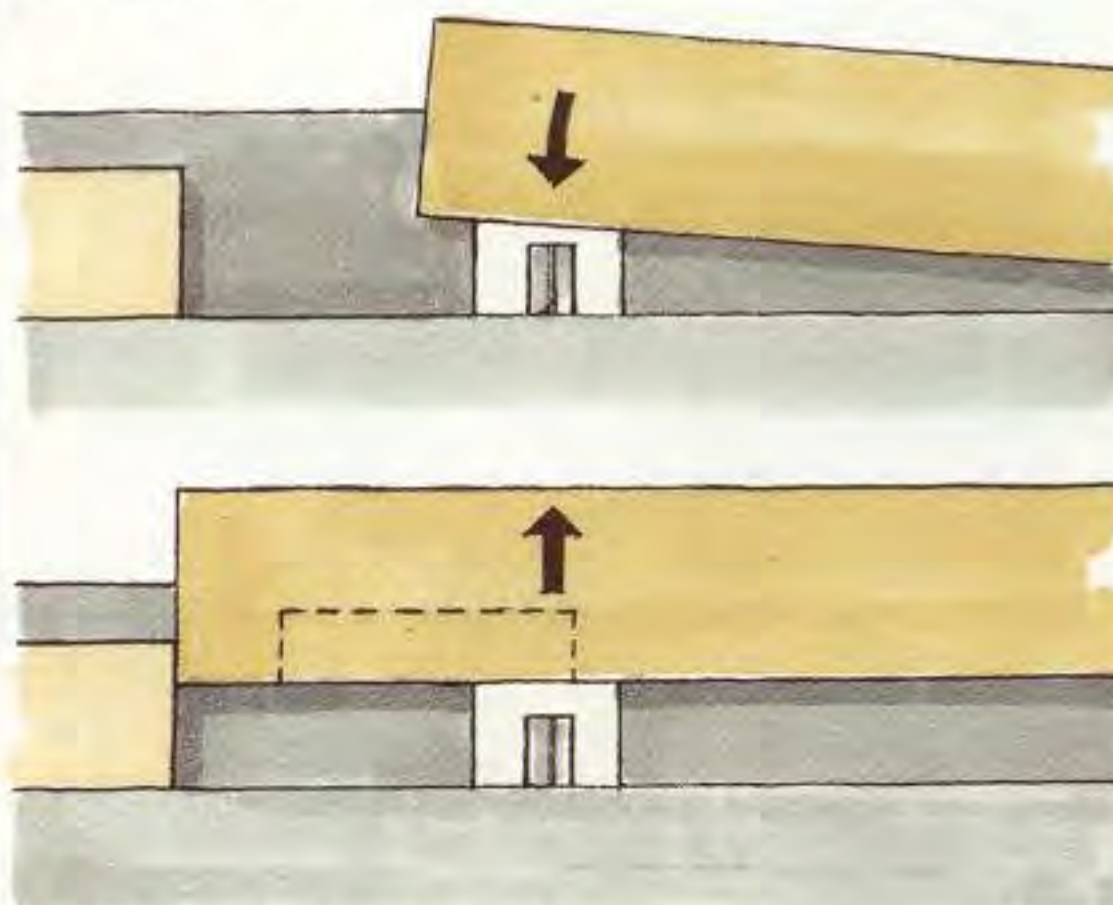
Cutting mortises with a router

Although you can cut mortises with a hand-held router, it is much more convenient to machine them with the tool inverted in a router table or workcentre. Once you have made the initial adjustments, you can cut any number of identical mortises without having to mark out the workpieces.



1 Setting up end stops

With all the workpieces cut to size, clamp a block of wood at each end of the fence to limit the movement of a workpiece to the length of the required mortise.



2 Machining the mortise

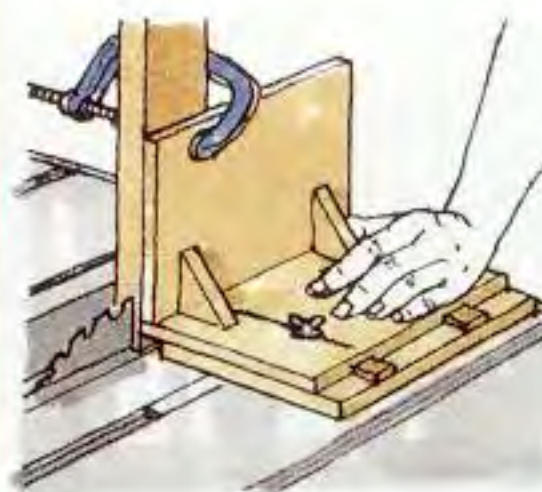
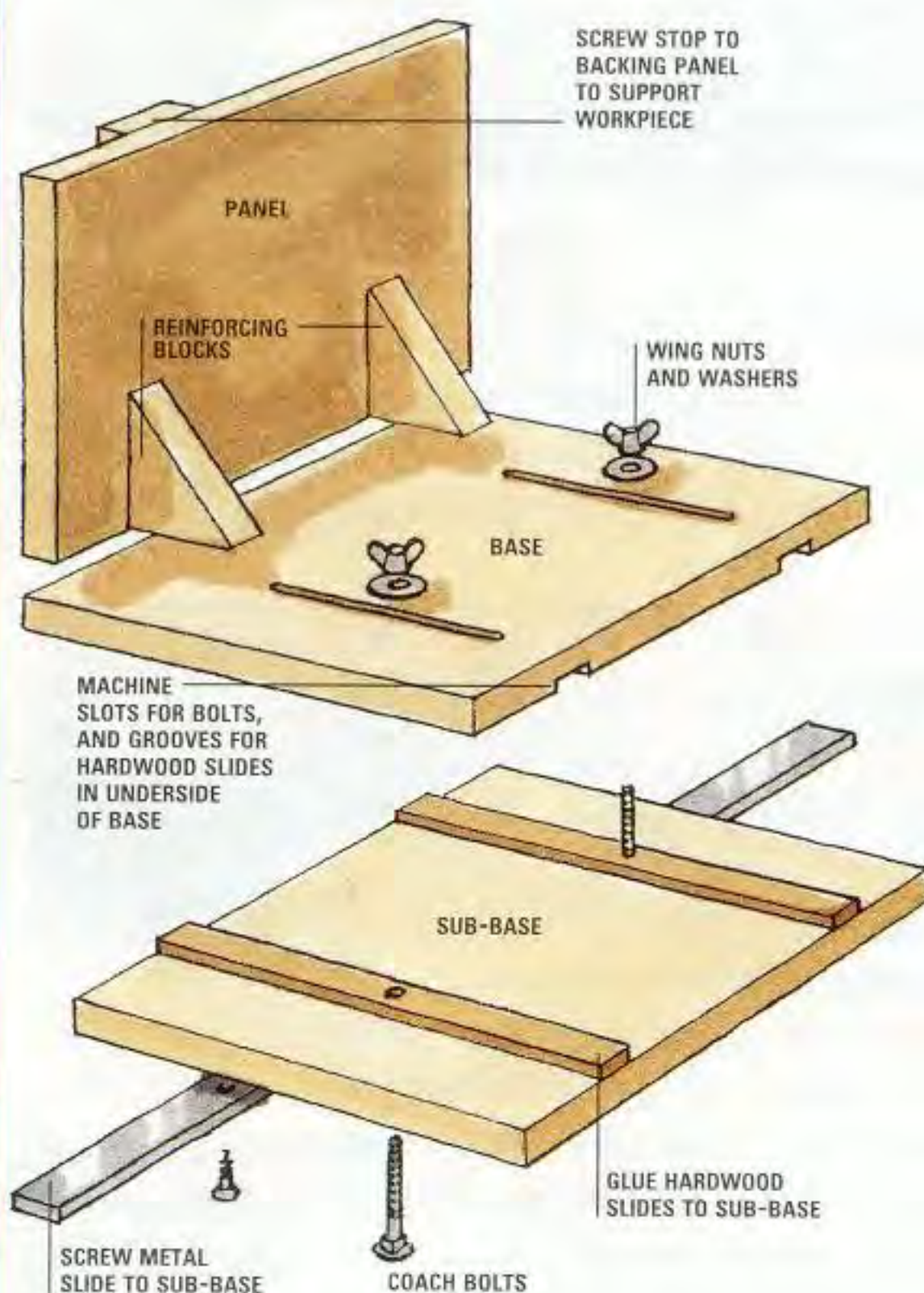
With the work butted against the rear end stop, hold the wood firmly against the fence and lower it slowly onto the rotating cutter. Feed the wood forward until it comes to rest against the other end stop, then carefully lift it clear of the cutter. Cut a deep mortise in stages, raising the cutter between each pass.

MACHINE-CUT TENONS

Although it is largely a matter of personal choice, perhaps the best way to produce tenons in quantity is to use a table saw. You can work relatively quickly without damaging its blade or powerful motor, and the sharp carbide-tipped saw teeth cut so cleanly that there should be no need for final fitting by hand. It may be possible to buy a purpose-made tenon-cutting jig for a particular model of saw; such jigs are designed to slide along the slot machined across the saw table for the mitre fence. Alternatively, you can make your own jig from MDF.

Making a tenon-cutting jig

Cut the components from 12 to 18mm ($\frac{1}{2}$ to $\frac{3}{4}$ in) MDF to fit your saw table. Make the slide from a metal strip that is an accurate sliding fit in the mitre-fence slot. Before machining joints, always make a test component and use it to check your settings before proceeding with actual workpieces.



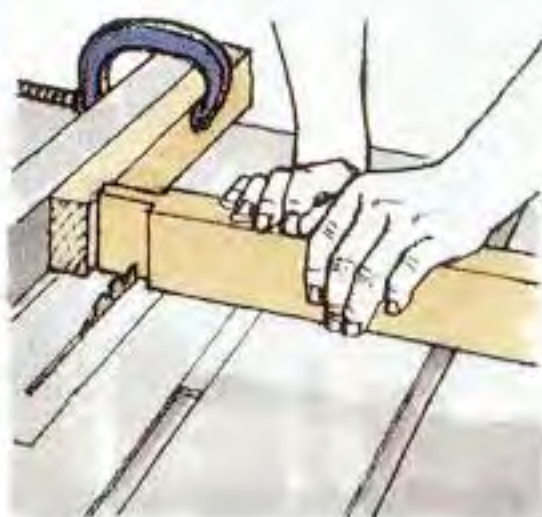
1 Cutting the tenon cheeks

Clamp the work to the jig and feed it past the blade to cut along one side of the tenon. Turn the work round and saw the other side.



2 Sawing the shoulders

Crosscut the joint's shoulders, using the mitre fence to feed the work past the blade. A block of wood clamped to the saw's rip fence serves to align the shoulder with the blade and also prevents the severed waste jamming between the blade and fence.

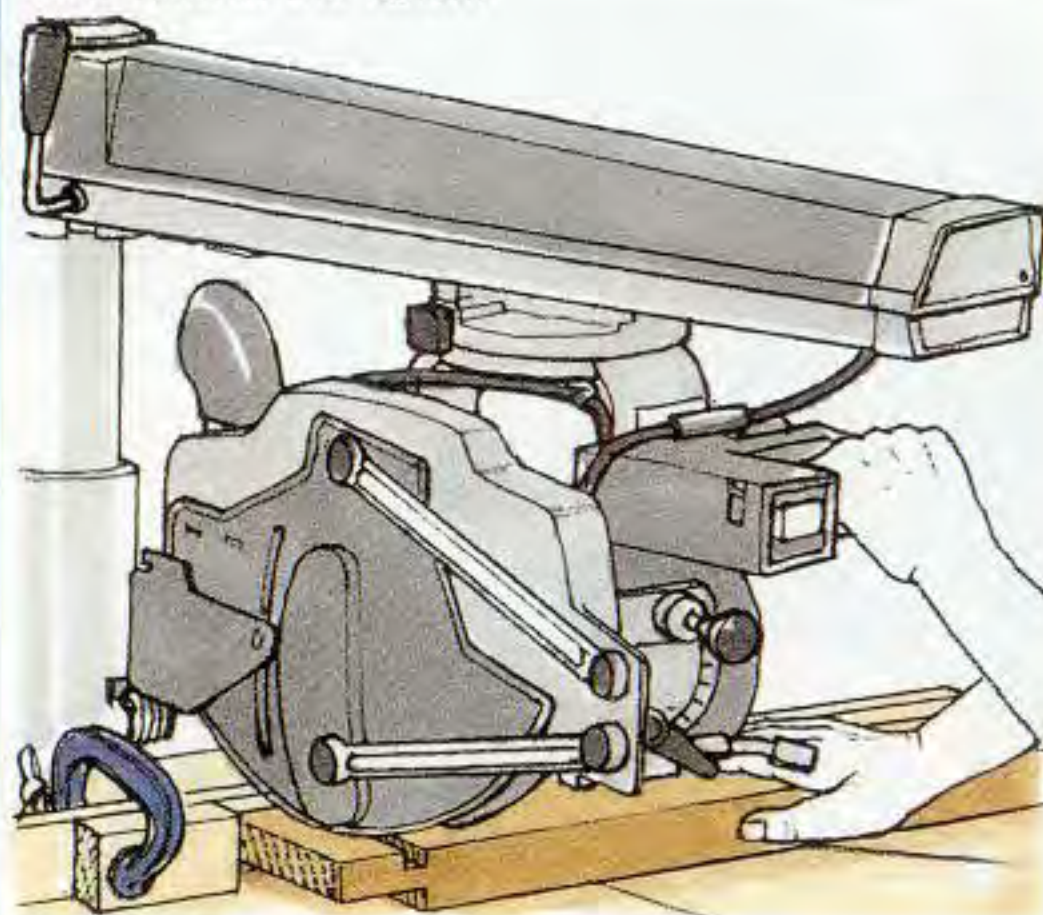


Cutting a haunch

Adjust the rip fence until the blade aligns with the end of the haunch. Make the first cut and remove the waste in stages, sliding the workpiece away sideways from the rip fence.

CUTTING TENONS ON A RADIAL-ARM SAW

With the workpiece butted against an end stop clamped to the fence, make the first cut along the shoulder line. Slide the work sideways, removing the waste little by little with successive crosscuts. Turn the work over and repeat the procedure to cut the other side of the tenon.



CHAPTER 10 Traditional drawer making utilizes the inherent strength of the dovetail joint to full advantage: the fan-shape ‘tails’ resist the forces applied to the joints when the drawer is used. Dovetails are so strong that it is rare to see a drawer that has broken as a result of joint failure, even when heavily laden. There is a great variety of forms of dovetail joints, some of which are used primarily for their decorative qualities.

DOVETAIL JOINTS

THROUGH DOVETAIL JOINT

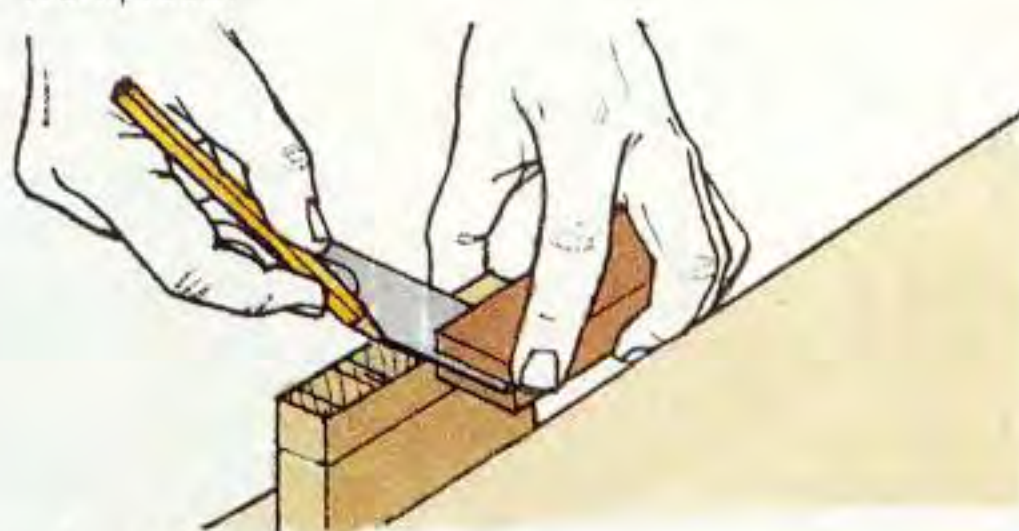
HAND CUT

The ability to cut tight-fitting dovetail joints seems to be regarded as the ultimate test of the woodworker's skill. It is also, undeniably, one of the most efficient joints for constructing boxes and cabinets from solid wood. Through dovetails, the most basic form of the joint, are visible on both sides of a corner.



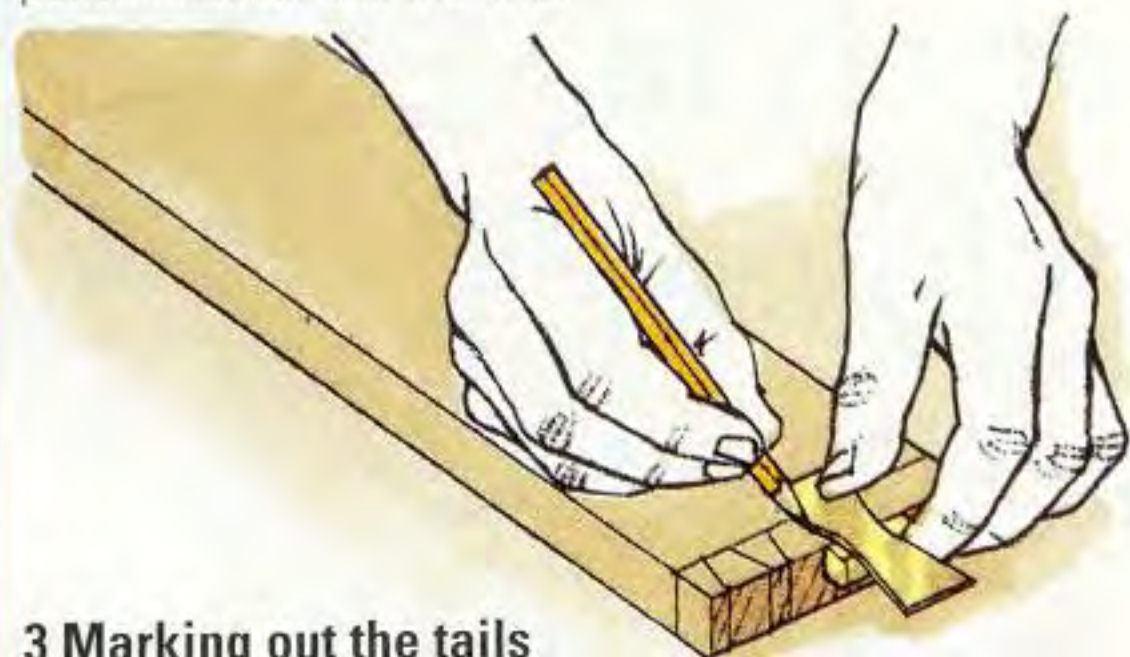
1 Scribing the shoulder line

Plane square the ends of both workpieces and, with a cutting gauge set to the thickness of the pin member, scribe the shoulder line for the tails on all sides of the other workpiece.



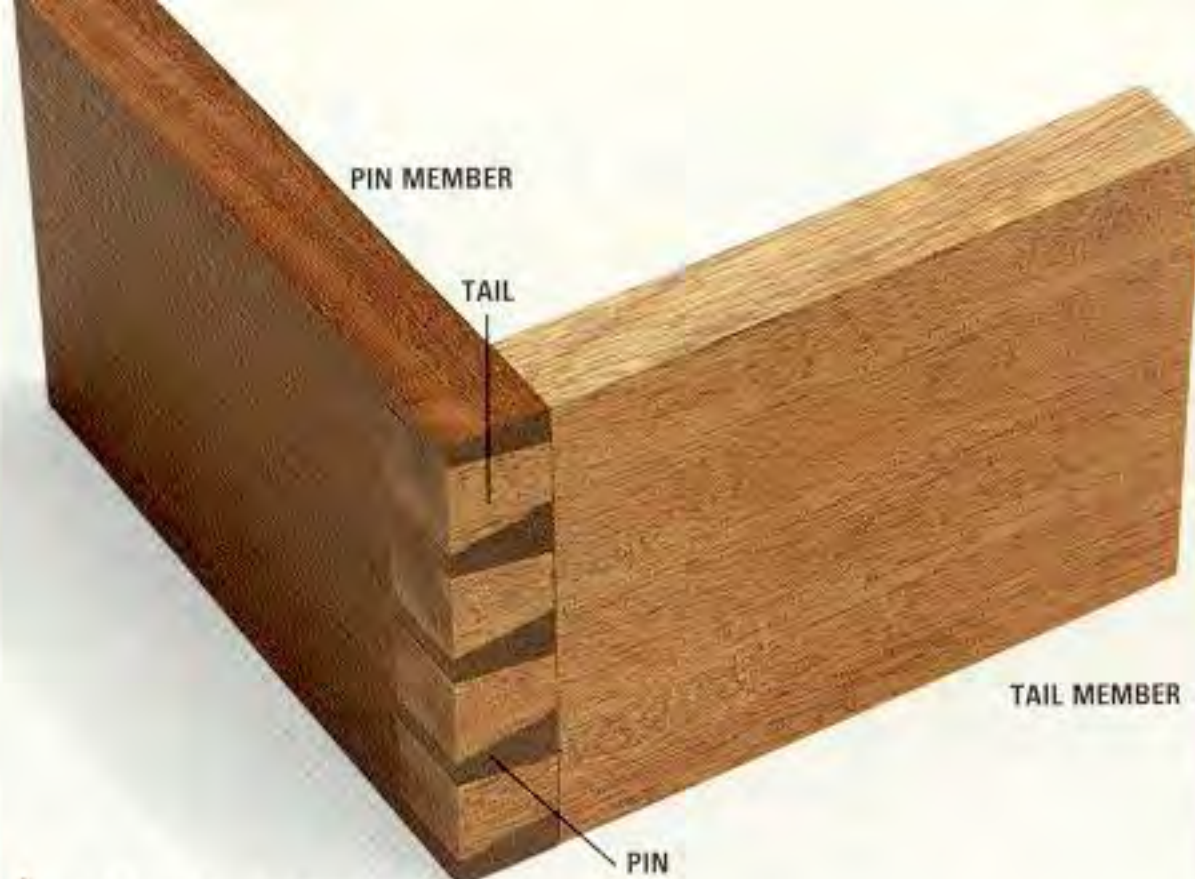
2 Spacing the tails

A good hand-cut joint has equal-size tails matched with relatively narrow pins. Pencil a line across the end grain, 6mm ($\frac{1}{4}$ in) from each edge of the work, then divide the distance between the lines equally, depending on the required number of tails. Measure 3mm ($\frac{1}{8}$ in) on each side of these marks and square pencil lines across the end.



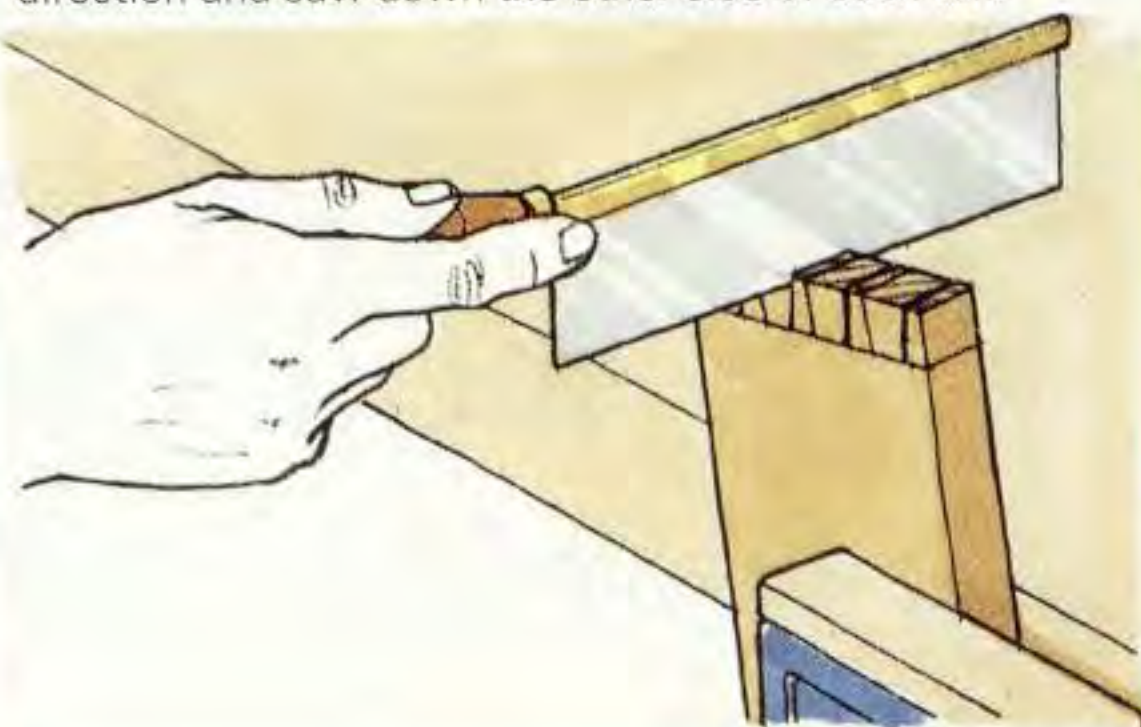
3 Marking out the tails

Mark the sloping sides of each tail on the face side of the workpiece, using an adjustable bevel or a ready-made dovetail template. Mark the waste with a pencil.



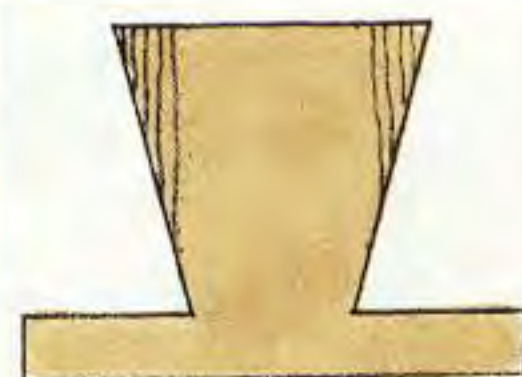
4 Cutting the tails

Clamp the work at an angle in a vice so that you can saw vertically beside each dovetail. When you have reached the last tail in the row, cant the work in the other direction and saw down the other side of each tail.

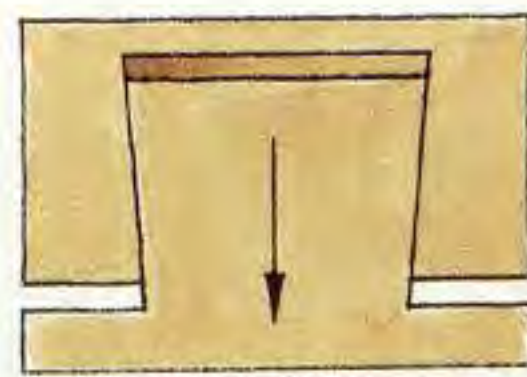


DOVETAIL ANGLES

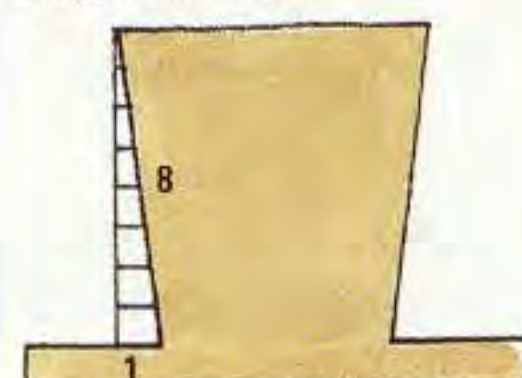
The sides of a dovetail must slope at the optimum angle. An exaggerated slope results in weak short grain at the tips of the dovetail, while insufficient taper invariably leads to a slack joint. Ideally, mark a 1:8 angle for hardwoods, but increase the angle to 1:6 for softwoods. The proportion of each tail is a matter of personal interpretation, but a row of small, regularly spaced tails looks better than a few large ones, and also makes for a stronger joint.



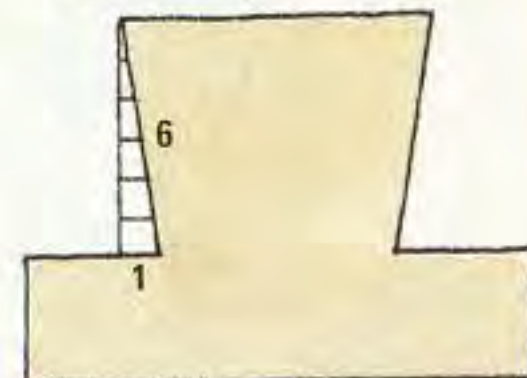
Exaggerated slope



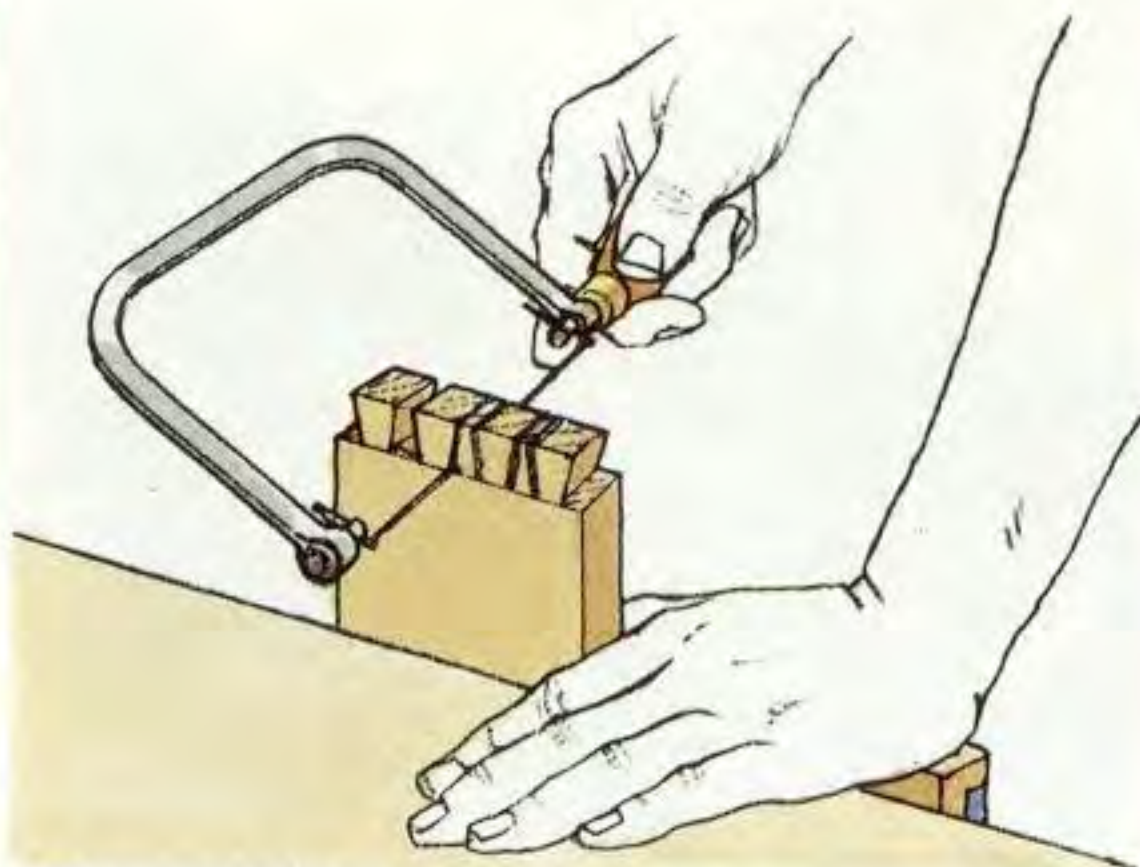
Insufficient taper



Hardwood

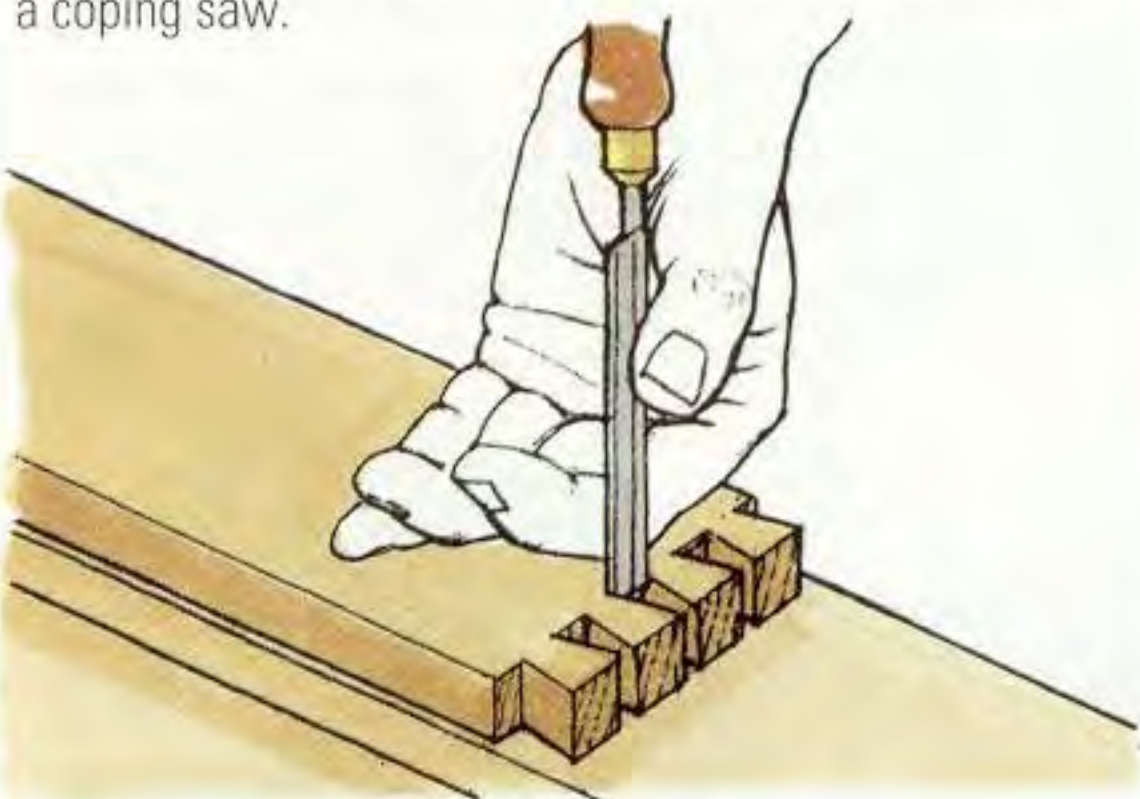


Softwood



5 Removing the waste

Set the work horizontally in the vice so that you can remove the corner waste with the dovetail saw, then cut the waste from between the tails, this time using a coping saw.



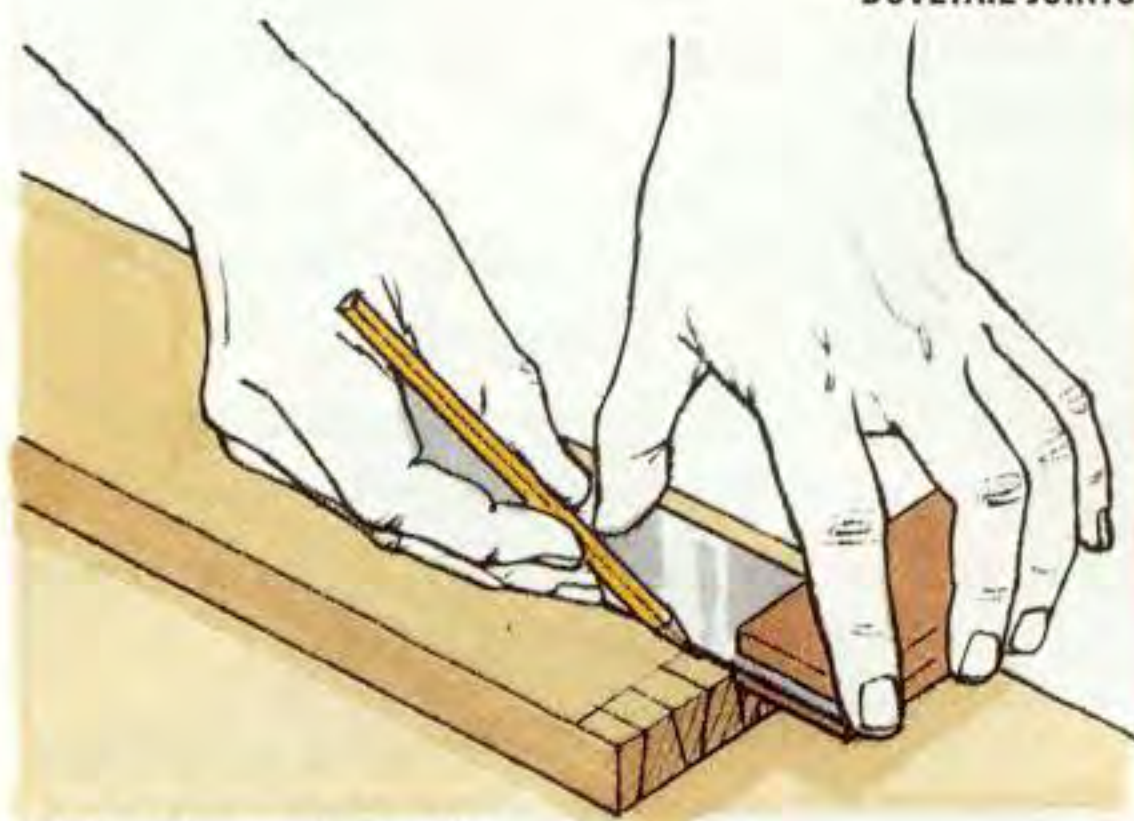
6 Trimming the shoulders

Use a bevel-edge chisel to trim what remains of the waste from between the tails. Finish flush with the shoulder line.



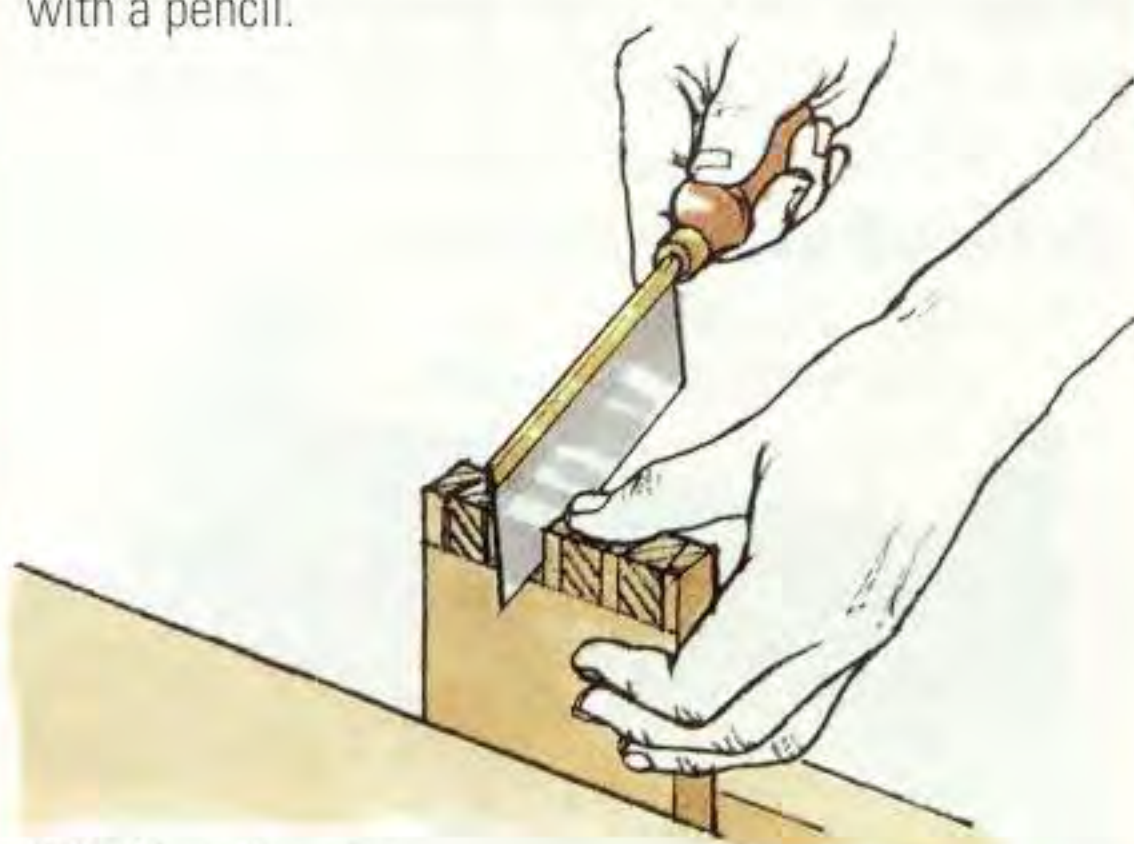
7 Marking the pins

Set the cutting gauge to the thickness of the tail member and scribe shoulder lines for the pins on the other component. Coat its end grain with chalk and clamp it upright in a vice. Position the cut tails precisely on the end of the workpiece, then mark their shape in the chalk with a pointed scribe or knife.



8 Marking cutting lines

Align a try square with the marks scored in the chalk, and draw parallel lines down to the shoulder on both sides of the work. Hatch the waste between the pins with a pencil.



9 Cutting the pins

Make fine saw cuts on both sides of each pin, following the angled lines marked across the chalked end grain. Finish flush with the shoulder.



10 Trimming the joint

Remove most of the waste wood with a coping saw, and pare the shoulders with a chisel. Assemble the joint dry, trimming any tight spots until the joint fits cleanly and snugly.

THROUGH DOVETAIL JOINT

MACHINE CUT

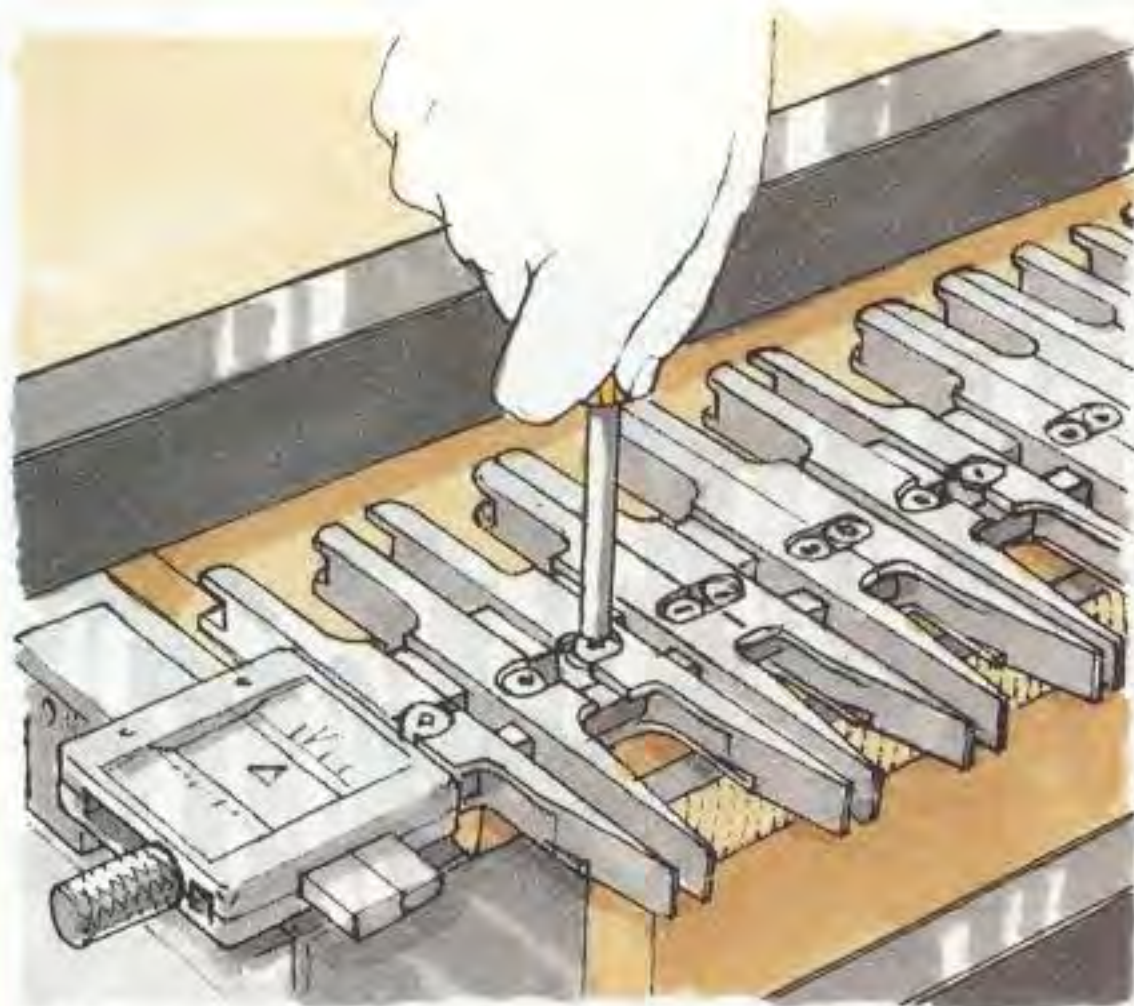
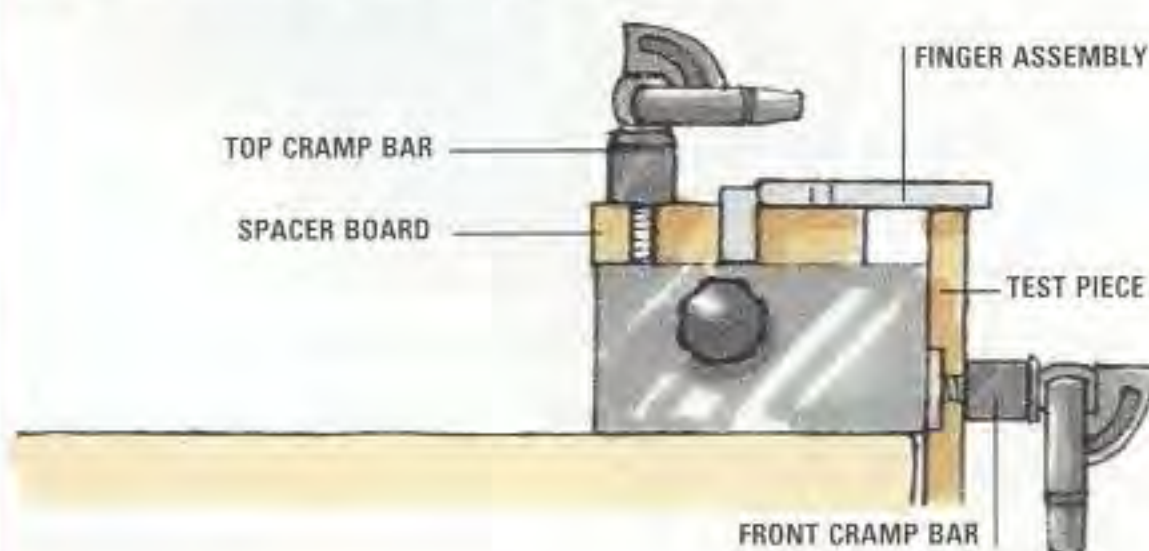
The versatility of the router has been enhanced by the development of ingenious jigs for cutting traditional joints. Although the initial adjustment is time-consuming, once these jigs are set, even complicated dovetail joints can be cut in a fraction of the time it takes to make them by hand.

The description here serves as a guide to cutting through dovetails on a jig that features individually adjustable fingers that guide the router cutter. The setting of the finger assembly governs the size and spacing of the tails and pins. Adjusting the fingers for the pins along one side of the assembly automatically sets the fingers for matching tails on the opposite side. There is also a device for fine fore-and-aft adjustment of the finger assembly.



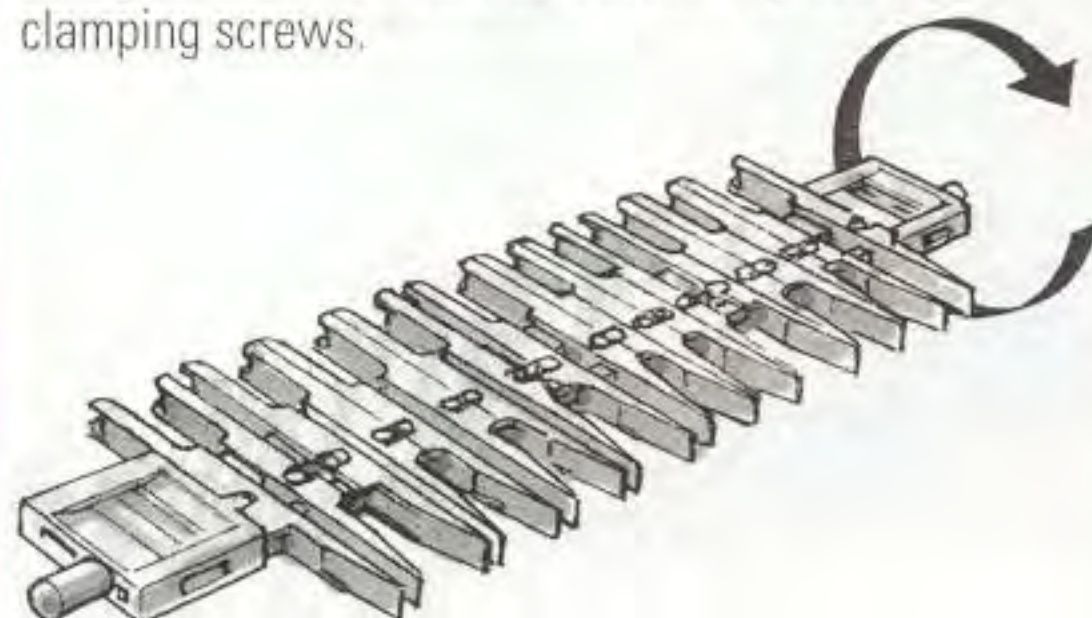
Fitting a test piece

Use test pieces to set up the jig and check the fit of the parts. Place an 18mm ($\frac{3}{4}$ in) spacer board under the finger assembly and secure it with the jig's top cramp bar. Clamp a test piece of the correct width to the front of the jig, making sure it butts against the side stop and the underside of the finger assembly.



Adjusting the finger assembly

You need one pair of fingers for each dovetail and a single finger at both ends of the row. Set these individual fingers first so that they are flush with each edge of the test piece, then space the pairs of fingers at regular intervals between them. Tighten the clamping screws.



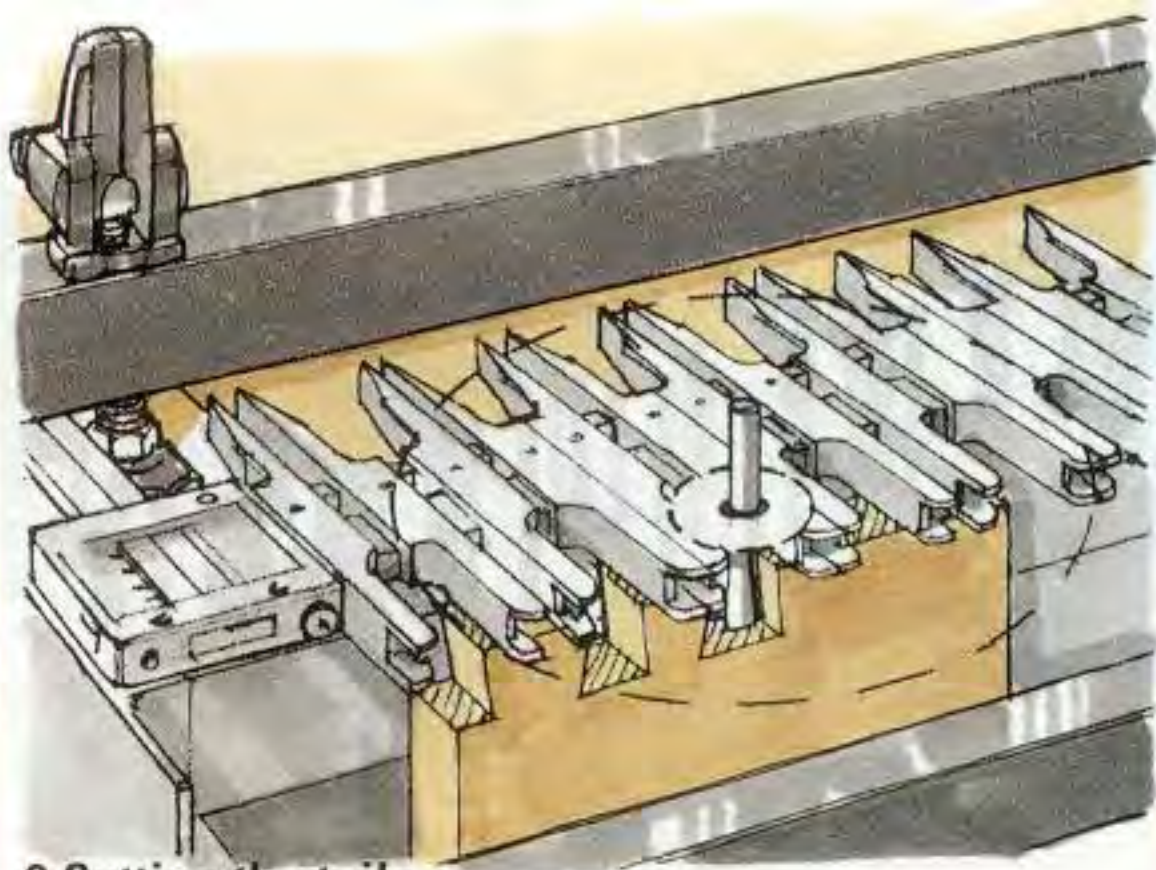
Rotating the fingers

Once you have adjusted one half of the assembly, all that is required to utilize the other set of fingers is to unclamp the entire assembly, rotate it, and clamp it down again.



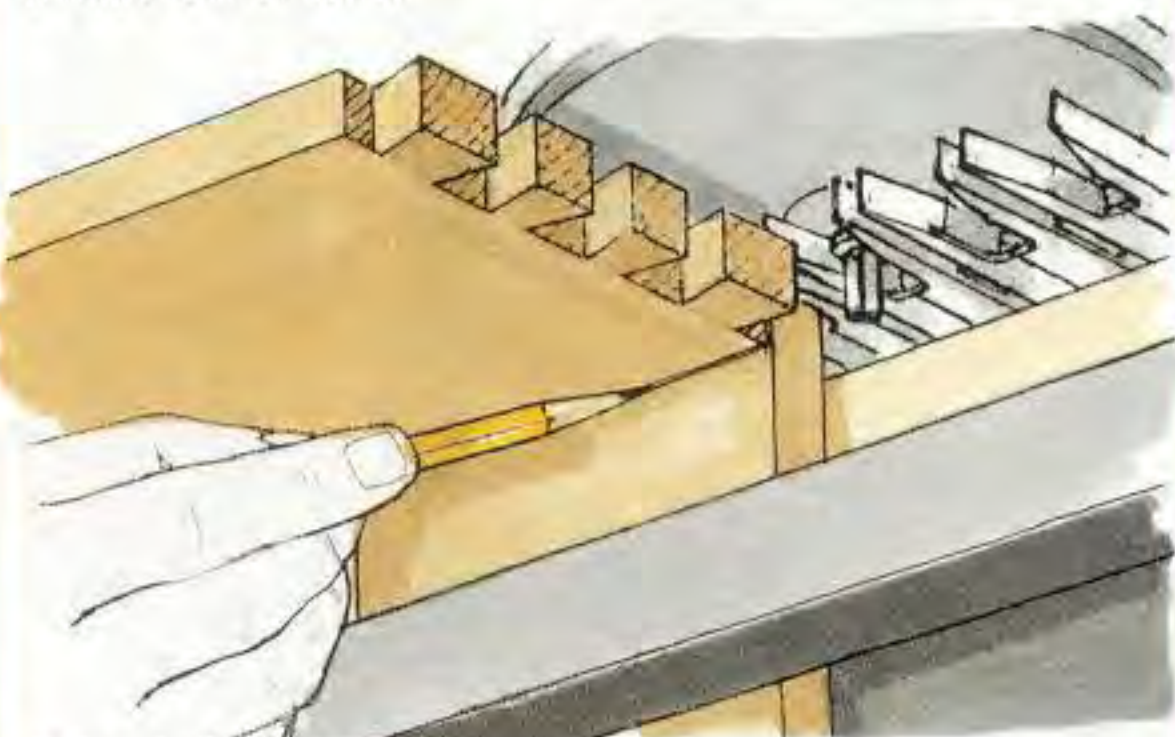
1 Setting up for tail cutting

Set the assembly with the straight-sided tail fingers pointing towards you. Fit into the router a compatible dovetail cutter and guide bush – check with your jig supplier. Using the other component as a template, mark the depth of cut on the tail member, and adjust the router cutter down to the marked line.



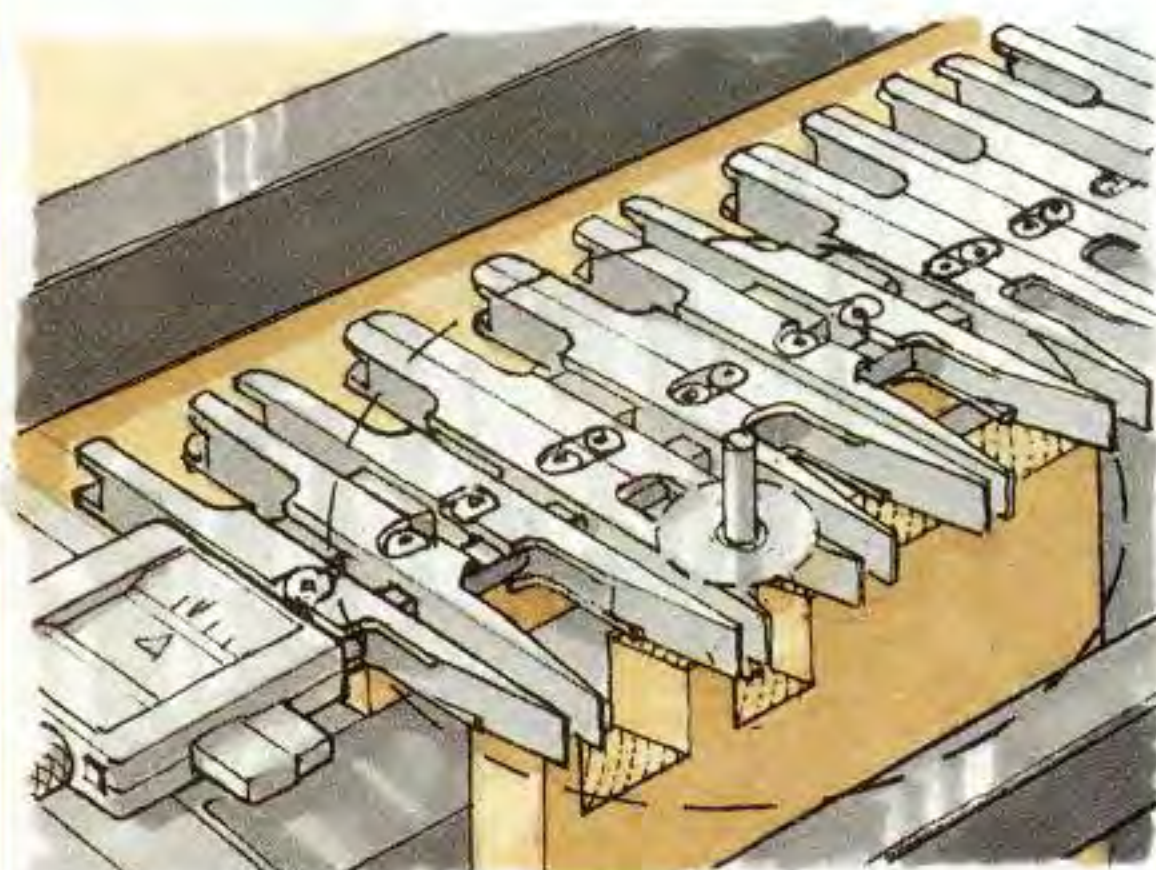
2 Cutting the tails

Always check that all parts of the jig and the test piece are securely clamped before switching on the router. Then run the cutter between each set of fingers (see box, right), cutting out the waste wood which leaves a neat row of tails.



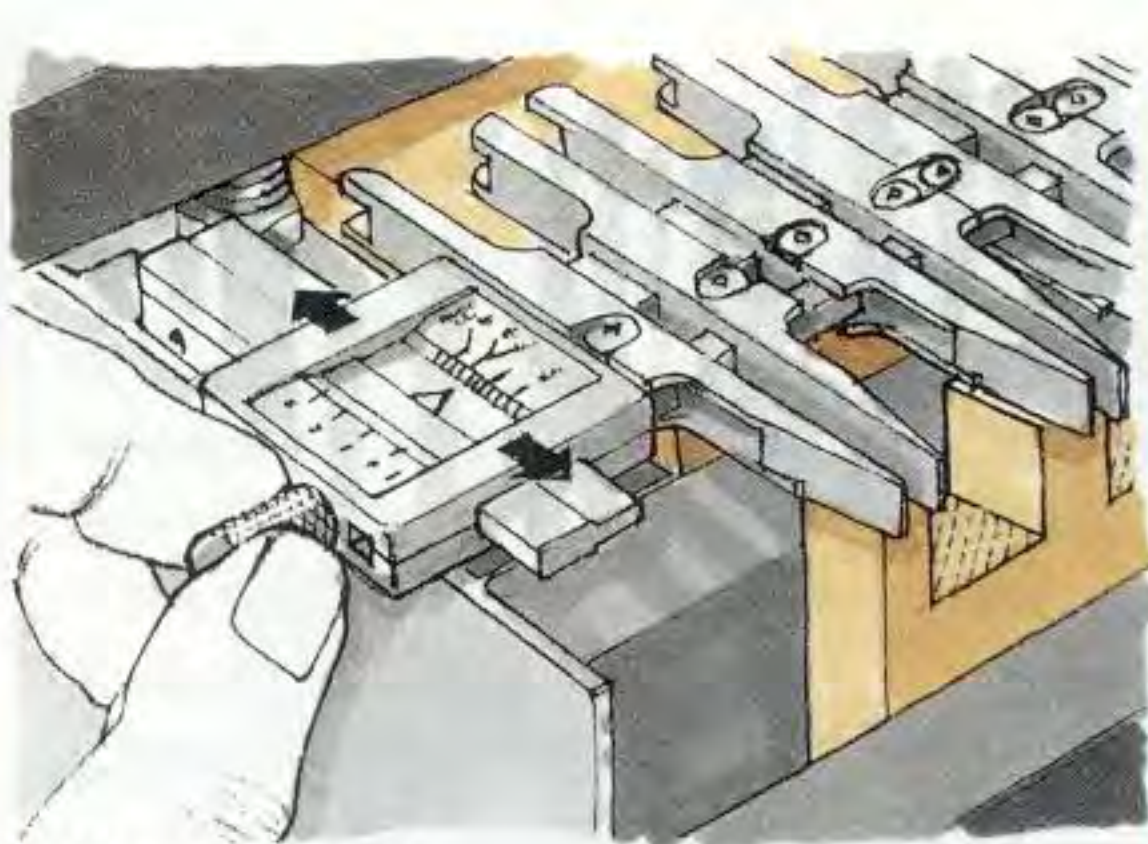
3 Setting up for pin cutting

Rotate the assembly to present the pin fingers to the front of the jig, and clamp a second test piece in the jig. Mark the depth of cut as before, using the tail member you have just cut as a template. Fit a straight cutter in the router and adjust it down to the marked line.



4 Cutting the pins

With the router placed flat on the finger assembly, switch on and then rout out the waste between each pair of fingers.

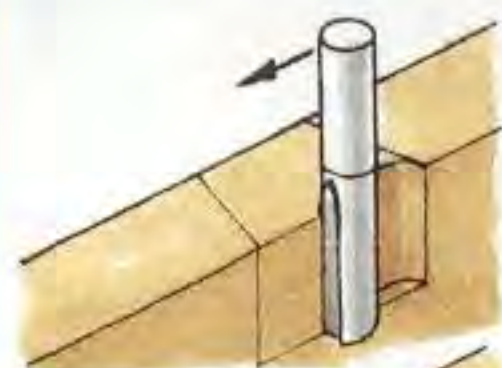


5 Checking the fit

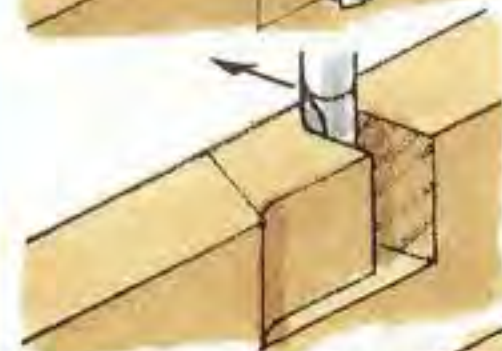
Assemble the joint to check it fits snugly. If it is slack, use the jig's fine-adjustment scale to move the finger assembly forward. If the joint is too tight, adjust the finger assembly backwards. Cut another pair of test pieces to check that the joint fits satisfactorily, before proceeding with the actual workpieces.

CUTTING NEAT PIN AND TAIL SOCKETS

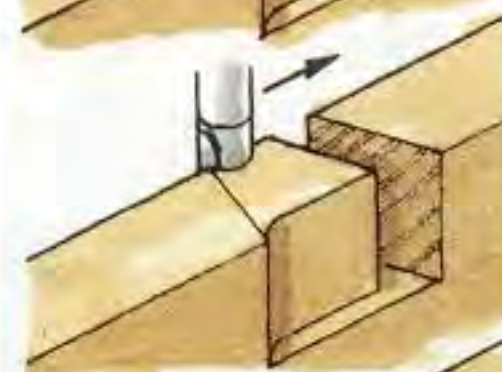
Simply driving the router cutter straight through the workpiece tears out the wood fibres along the shoulder line. Using the following sequence, incorporating a technique known as 'back cutting', takes a little longer but leaves you with neat sockets.



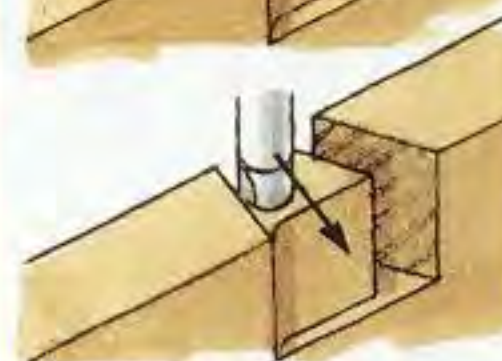
1 Make a shallow cut in the face of the wood, guiding the machine from right to left (back cutting).



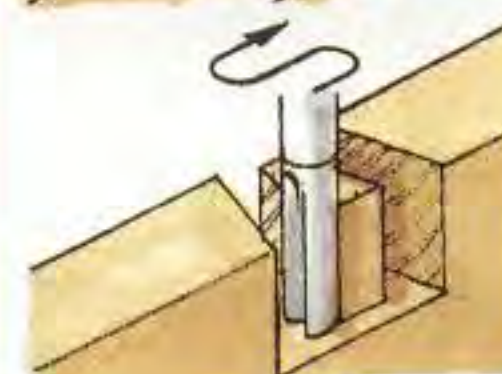
2 Return to the right of the socket and feed the cutter through to the back of the workpiece.



3 Make another shallow cut across the back of the socket.



4 Feed the cutter towards you on the left-hand side.

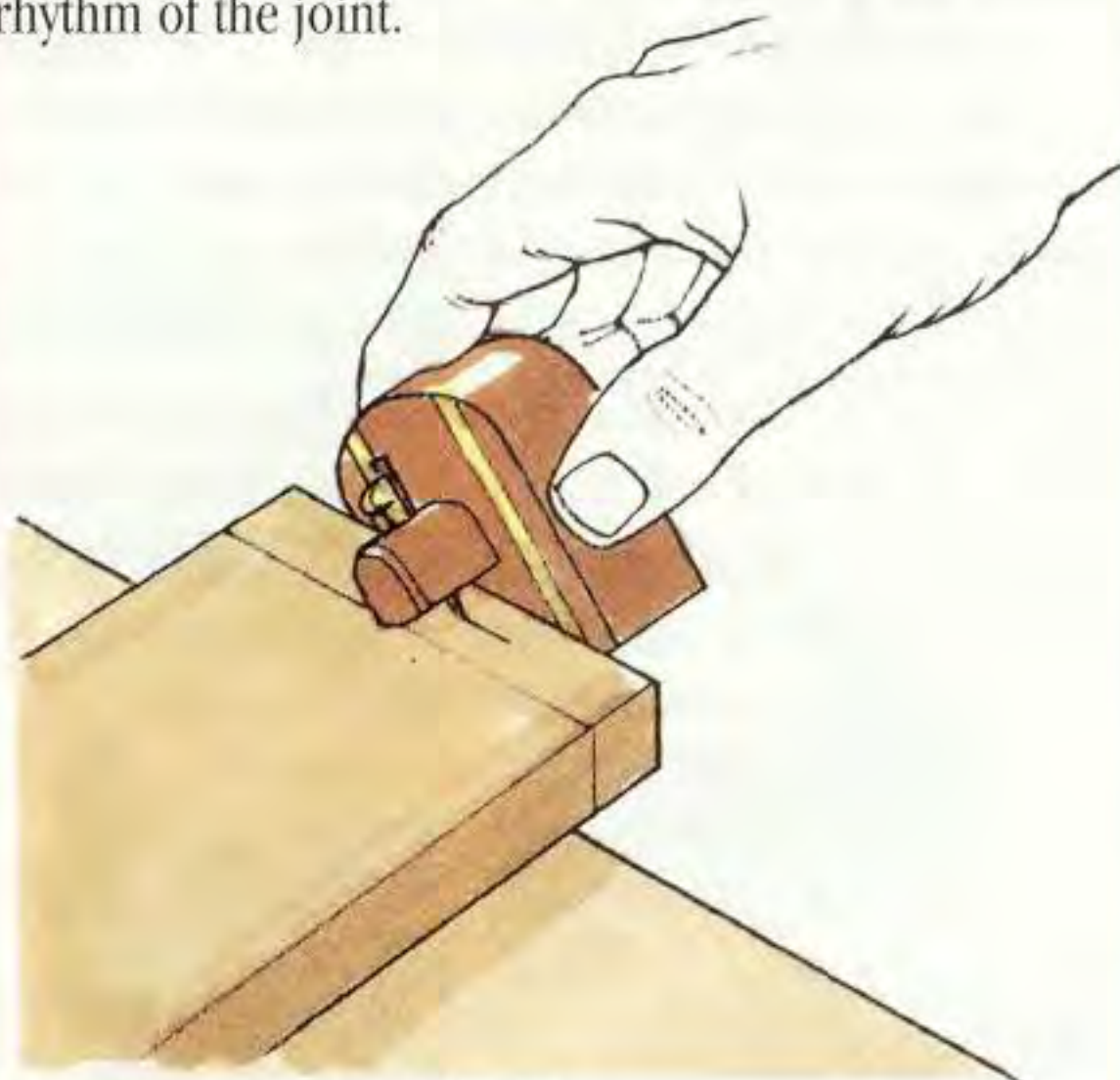


5 Remove the waste from the centre of the socket.

DECORATIVE THROUGH DOVETAIL JOINT

HAND CUT

A standard through dovetail is considered to be attractive, and the decorative qualities of the joint can be exploited still further by varying the size and spacing of the tails and pins. The example shown here has fine triangular pins and a central half-depth dovetail that interrupts the regular rhythm of the joint.



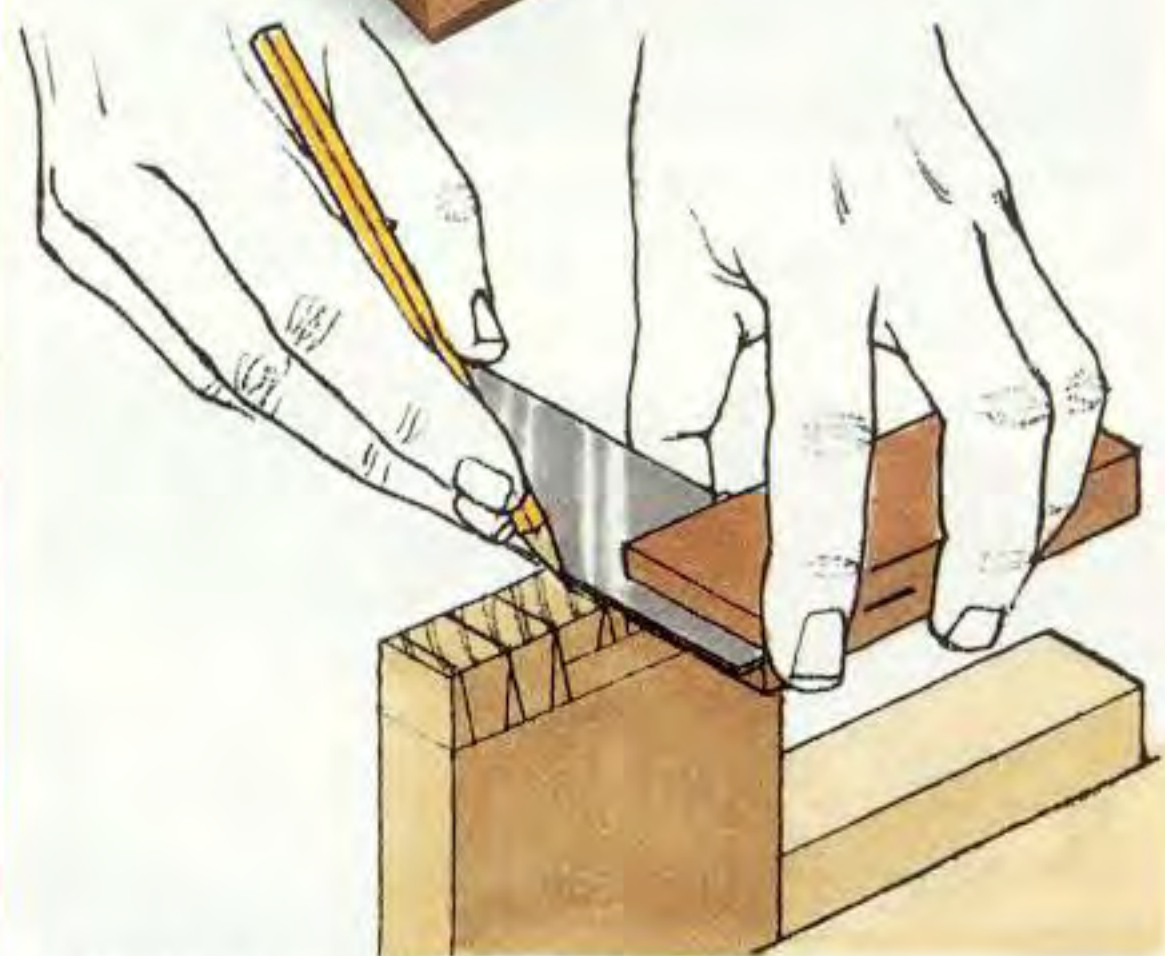
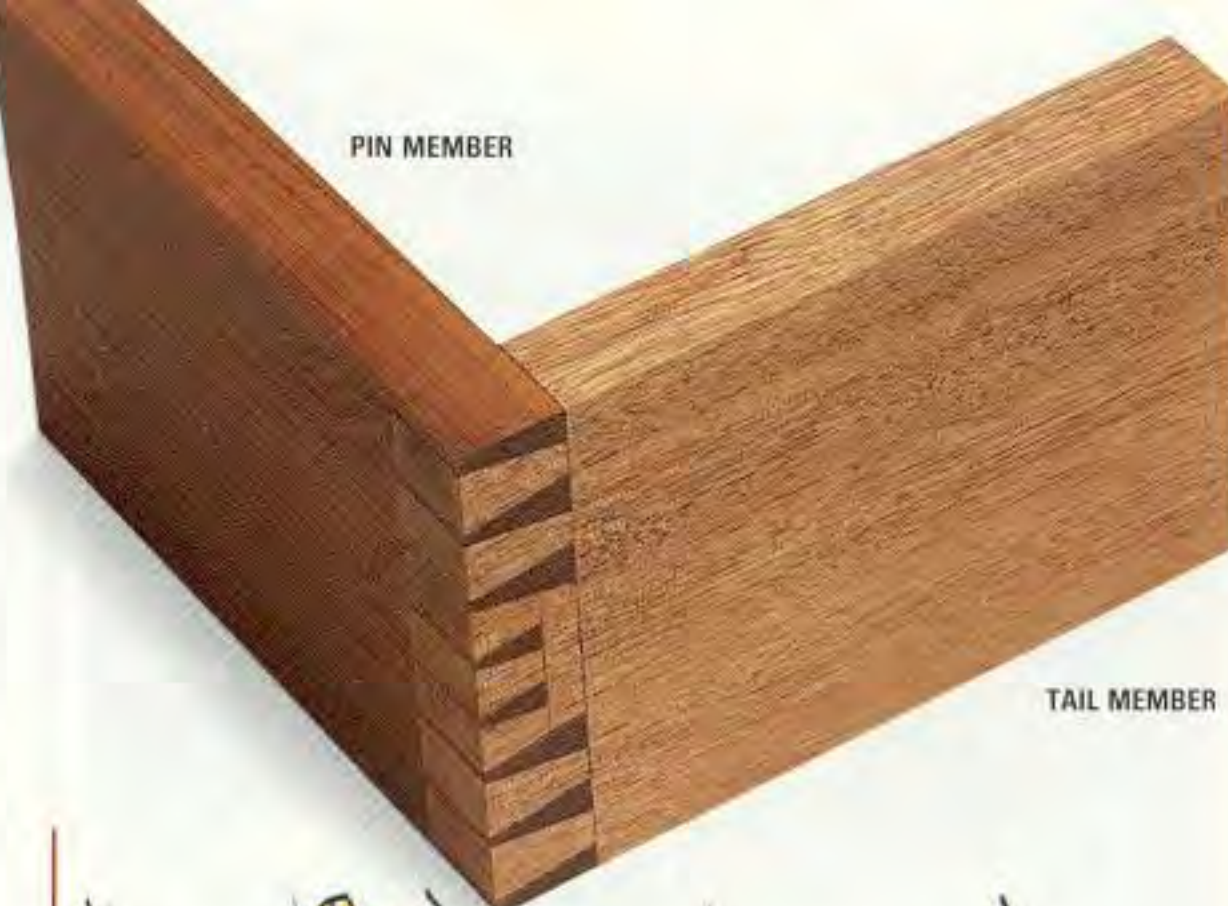
1 Scribing the shoulder line

Begin by marking out the tails, lightly scribing the shoulder line on all sides of the workpiece. Similarly mark the shoulder line for the half-depth dovetail.



2 Marking the sloping sides

Use a dovetail template to draw the sloping sides of the tails. Group the tails closely together, with no more than the thickness of a saw cut between them.



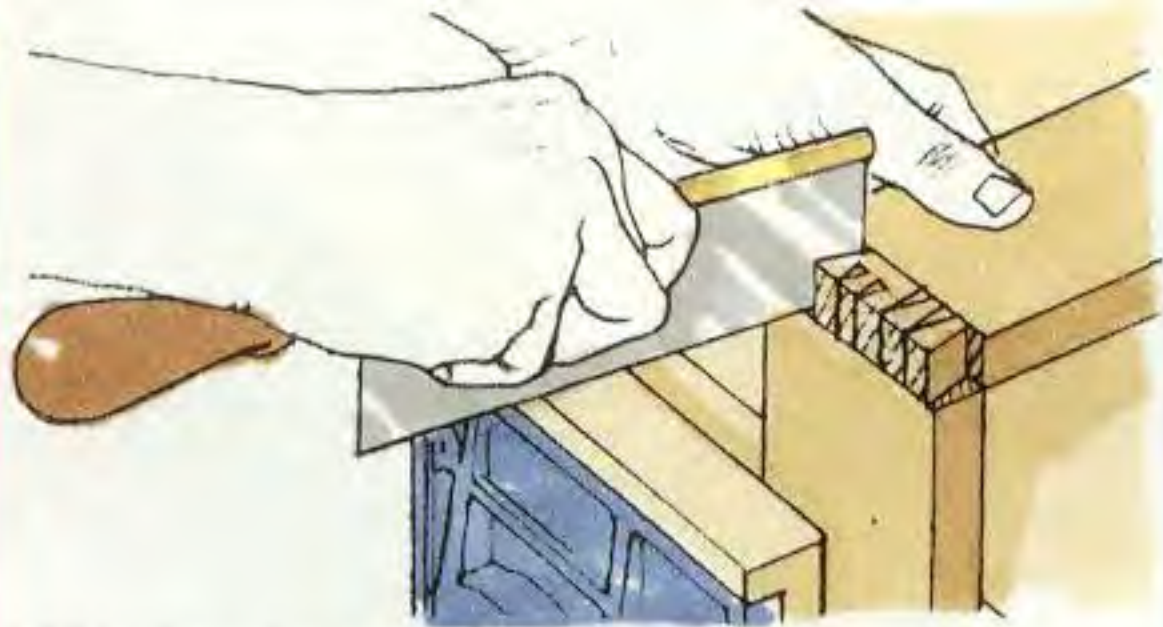
3 Squaring across the end grain

Using a try square, draw the tips of the tails on the end of the workpiece, then, with a dovetail saw and coping saw, remove the waste between them as described for a standard through dovetail joint. Trim the shoulder lines square with a narrow bevel-edge chisel.



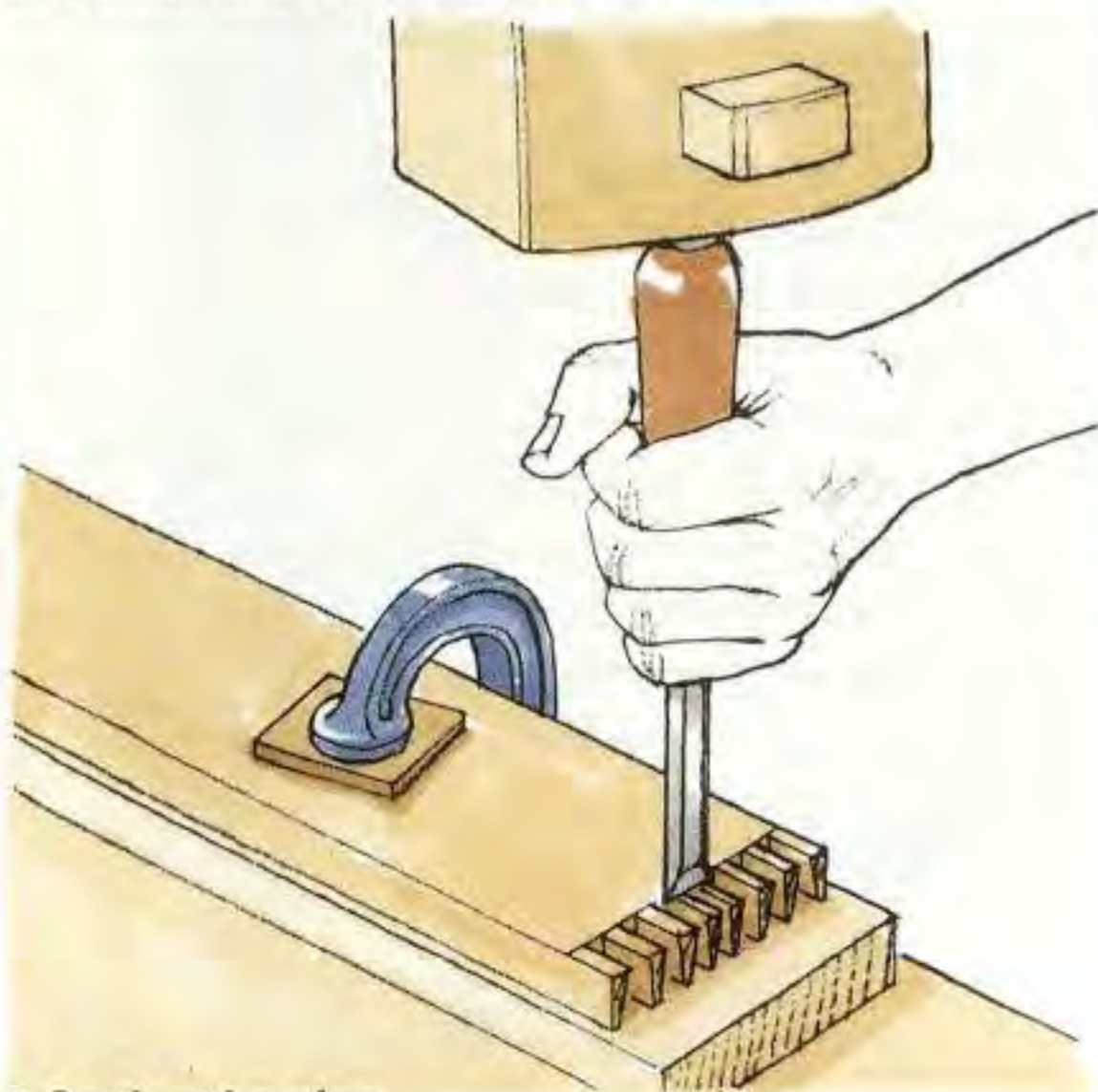
4 Scribing the pin shoulder line

Mark the shoulder line on all four sides of the pin member, then reset the gauge to score the length of the half-depth pins on the end grain. Rub chalk on the end of the workpiece.



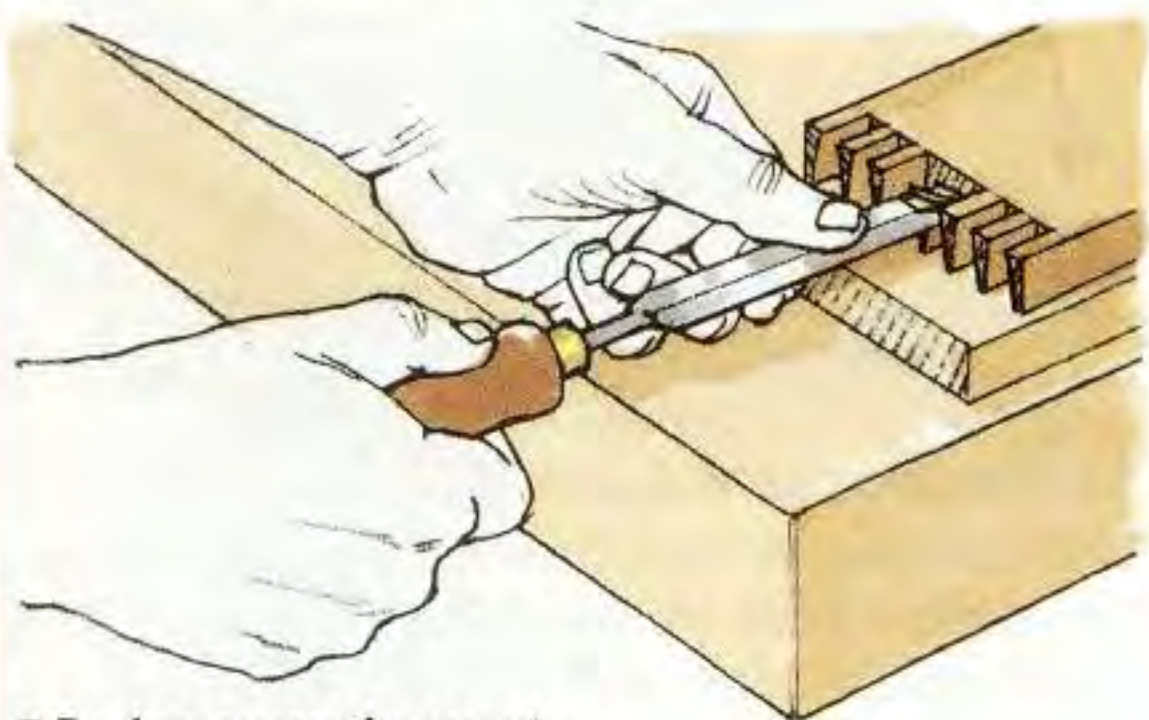
5 Marking the pins

With the tail member held down on the end of the pin member, score the shape of the pins in the chalk by drawing the tip of a dovetail saw between each pair of tails. Square the marks down to the shoulder line on both sides, and then hatch the waste, using a pencil.



6 Cutting the pins

Cut out the waste from between the pins, using a dovetail saw and coping saw, then pare down to the shoulder line with a chisel. To trim the half-depth pins to size, first make a cut across the grain close to the shoulder line, using a chisel and mallet.

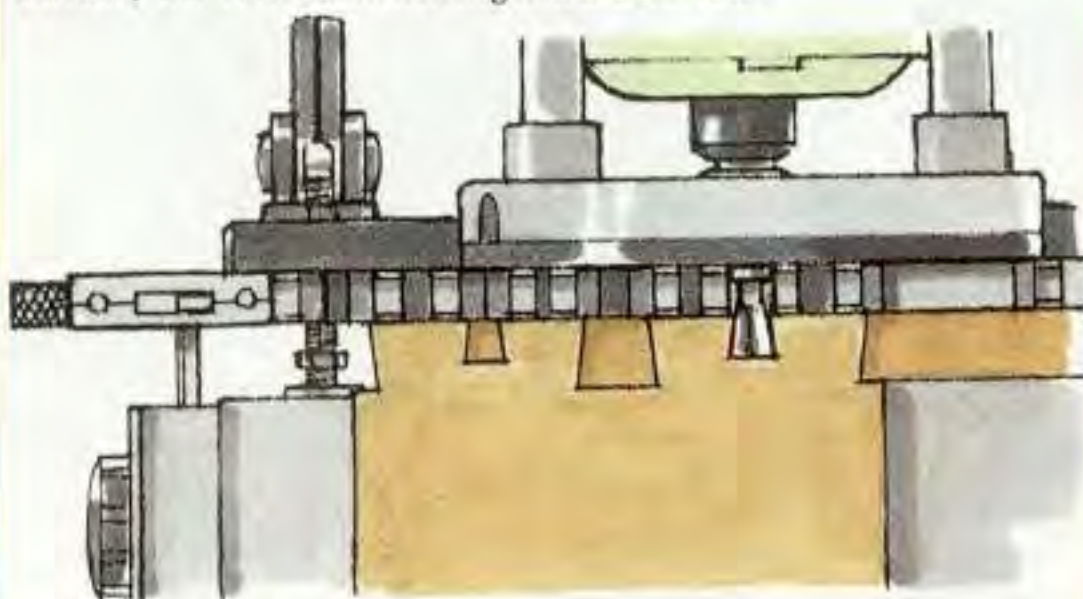


7 Paring away the waste

Cutting towards the shoulder, pare the pins down to the line scribed on the end grain. Finally, cut across the grain once more to trim accurately to the shoulder line.

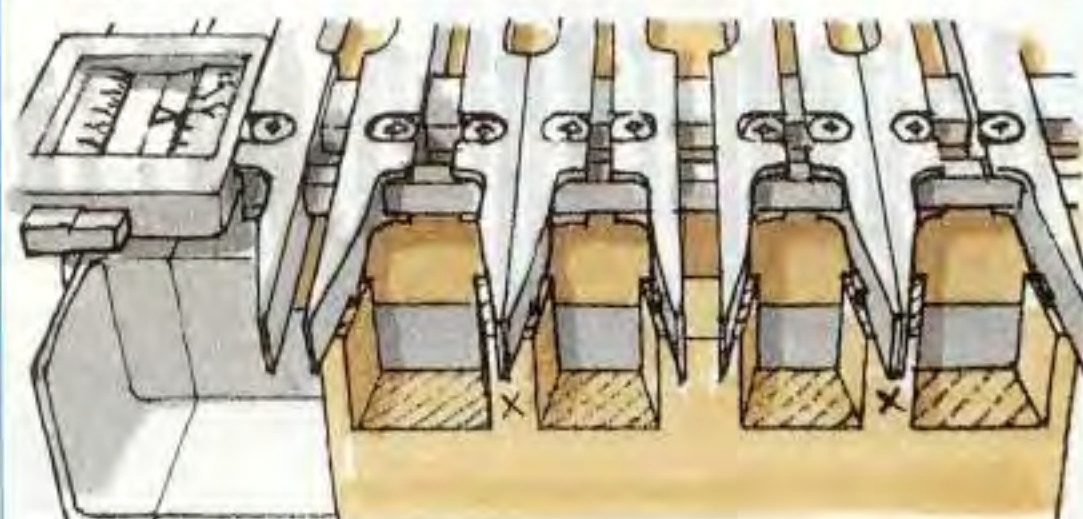
ROUTING DECORATIVE DOVETAILS

Using a dovetail jig with adjustable fingers, it is possible to cut decorative joints with a power router. You need two different dovetail cutters and a straight cutter, all with suitable guide bushes.



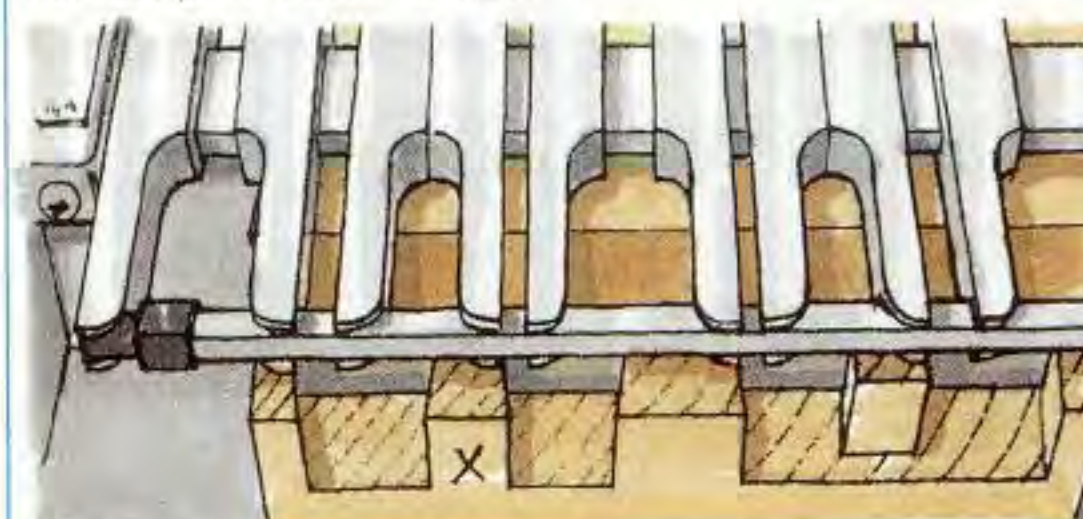
1 Making the tails

Set up the jig and adjust the fingers (see pages 84-5). Make trial cuts to ascertain the exact finger settings required for each dovetail cutter. Clamp the work in the jig, machine the larger pin sockets, then swap cutters and machine the smaller ones.



2 Making the pins

Since some of the pins are narrower than others, you must experiment with fore-and-aft adjustment of the finger assembly until you achieve the appropriate settings for cutting each size of pin. Make a careful note of these settings for reference. Cut all the sockets with the straight cutter, then adjust the finger assembly backwards so that you can shave the narrow pins down to size.

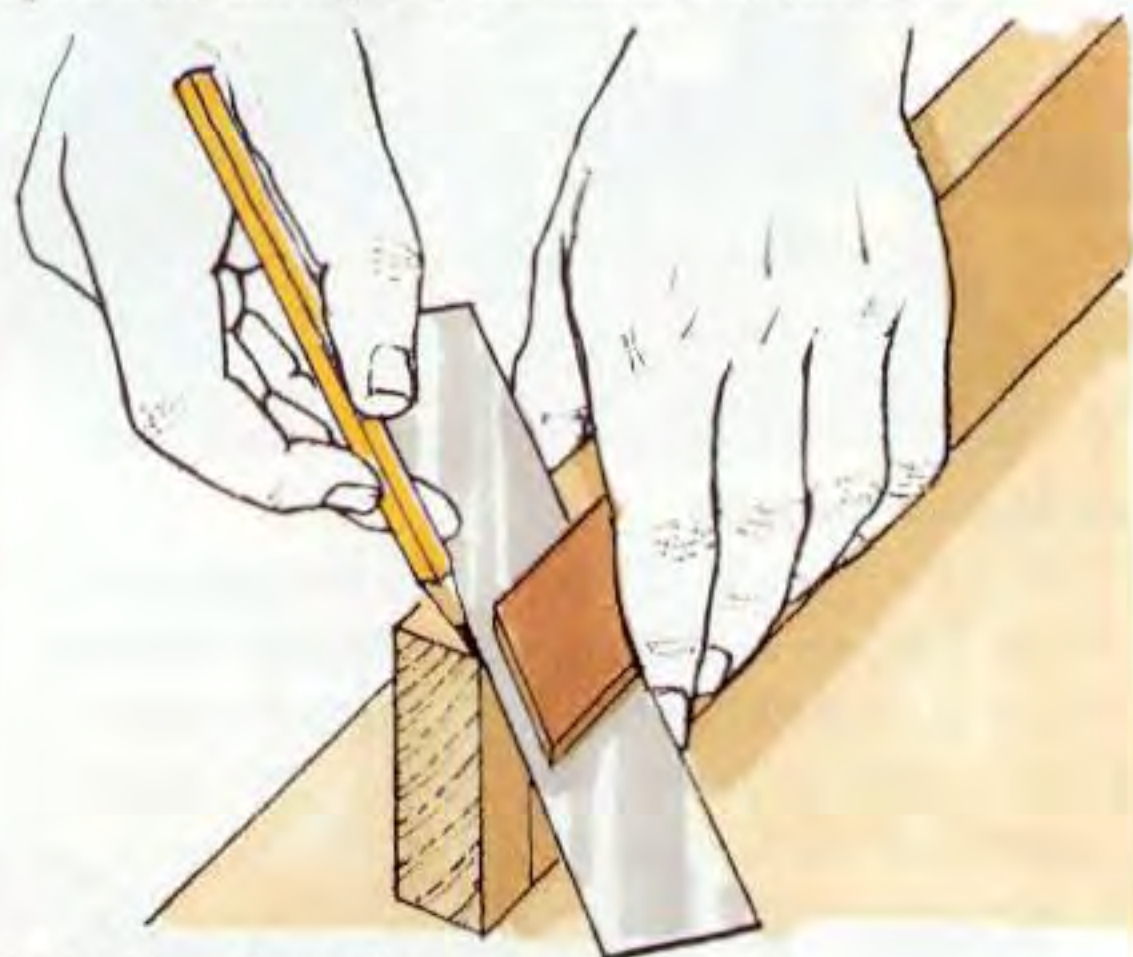


3 Shortening the pins

Turn the pin member to face inwards and rotate the finger assembly. Fit the jig's crossbar attachment to the fingers and adjust the assembly backwards, so that you can feed the router along the bar to shorten the narrow pins.

MITRED THROUGH DOVETAIL HAND CUT

Should you wish to mould the edge of a dovetailed workpiece, perhaps to make a sliding tray or an open box, incorporate a mitre at each corner.



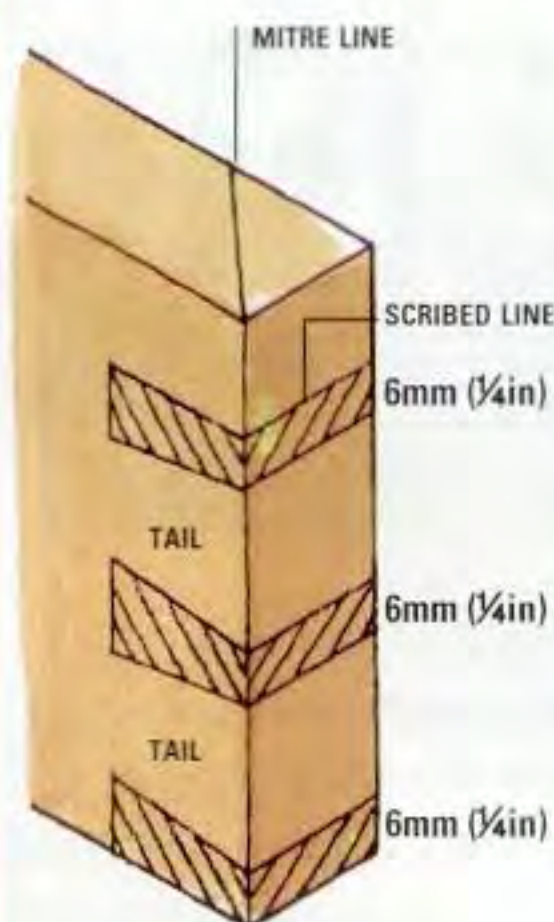
1 Marking the tail member

After scribing the shoulder line on the two sides and across the bottom of the tail member, mark the mitre on the top edge.



2 Marking the depth of the moulding

Set a marking gauge to the depth required for the moulded edge, and scribe a line on the end grain and round to the shoulder line on both sides of the work.



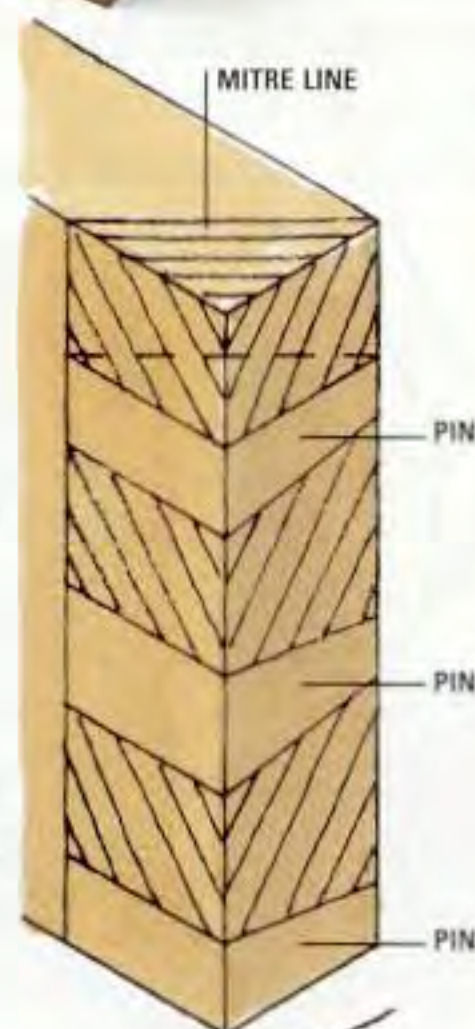
3 Completing the tails

Draw a pencil line 6mm (1/4in) below the scribed line, marking the tip of the first tail. Make a similar mark 6mm (1/4in) from the other edge. Divide the distance between these lines into the required number of equal-size tails. Saw the waste from between the tails and trim the shoulders square with a chisel. Cut the mitre, using a dovetail saw.



4 Marking the pins

Mark the shoulder lines and mitre on the pin member as described below left. Chalk the end grain and mark the position of the pins, using the tail member as a template. Square these marks down to the shoulder line on both sides of the workpiece. Use a pencil to mark the waste for the mitre and between the pins.



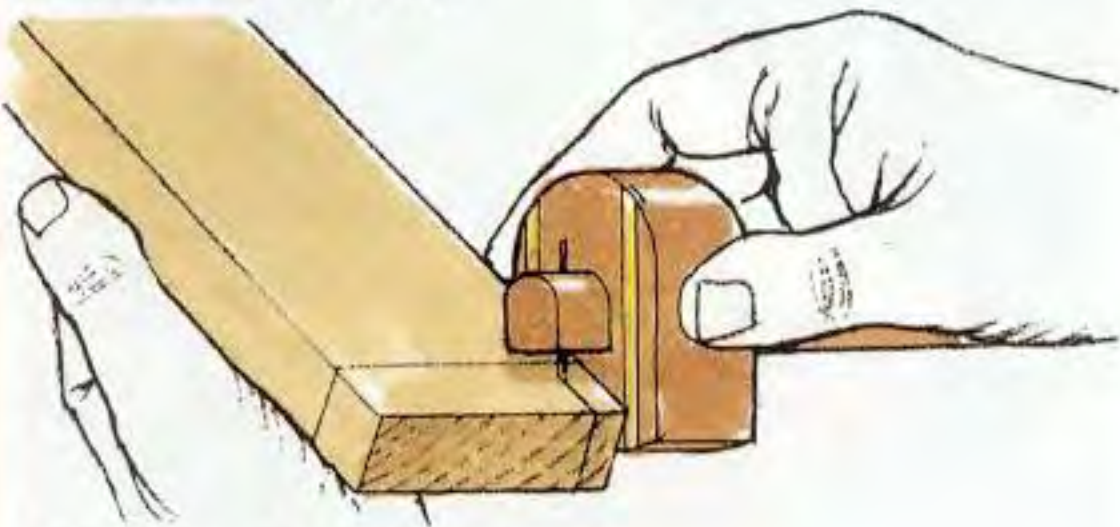
5 Cutting the pins and mitre

Cut out the waste from between the pins, then reclamp the work in the vice. Holding the dovetail saw at an angle, cut alongside the last pin, down to the line of the mitre. Finally, cut the mitre itself, then plane or router the moulding before assembling the joint.

RABBETED THROUGH DOVETAIL HAND CUT

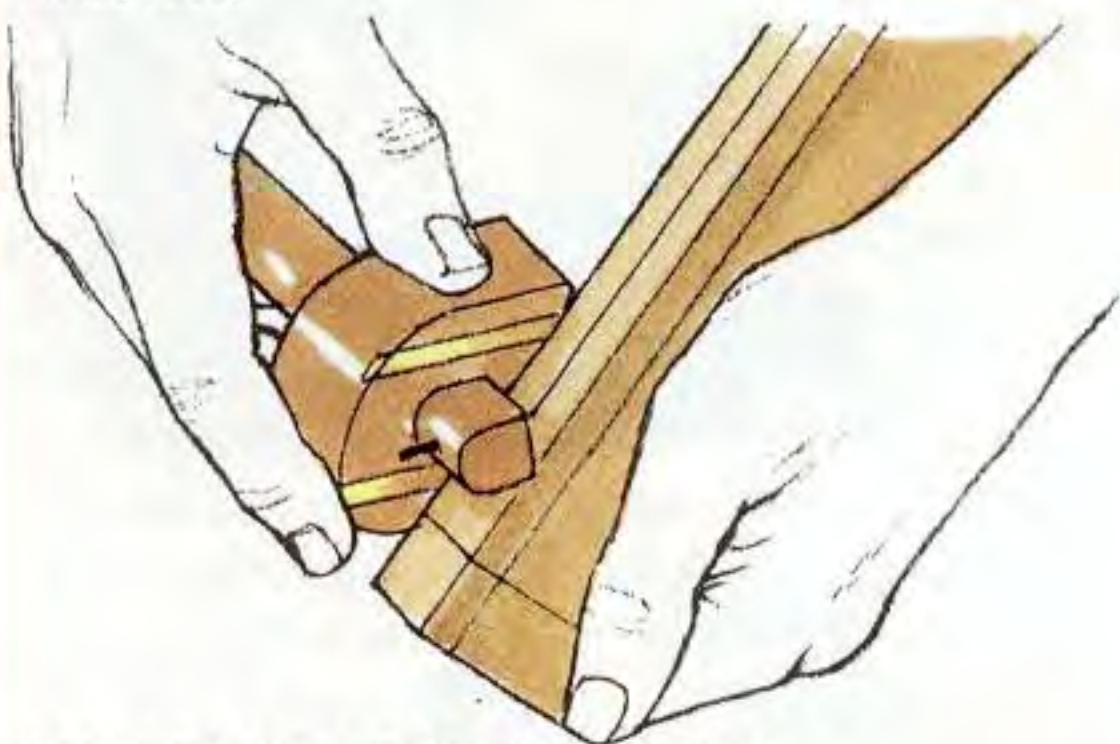
DOVETAIL JOINTS

It is quite common to cut a rabbet for fitting a tray bottom or to house the back of a cabinet. If you are also planning to incorporate through dovetail joints, it is necessary to extend the shoulder at the bottom edge of each tail member to plug the rabbet at the corner.



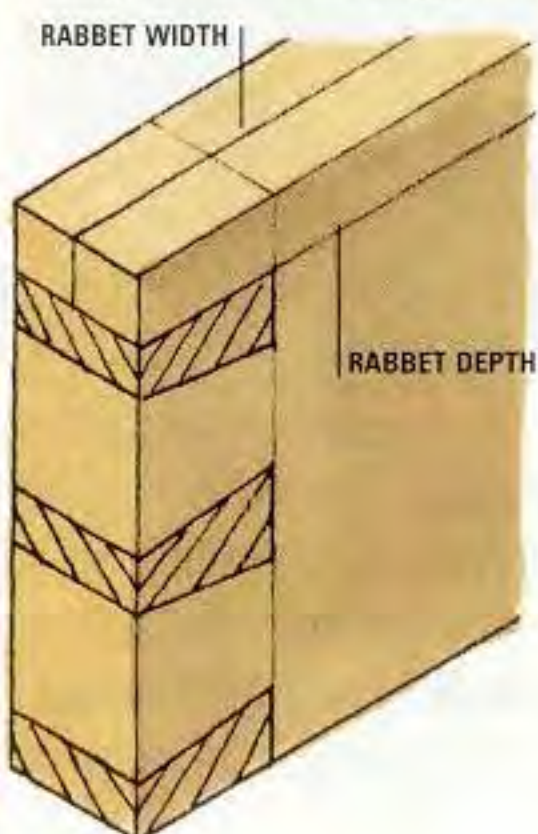
1 Scribing the rabbet depth

Mark the shoulder line for the joint on both sides and across the top edge of the tail member. Set a marking gauge to the depth of the rabbet and scribe a line along the inside of the same workpiece, then across its end and along to the shoulder line on the outside face. Scribe a similar line on the pin member, but only on the inside face.



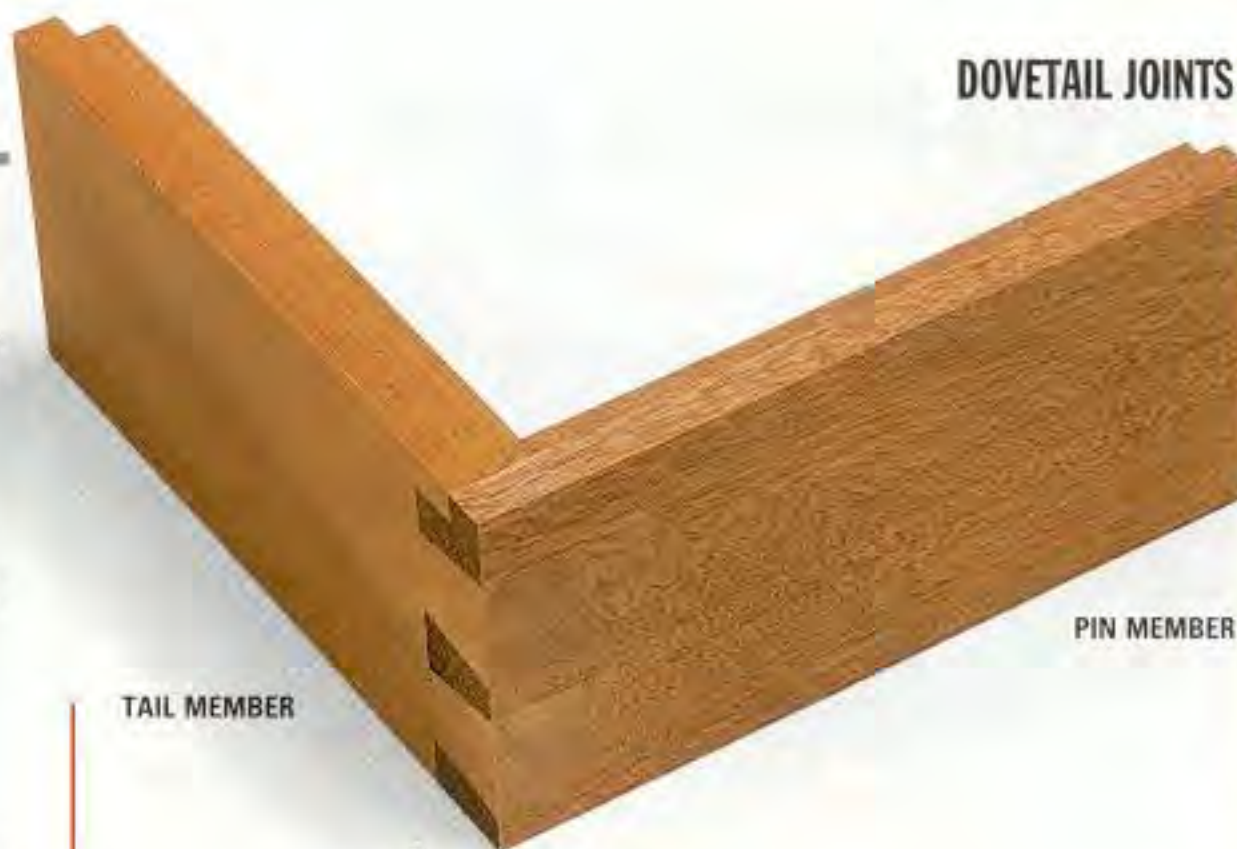
2 Marking the width of the rabbet

Reset the gauge and scribe the width of the rabbet along the bottom edge of both workpieces.



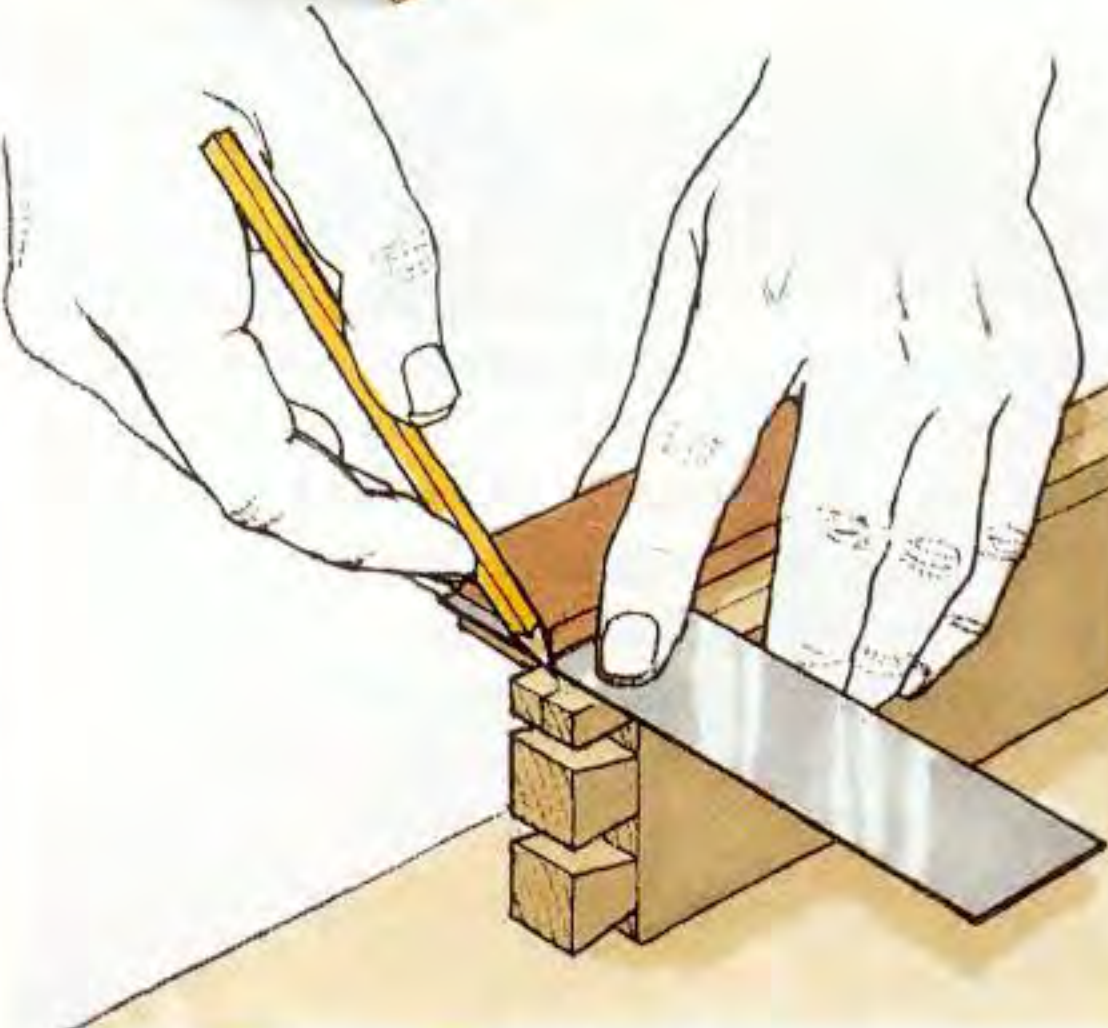
3 Marking and cutting the joint

Mark out the required number of equal-size tails, as described opposite, and cut them with a dovetail saw and chisel. Use the tail member as a template for marking out the pins, then cut that half of the joint.



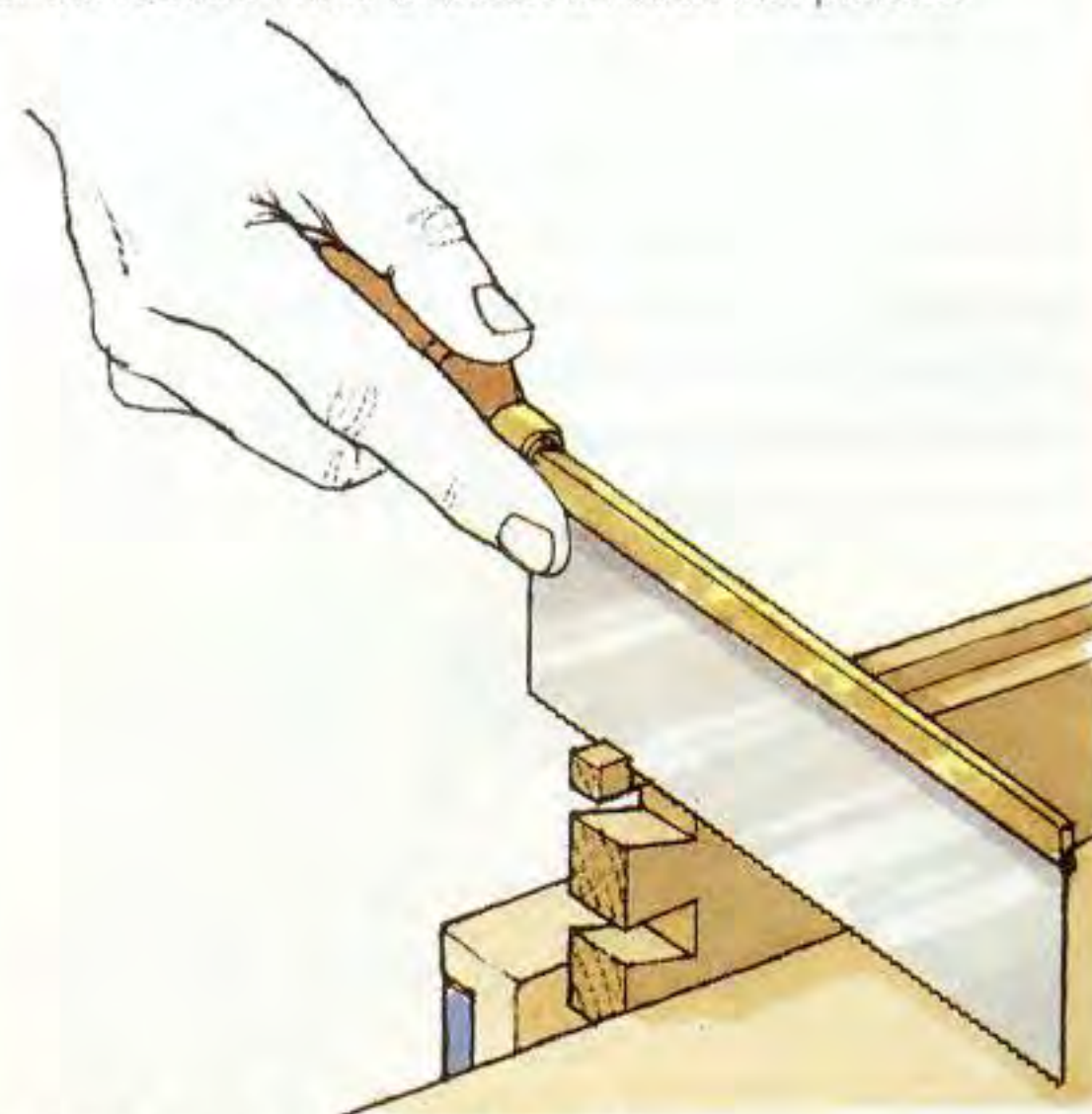
TAIL MEMBER

PIN MEMBER



4 Marking the extended shoulder

Mark the extended-shoulder line on the bottom edge of the tail member – the extension should equal the width of the rabbet. Plane a rabbet on each component.



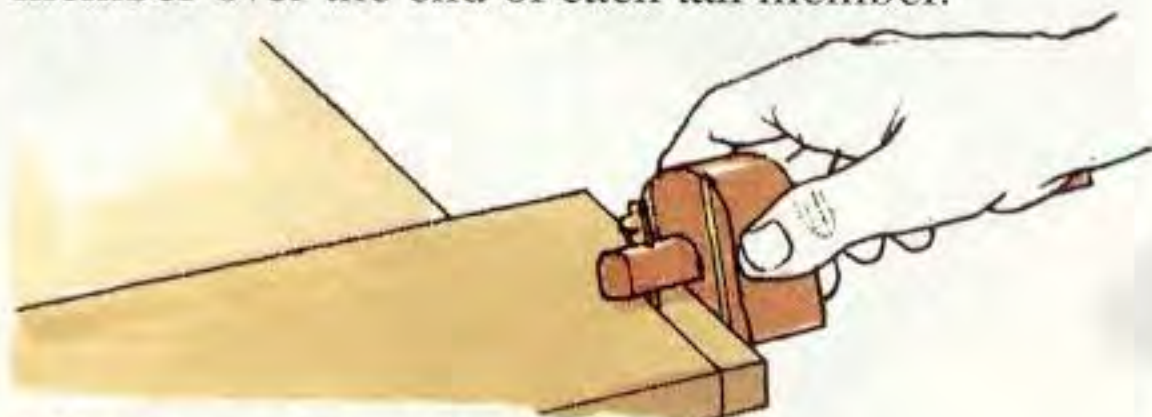
5 Cutting the extended shoulder

Use a dovetail saw to trim the waste back to the extended-shoulder line before assembling the joint.

LAPPED DOVETAIL JOINT

HAND CUT

In traditional drawer construction, it is standard practice to use through dovetails at the back corners while fitting the drawer front, using lapped dovetail joints that are invisible when the drawer is closed. This is achieved by lapping the pin member over the end of each tail member.



1 Marking and cutting the tails

Set a cutting gauge to the thickness of the pin member less the thickness of the lap, which should be at least 3mm ($\frac{1}{8}$ in). Use the gauge to scribe a shoulder line all round the tail member. Set out and cut the tails as described for a through dovetail (see pages 82-3).



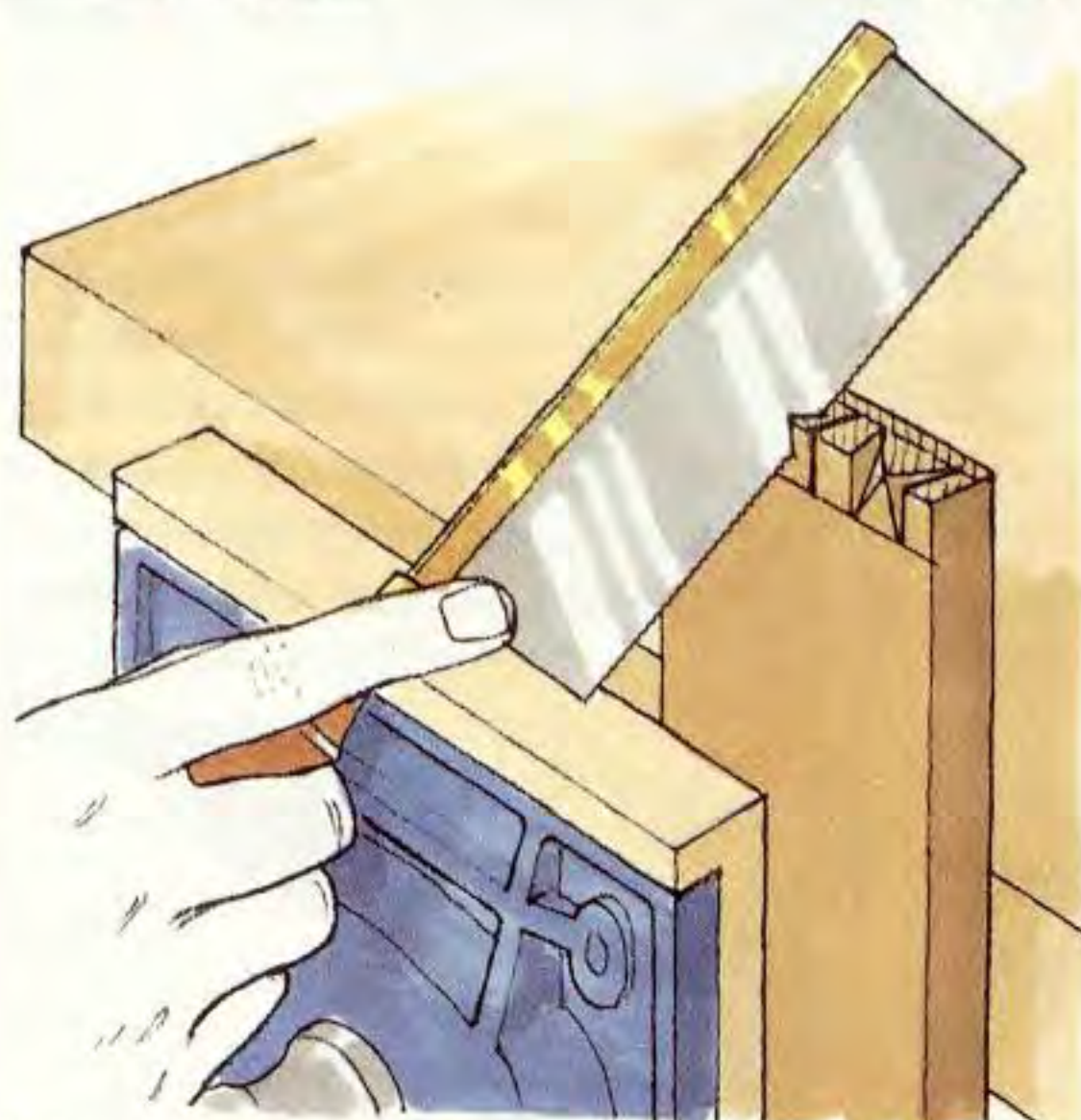
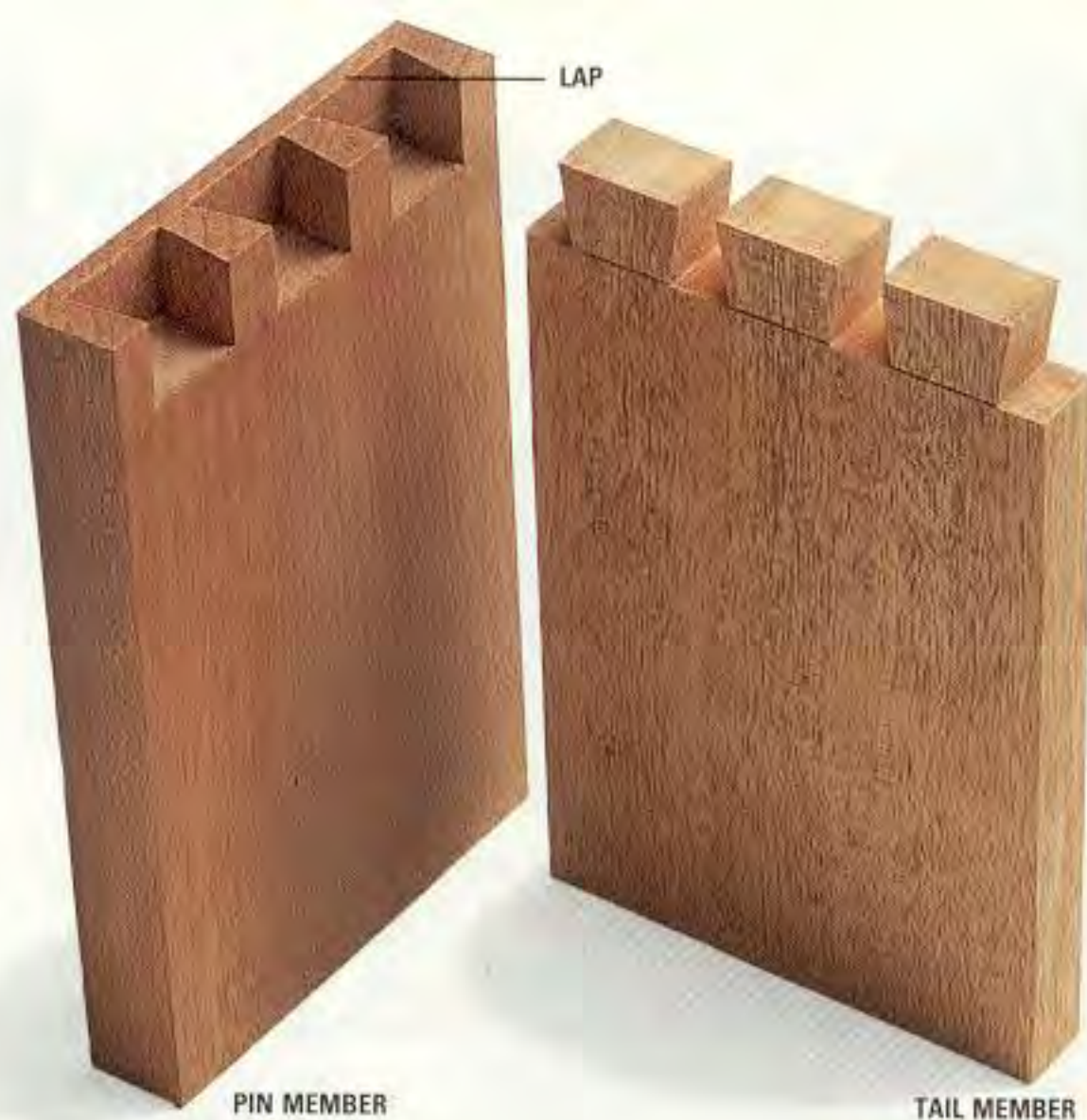
2 Marking the pins

Set a cutting gauge to the length of the tails and, working from the inside face of the pin member, scribe the lap line on the end grain. Reset the gauge to the thickness of the tail member and scribe the pin shoulder line across the inside face of the same workpiece. Chalk the end grain and, using the tails as a template, score the shape of the pins in the chalk. From these marks, square parallel lines on the inside face, down to the shoulder line.



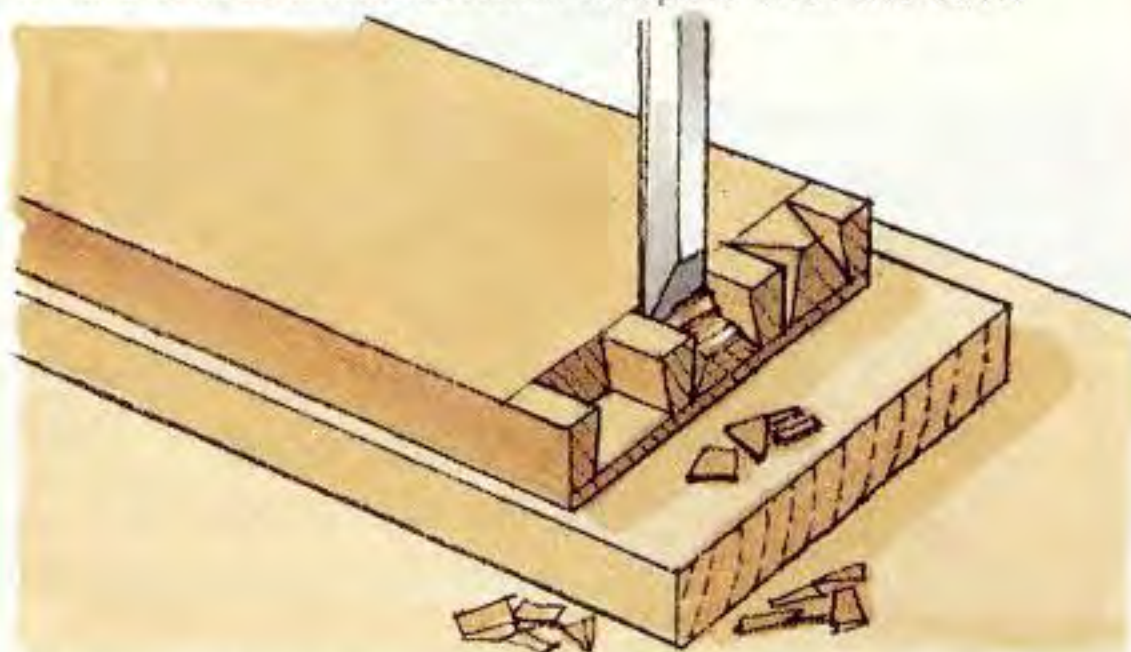
3 Cutting the pins

Clamp the work in a bench vice. Holding a dovetail saw at an angle, cut down on the waste side of each line, stopping at the lap and shoulder lines.



4 Sawing out the waste

Before you take the work out of the vice, remove some of the waste from between the pins with the saw.



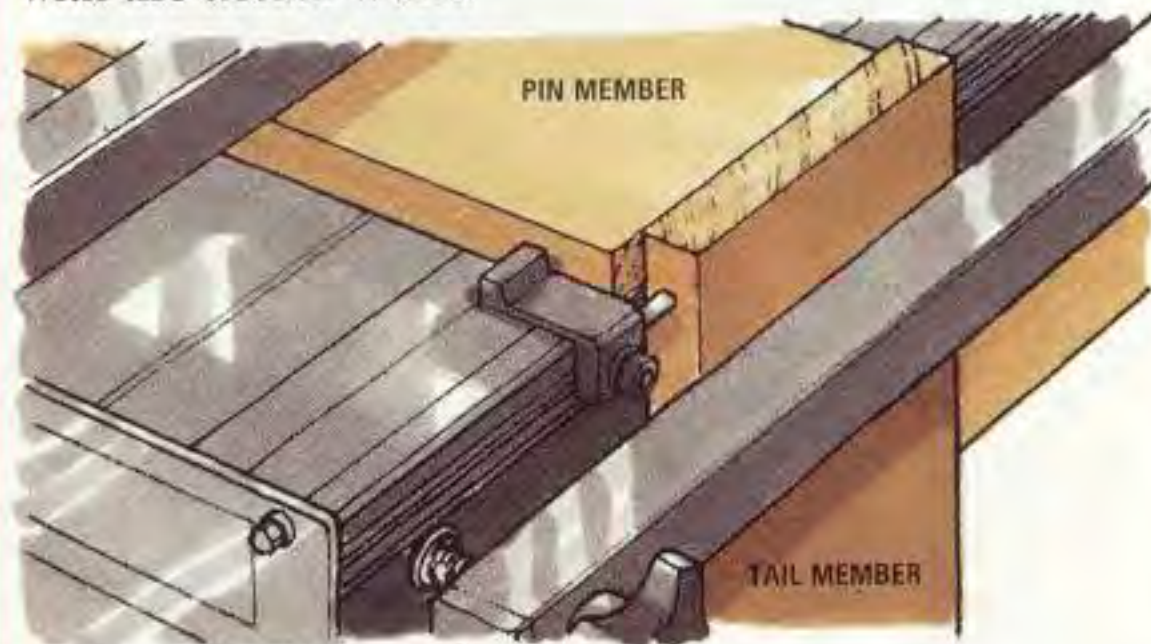
5 Paring down to the lines

Remove what is left of the waste by cutting back to the shoulder line and paring down to the lap line with a bevel-edge chisel. It pays to cut away the wood gradually, making alternate cuts, first across the grain, then parallel with it.

LAPPED DOVETAIL JOINT

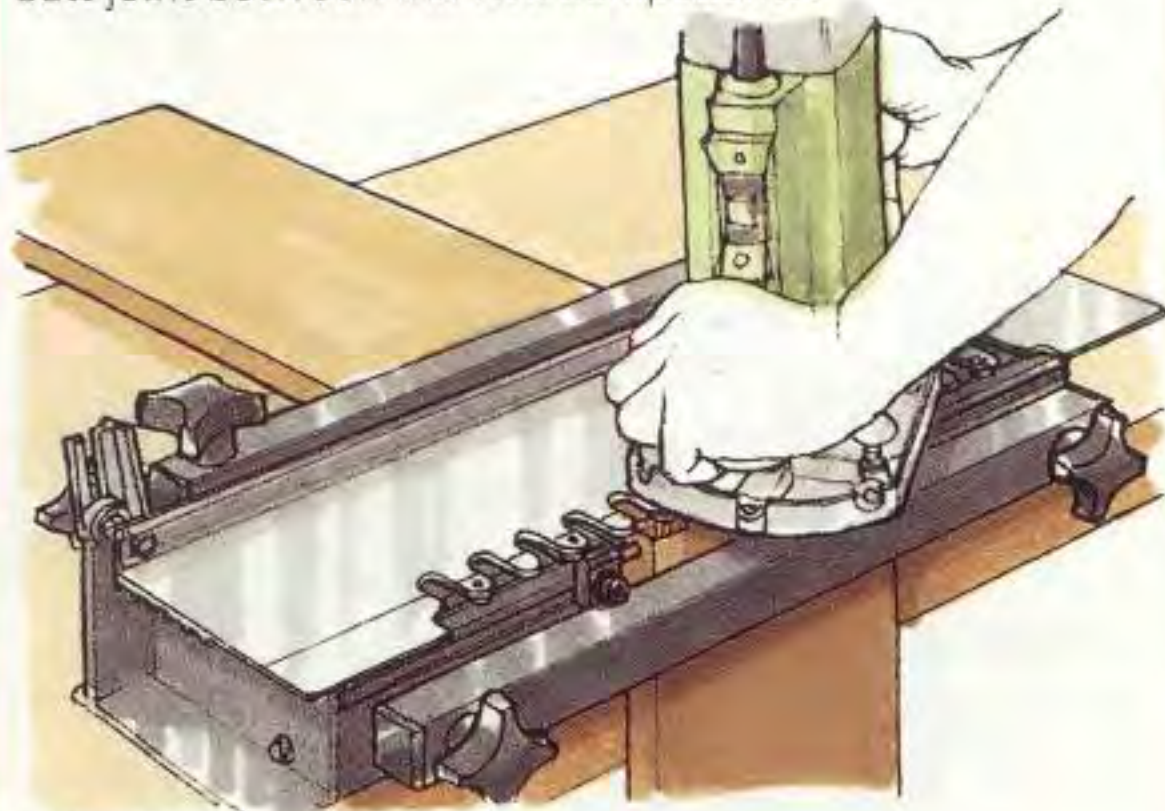
MACHINE CUT

A lapped dovetail joint can be cut with a hand-held power router, using a fixed-finger dovetail jig which enables both the pins and tails to be cut simultaneously. It is a relatively inexpensive jig that produces equal-size, regularly spaced pins and tails. The joint is perfectly functional, but it is necessary to design the width of the components to suit the finger spacing of the jig. Test the jig's settings by cutting test pieces before you proceed with the actual work.



1 Clamping the work

Mount the tail member vertically in the jig, face-side inwards, then insert the pin member (drawer front) face down, and butt its end grain against the tail member. Slide the pin member up to the jig's edge stop, then offset the tail member sideways by half the finger spacing. Now fit the finger template, which is marked with a 'sight line' that runs centrally down the row of fingers. Adjust it until the sight line corresponds to the butt joint between the two components.



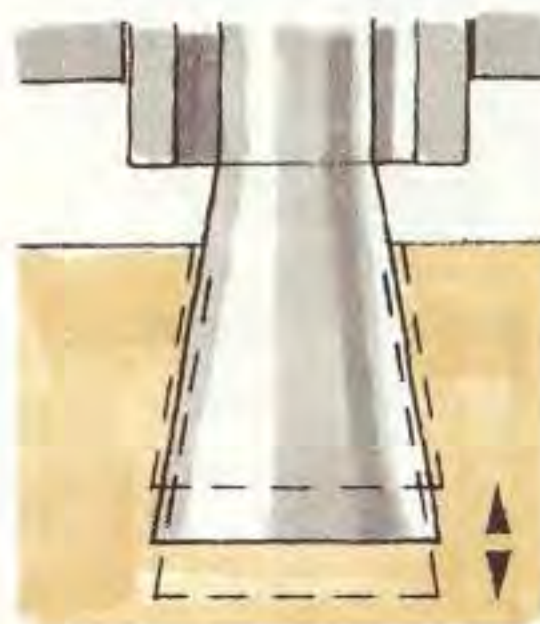
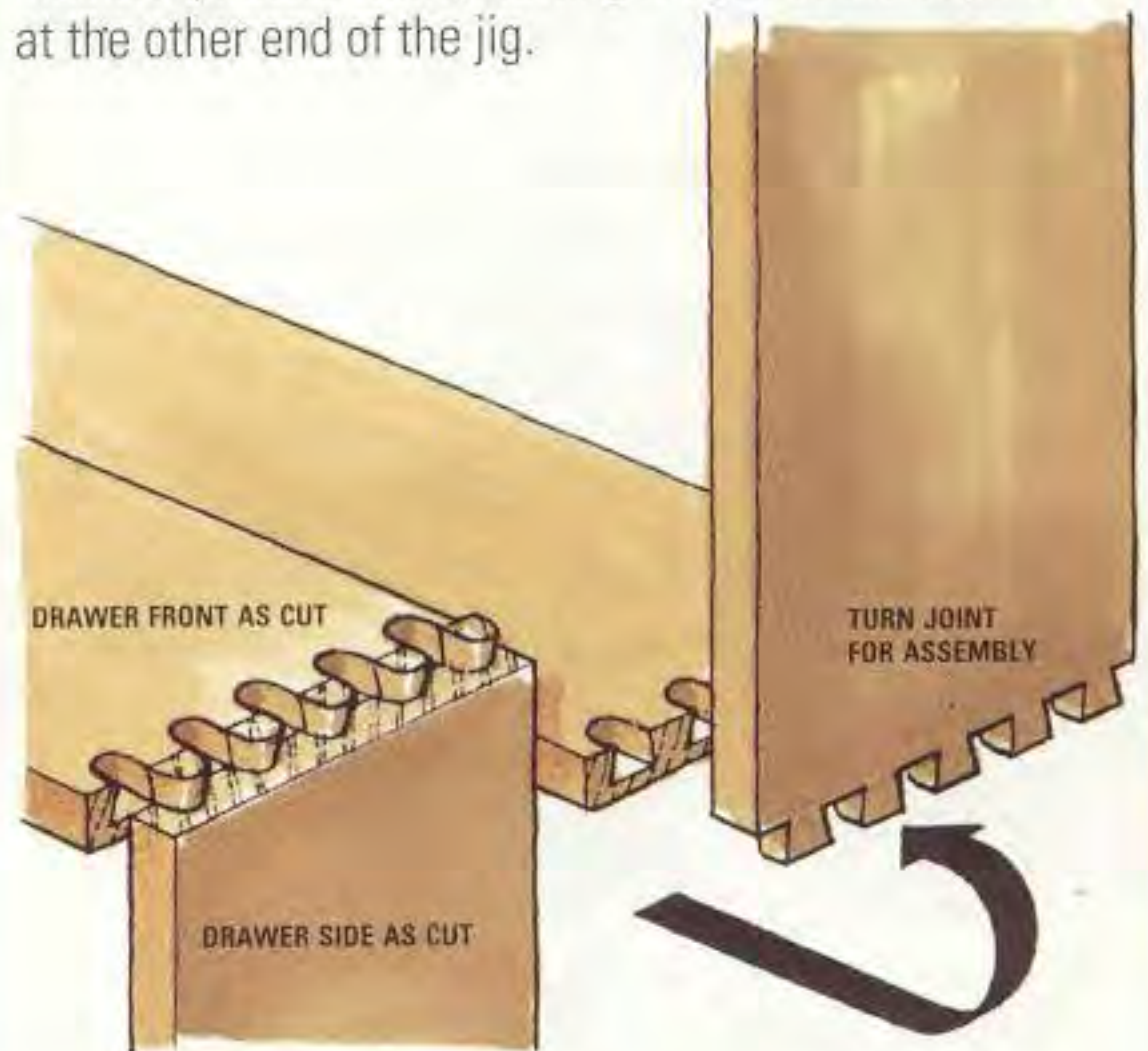
2 Cutting the joint

Prepare the router, fitting the guide bush and dovetail cutter recommended by the jig manufacturer. Working from left to right, feed the cutter between each pair of fingers, keeping the router level and following the template with the guide bush.



3 Assembling the joint

Unclamp the test pieces and rotate one of them through 180 degrees to mate their jointed ends. If the joint fits snugly, cut a similar joint for the other end of the pin member (drawer front), butting it against the edge stop at the other end of the jig.

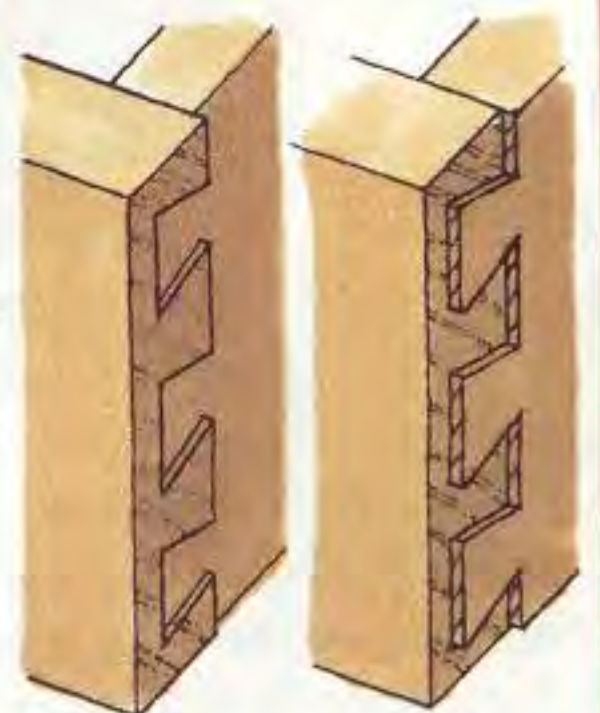


4 Adjusting the cut

If you find the joint is loose, increase the cutting depth of the router slightly. If the joint's too tight, raise the cutter.

5 Modifying sockets

If the sockets are too deep, adjust the finger template forward. If the tail member projects slightly, set the template backwards.



DOUBLE-LAPPED DOVETAIL

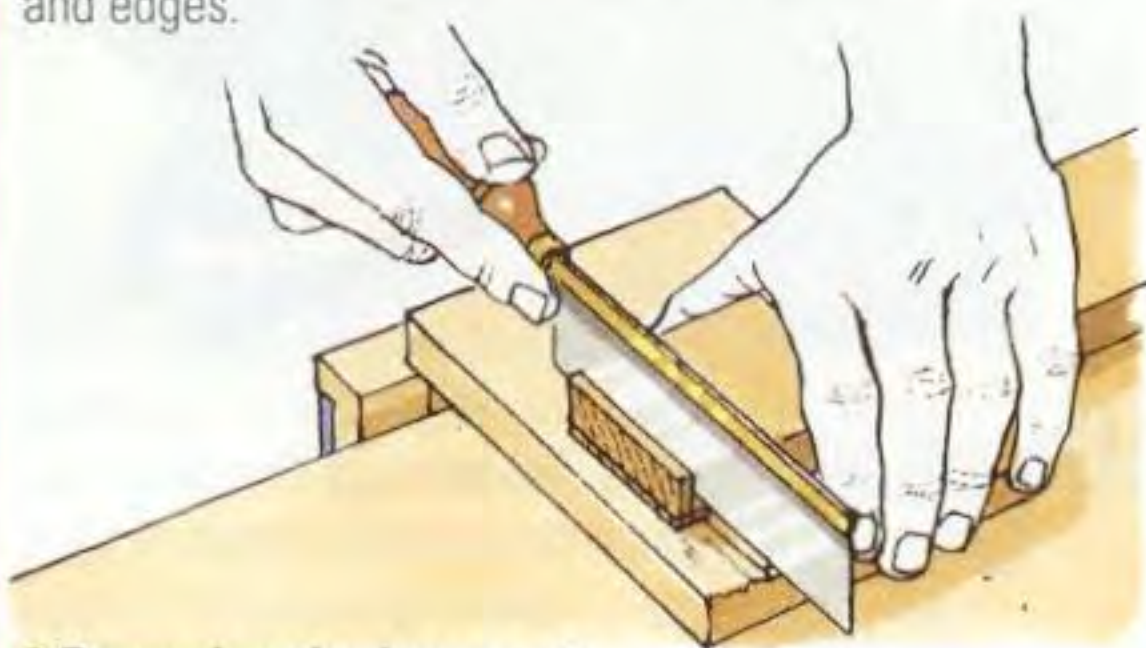
HAND CUT

Except for a narrow band of end grain, the double-lapped dovetail is virtually undetectable when the joint is assembled. It is used primarily for cabinet-making or box construction.



1 Marking the tail member

Set a cutting gauge to the thickness of the pin member and scribe the joint shoulder line on the inside face and edges of the tail member. Reset the gauge to the width of the double lap and, working from the outside face, scribe a line across the end grain and down to the shoulder line on both edges. Use the same setting to scribe the depth of the double lap on the inside face and edges.



2 Removing the lap waste

Cut the double lap on the end of the tail member, following the gauged lines with a dovetail saw.



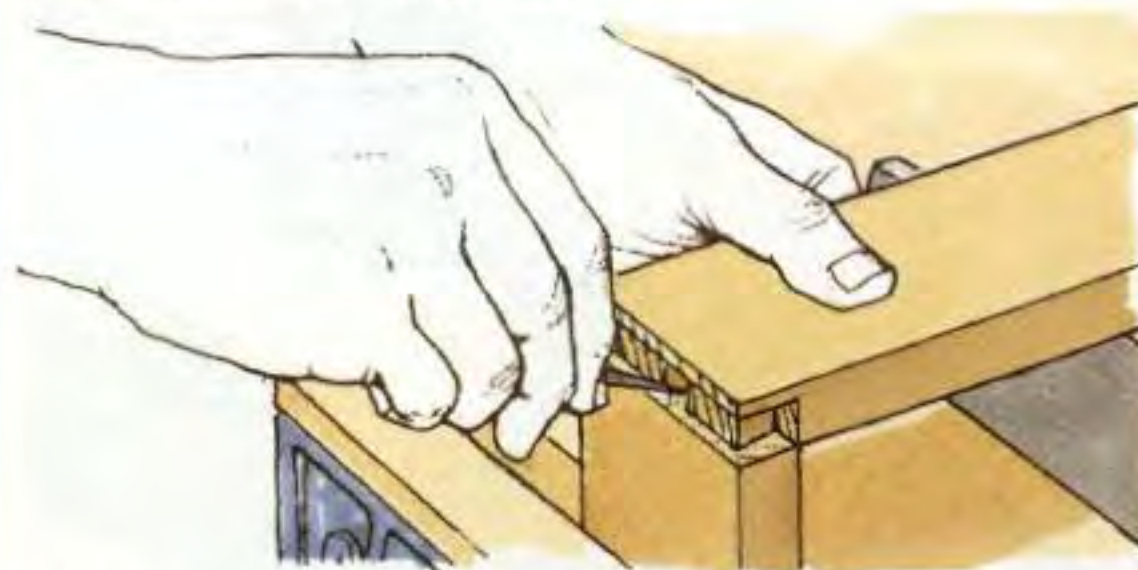
3 Trimming the lap

If necessary, trim the end grain and the inside of the double lap with a shoulder plane, to make sure both surfaces are flat and square.



4 Marking and cutting the tails

Mark out the tails with a dovetail template, and square their tips across the end grain. Saw and chisel out the waste as described for cutting the pins in a lapped dovetail joint (see page 90).



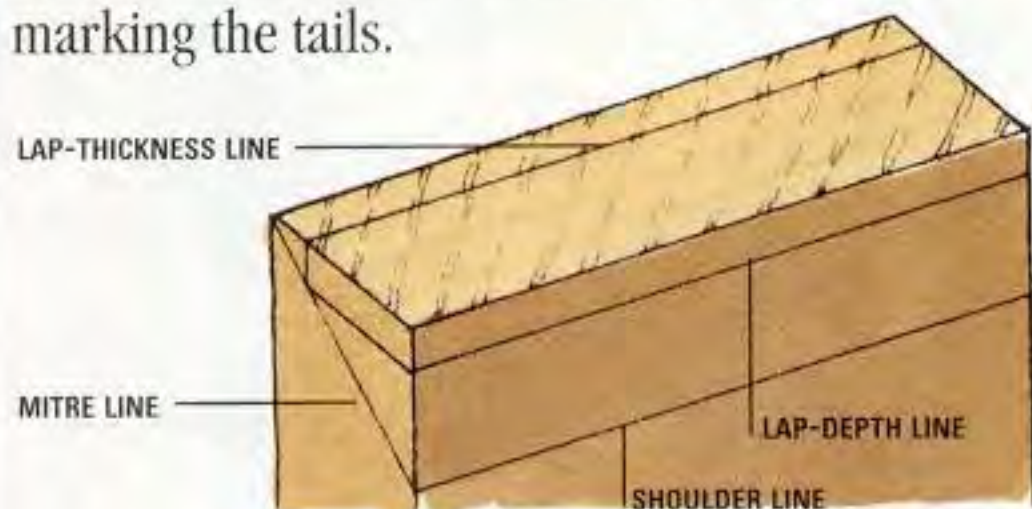
5 Marking and cutting the pins

Scribe the width of the lap on the end of the pin member. Reset the gauge to match the thickness of the tails only and mark the pin shoulder line across the inside face of the workpiece. Chalk the end grain and mark the shape of the pins, using the tails as a template. From these marks, square parallel lines down to the shoulder line on the inside face. Saw and chisel out the waste (see page 90).

MITRED DOVETAIL JOINT

HAND CUT

A mitred dovetail, which is typically used when both components are the same thickness, requires careful marking and cutting. Since it is entirely hidden, it is sometimes referred to as a secret mitred dovetail. Contrary to usual practice, cut the pins first and use them as a template for marking the tails.



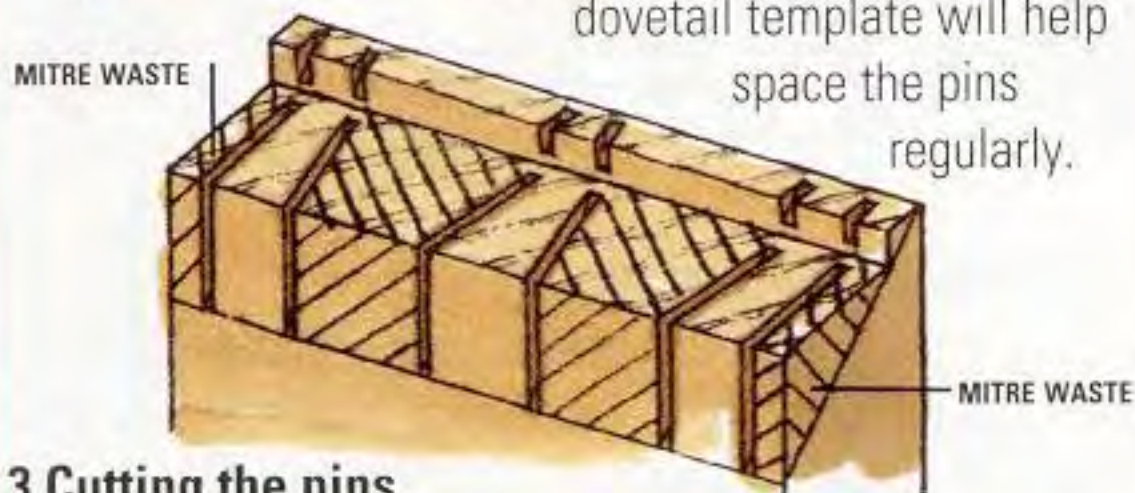
1 Marking guide lines

Set a cutting gauge to match the thickness of the wood, and scribe a shoulder line across the inside face of each component. Using a marking knife and mitre square, mark the mitre on both edges, running from the shoulder line to the outside corner. Reset the gauge to the thickness of the mitre lap and, working from the outside face, scribe a line across the end grain. Using the same setting, scribe the depth of the mitre lap on the inside face. Cut and trim the lap on each component (see opposite).



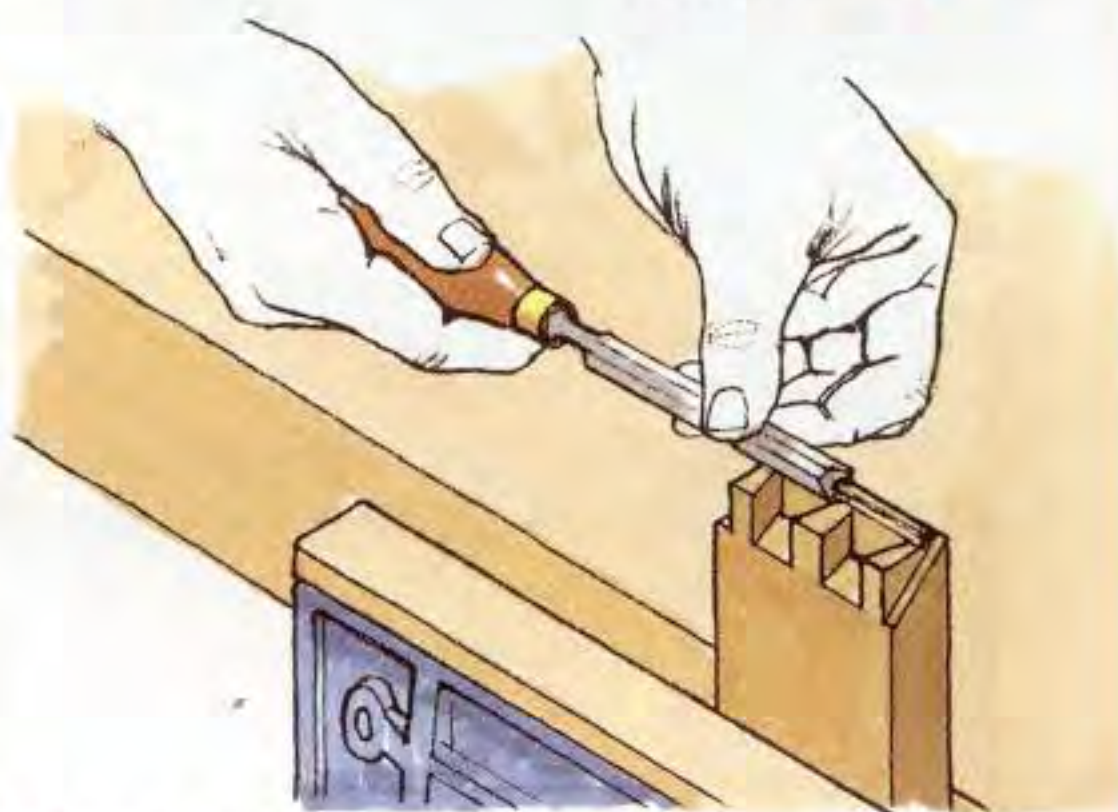
2 Marking the pins

Set a marking gauge to 6mm (1/4in) and scribe a line parallel with each edge of the work, running up from the shoulder line and across the end grain to the lap. Set out the pins between these lines. A home-made cardboard dovetail template will help space the pins regularly.



3 Cutting the pins

From the marks drawn on the end grain, square parallel lines down to the shoulder on the inside face. Saw and chisel out the waste between the pins (see page 90). Don't worry if you saw into the lap. Cut the mitre on each edge, following the marked line with a saw.



4 Bevelling the lap

Trim the lap to a mitred edge with a chisel, working from each end towards the middle. If necessary, finish with a shoulder plane.



5 Marking and cutting the tails

Lay the tail member flat on a bench. Holding the pin member on end, align its inside face with the shoulder line marked across the tail member. Scribe around the pins to mark the shape of the tails. Square parallel lines across the end grain to mark the tips of the tails. Cut the tails and mitres as described for the pins, and mitre the lap in the same way.

MOCK DOVETAIL JOINT

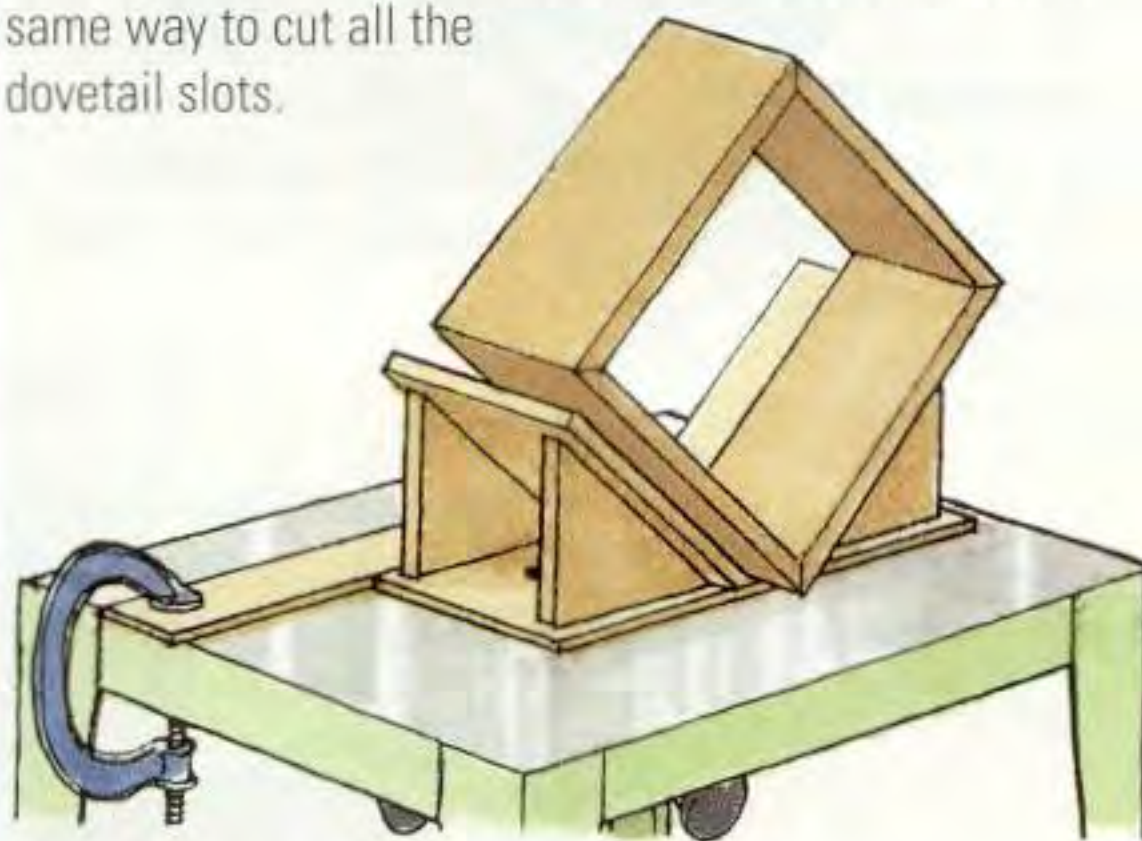
MACHINE CUT

The mock dovetail is a mitred butt joint reinforced with tapered splines that create a decorative corner effect similar in appearance to the end-grain pins of a conventional dovetail joint. The first step is to construct the box or carcass with a glued mitre joint at each corner (see pages 20–22).



Cutting the dovetails

Set up the fence and jig so that the dovetail cutter fits accurately in the slot in the cradle. Place the workpiece in the cradle, aligning one edge with the marked line, and feed the jig into the cutter to make the first slot. Move the work sideways, slipping the first slot over the locating strip, then make the next cut. Continue in the same way to cut all the dovetail slots.

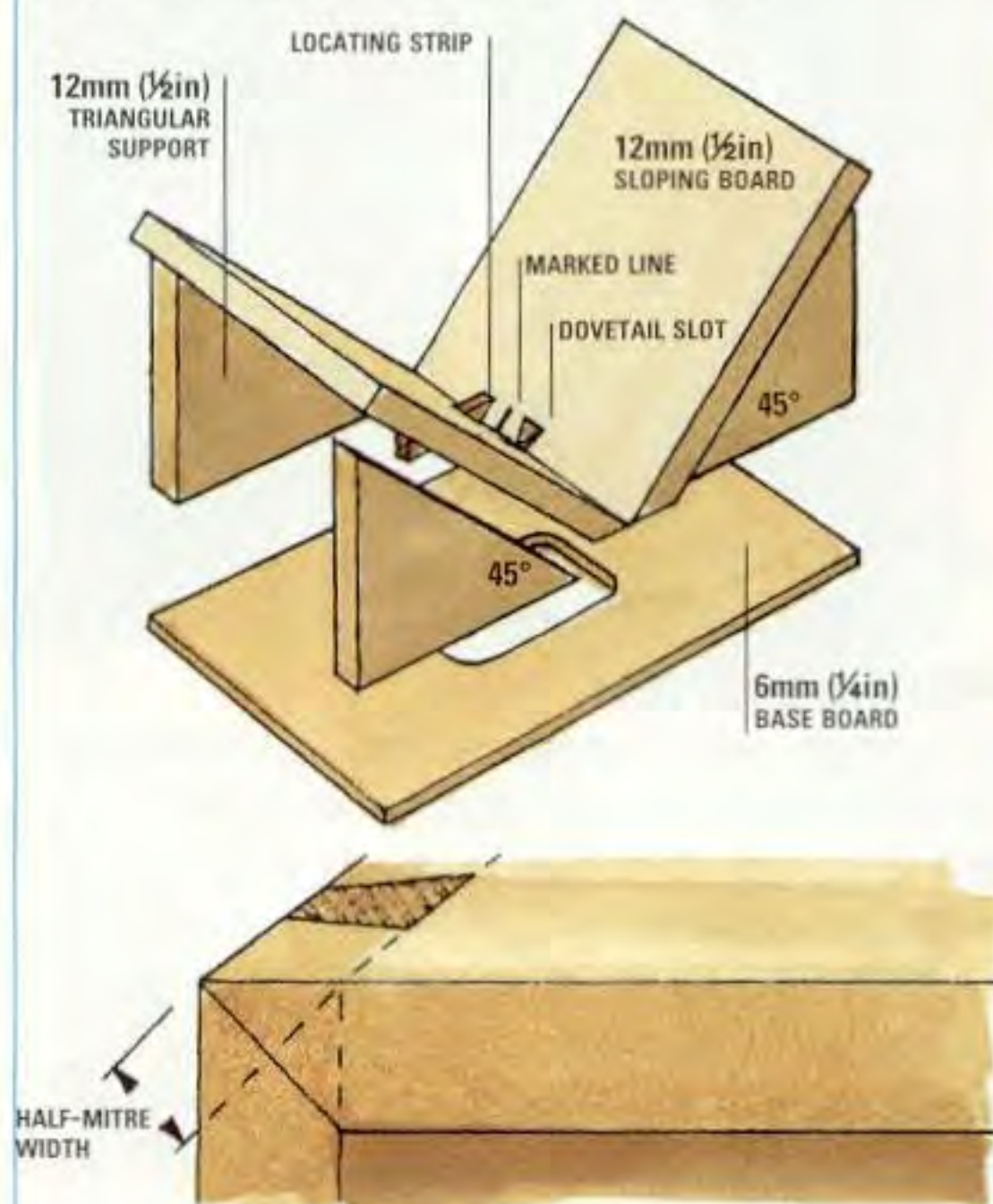


Making dovetail splines

Use the router to machine a strip of wood that fits snugly in the dovetail slots. Cut the strip into short lengths and glue one into each slot. When the glue sets, saw off the waste and plane the splines flush.

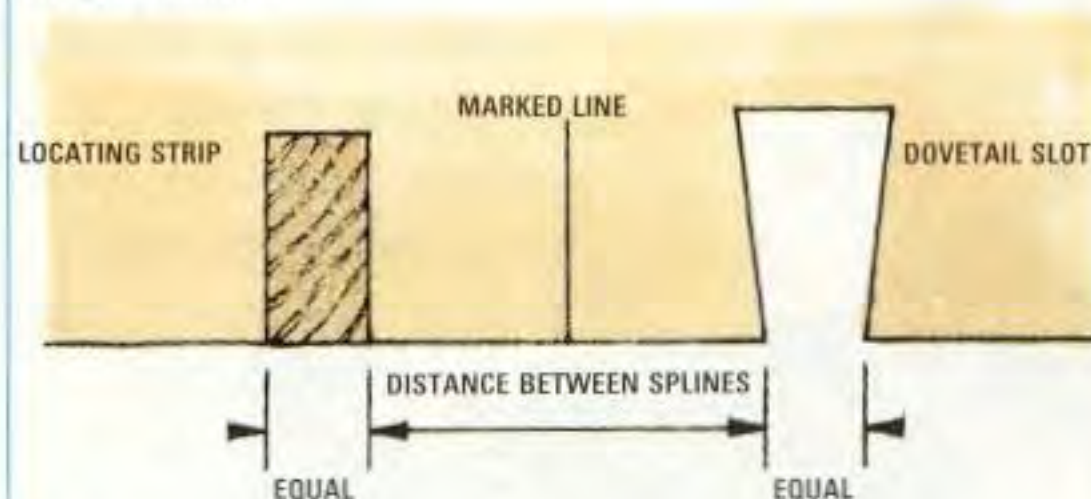
MAKING A CRADLE JIG

Construct a cradle from MDF to hold the assembled workpiece at 45 degrees to the router table. Machine a small rectangular opening in the base before you assemble the basic jig with glue. Set the router to cut a dovetail slot in the centre of the cradle.



1 Cutting the dovetail slot

Measure the width of the mitre used to construct the box or carcass, and set the depth of cut on the router to half that width, plus 6mm (1/4in) for the jig base. Running the jig along a 6mm (1/4in) thick fence clamped to the router table, machine a dovetail slot in the centre of the cradle.



2 Fitting the locating strip

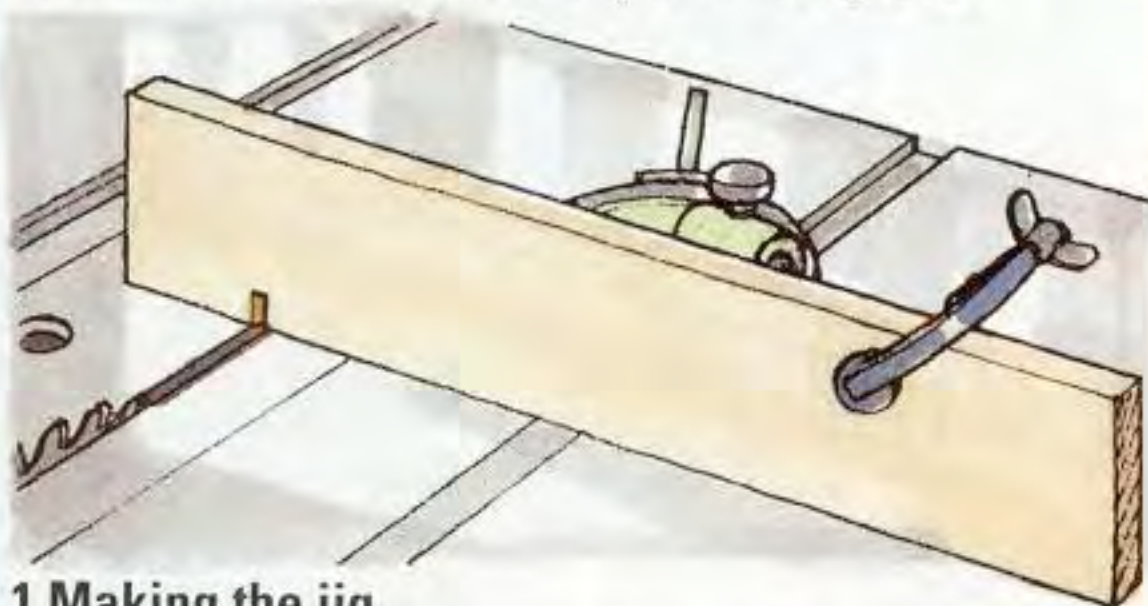
Select a straight cutter that matches the width of the dovetail slot at its base. Machine a straight slot to one side of the dovetail slot, with the distance between them equal to the required spacing of the splines. Glue a tight-fitting strip of wood into it. Mark a line centrally between the dovetail slot and the locating strip.

CHAPTER 11 The finger joint is a product of the machine age – it is perfectly feasible to cut one by hand, but this process is both tedious and time-consuming. A finger joint is a strong and decorative corner joint used for box construction and to make sliding trays and drawers for modern-style furniture.

FINGER JOINT

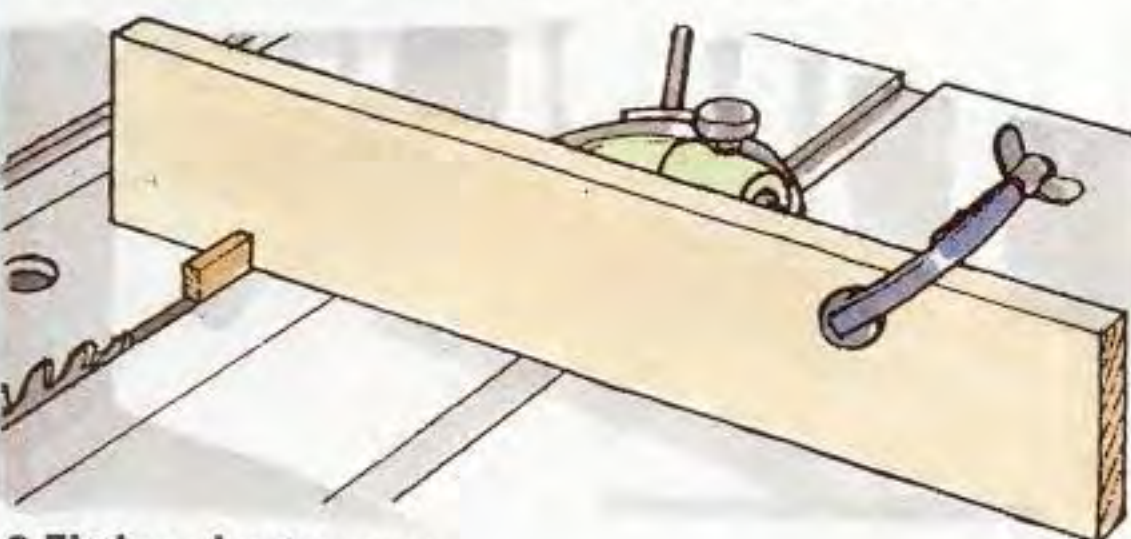
MACHINE CUT

Though it cannot compare with the production rate of a commercial spindle moulder, it is not too difficult to cut batches of finger joints on a table saw, using a simple jig. Use a blade that will cut a generous kerf between fingers or, for wider spacing, use wobble washers, where the cutting edge moves from side to side with each revolution. The exact size and spacing of fingers will be determined by the width of your workpiece.



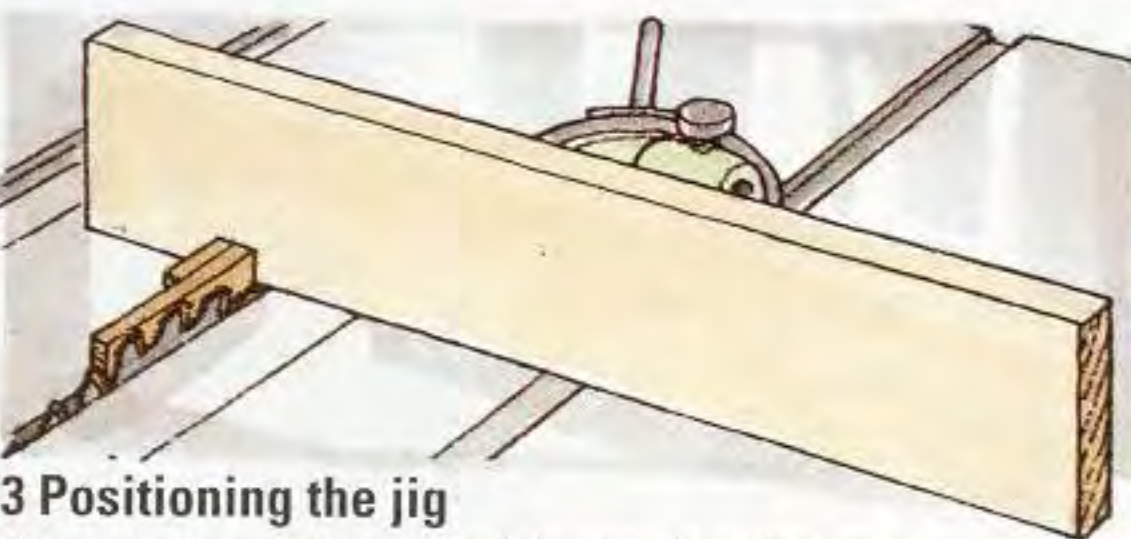
1 Making the jig

Clamp a length of wood or MDF to the saw's sliding mitre fence. Adjust the blade height to just over the thickness of the intended workpiece, then make one cut to leave a finger-width slot in the clamped board.



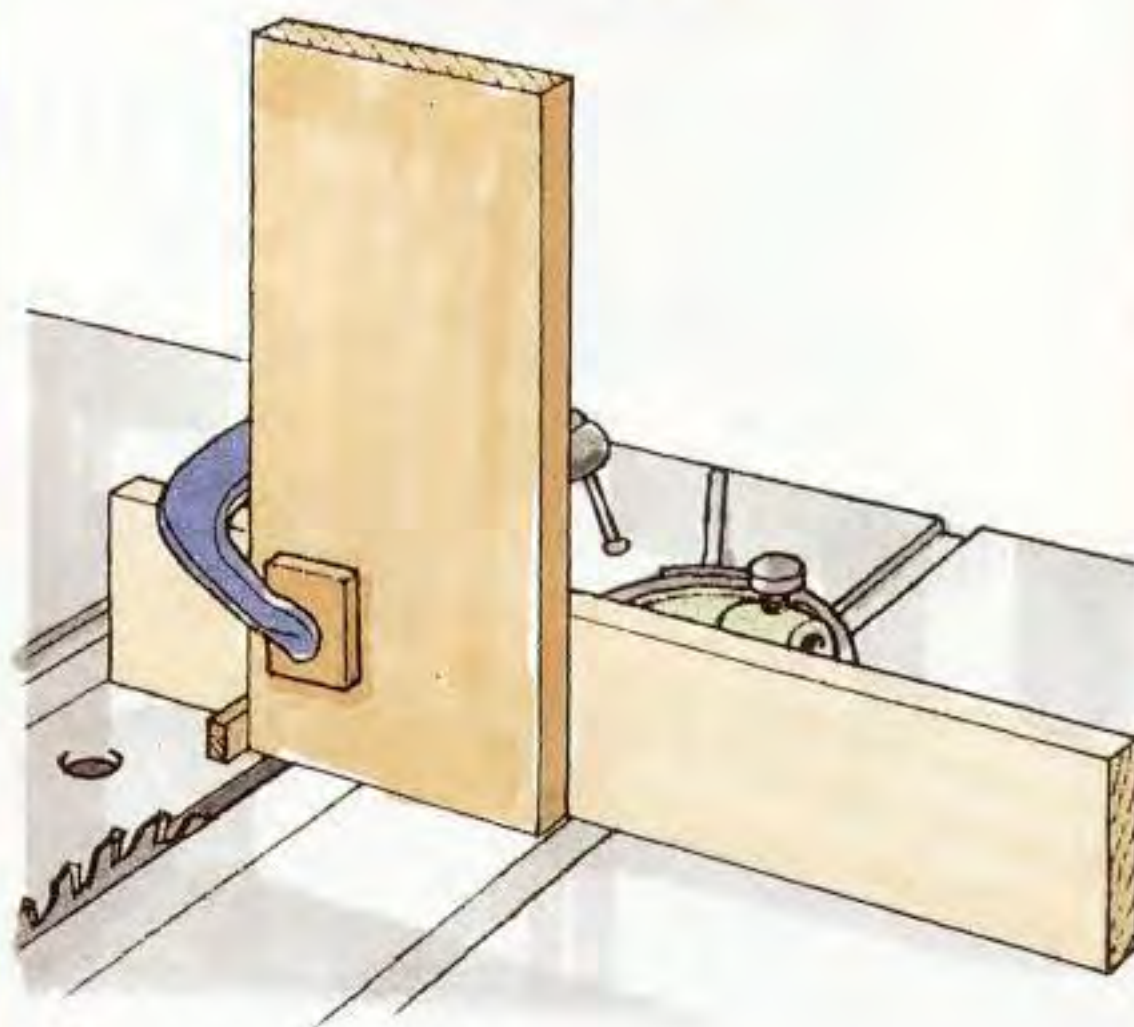
2 Fitting the tongue

Plane a length of hardwood to make a snug fit in the slot. Cut off a short strip and glue it into the slot, forming a tongue that projects about 38mm (1½in) from the face of the board.



3 Positioning the jig

Remove the clamp and slide the jig sideways, sandwiching the offcut from the planed strip between the tongue and saw blade. Clamp or screw the board securely to the fence, and remove the loose strip.



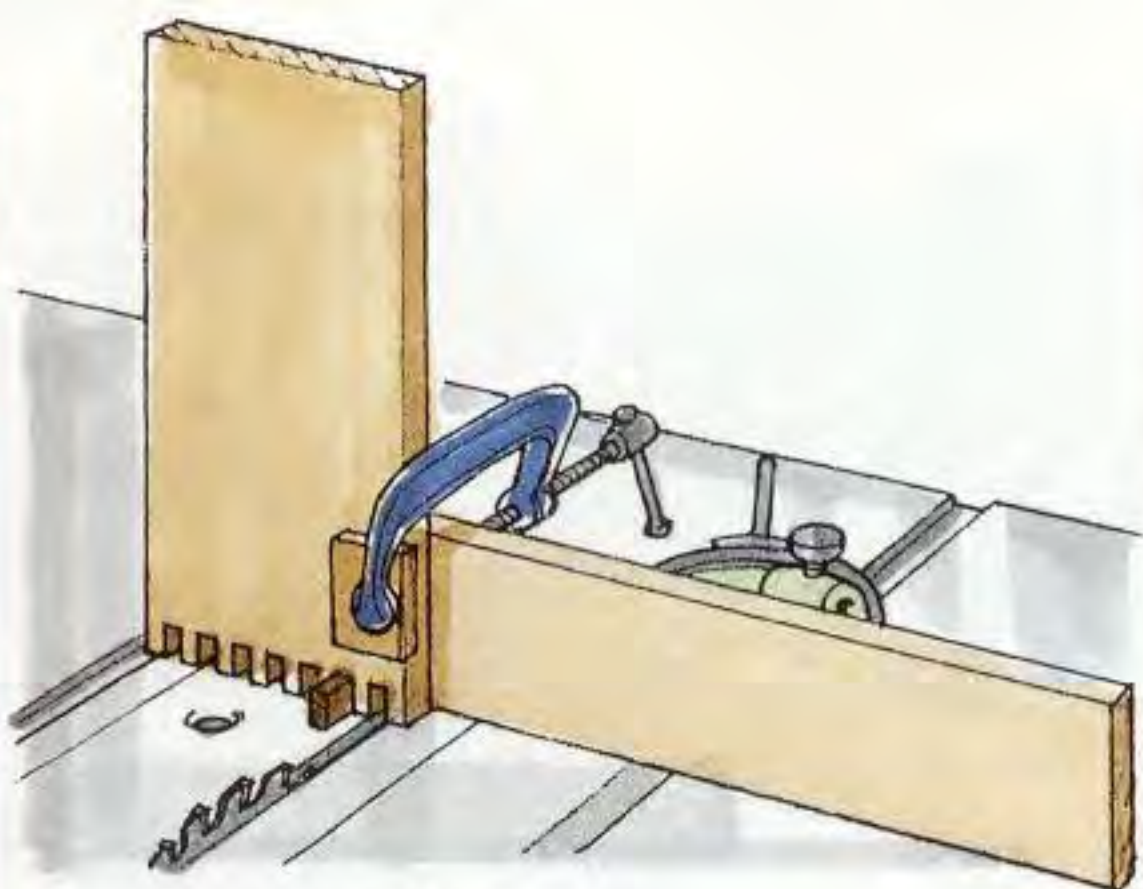
1 Clamping the work

Stand the work on end and butt it against the projecting tongue. Hold it in place with a G-clamp. Although only one workpiece is shown here, you can clamp a number of pieces together and cut them simultaneously.



2 Cutting and locating the work

Feed the work into the blade to cut the first slot, then unclamp the work and fit the slot over the tongue. Replace the clamp and cut the next slot.



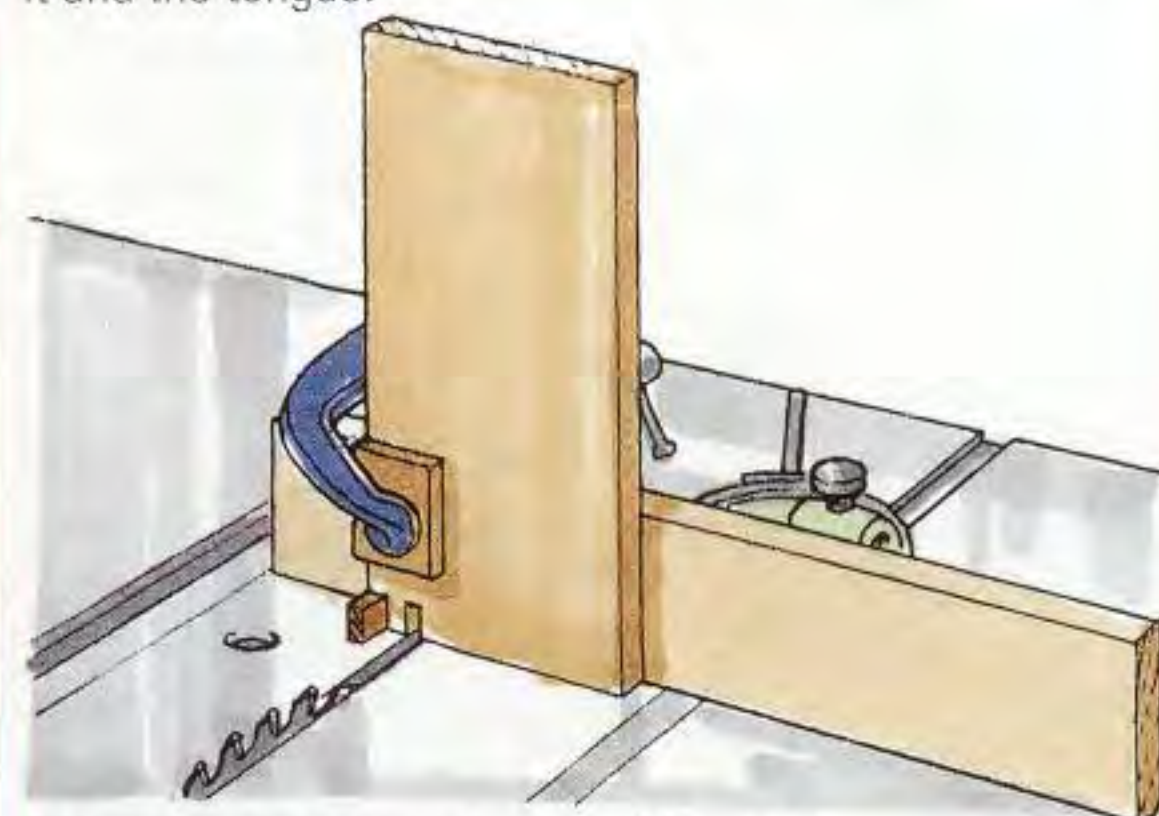
3 Cutting a row of fingers

Continue in the same way until you have completed the row of fingers. To cut a similar joint at the other end of the workpiece, turn it end-for-end, butting the same edge against the tongue, and repeat the sequence.



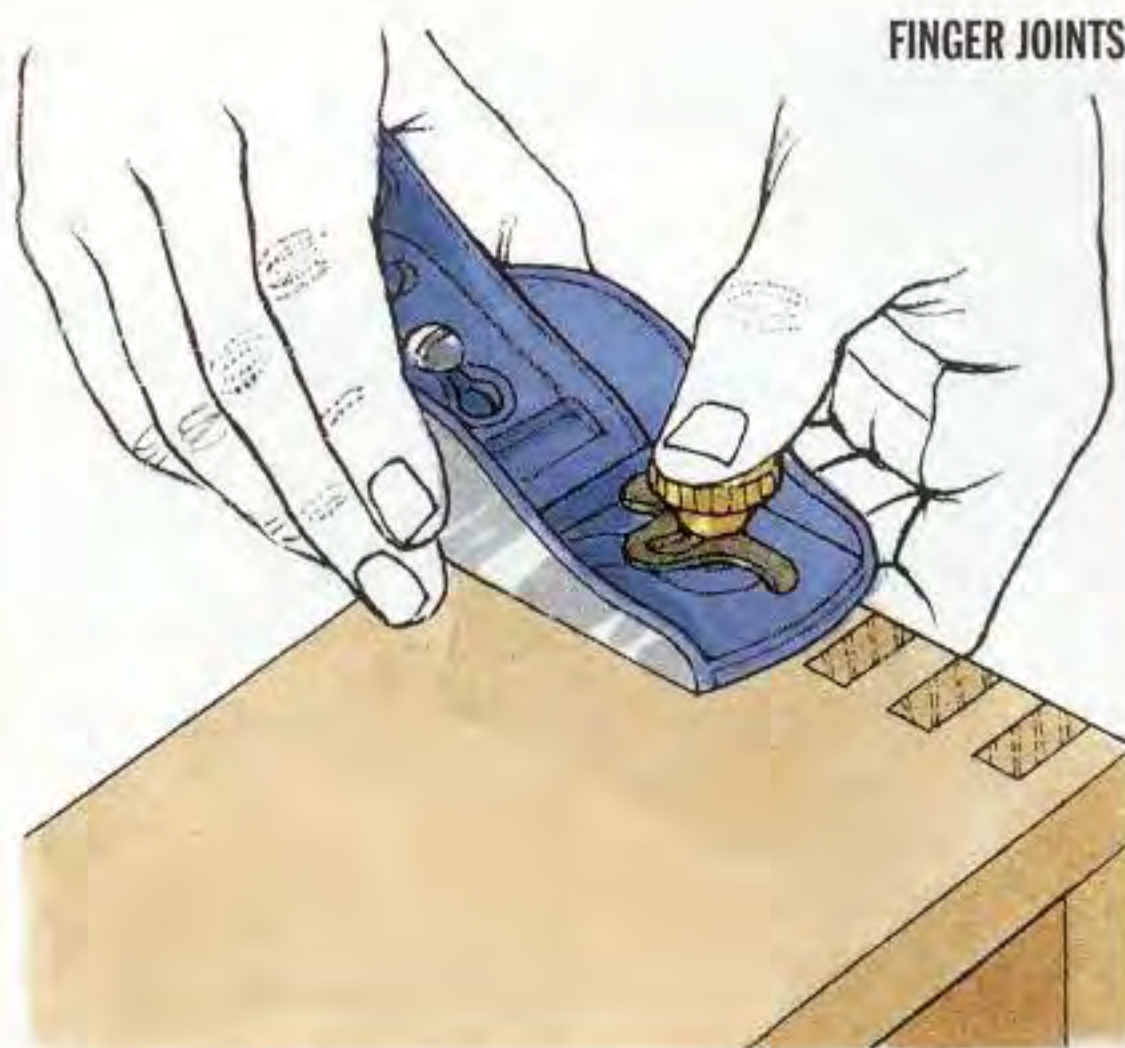
4 Clamping the other half of the joint

The row of fingers in the second component is offset to fit between the fingers you have just cut. Clamp the work as before, but sandwich the offcut strip between it and the tongue.



5 Cutting the second row of fingers

Remove the loose strip and saw a notch in the edge of the work. Remove the clamp, slide the work to locate the notch over the tongue, and clamp it again. Cut a row of fingers as described above, finishing with another notch at the far edge. Flip the work over to cut the other end.



6 Planing the fingers flush

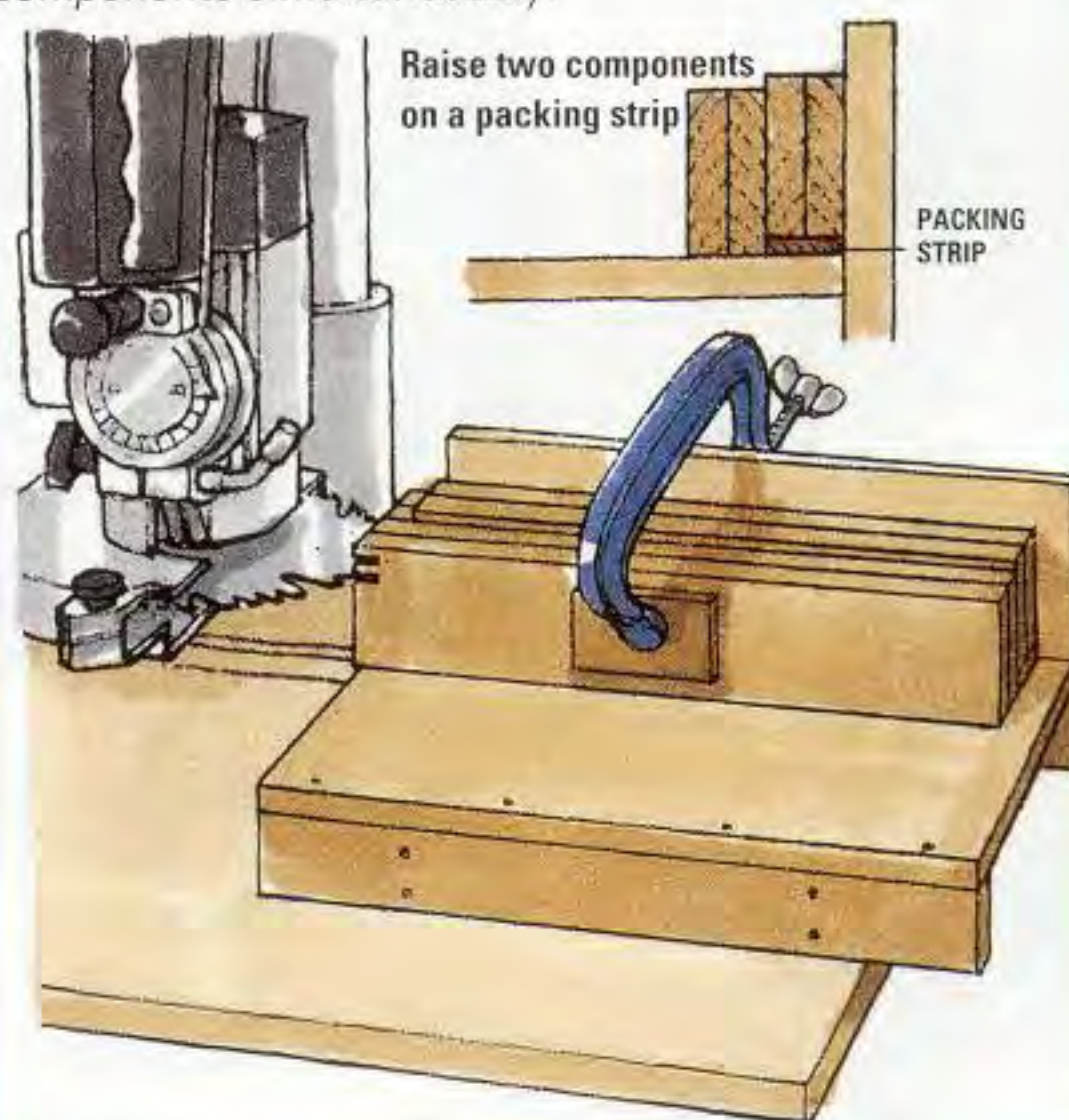
Assemble the joints and, when the glue has set, plane flush the ends of the slightly projecting fingers.

CUTTING FINGER JOINTS ON A RADIAL-ARM SAW

To cut finger joints on a radial-arm saw, rotate the mounting to set the blade in a horizontal plane. To support the work, replace the saw's main guide fence with a small raised table and fence made from MDF.

Clamp four workpieces together on the raised table, with their ends projecting by the required depth of cut. To offset the fingers for one half of each joint, raise two of the components on a packing strip that equals the width of the saw cut.

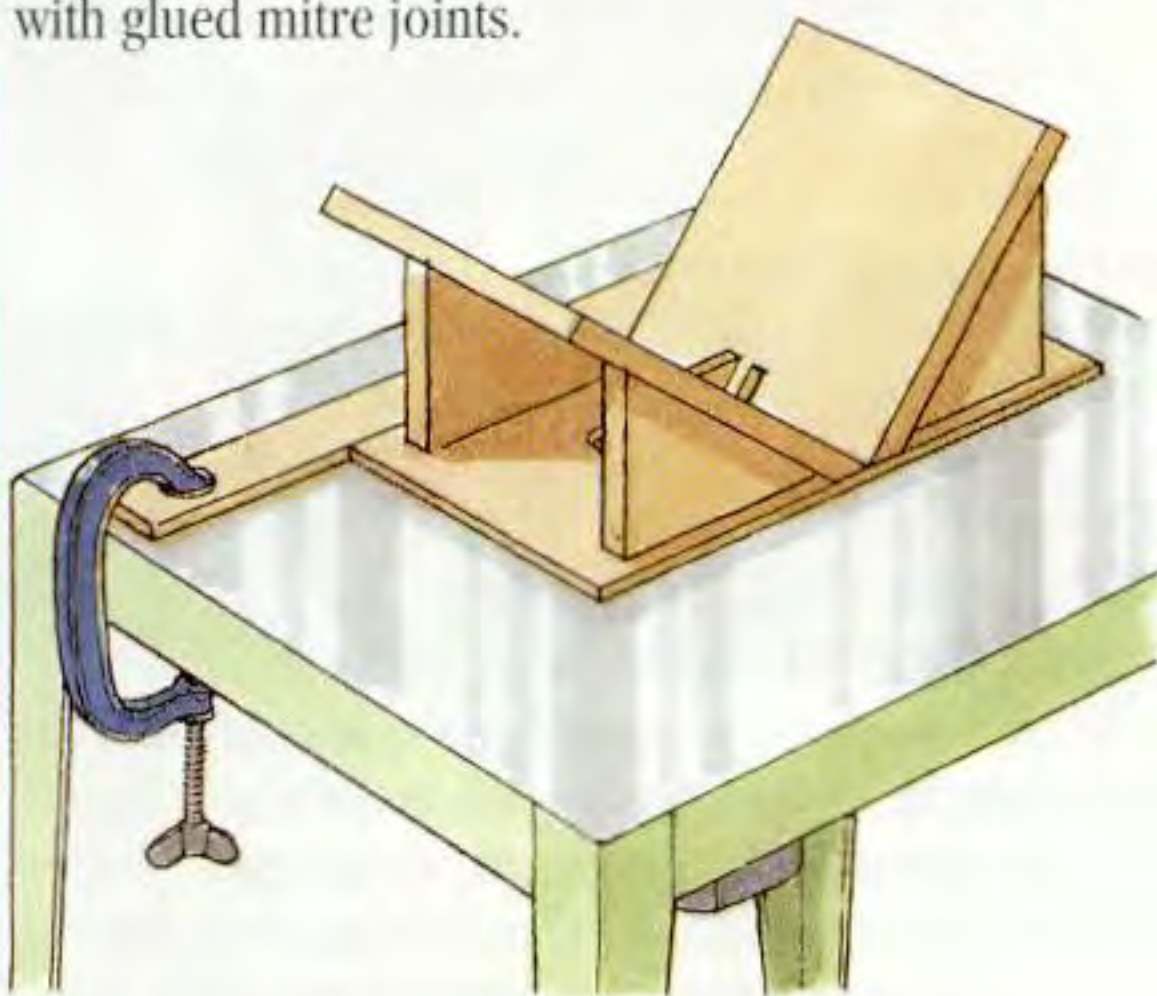
Begin by adjusting the blade to cut open notches in the raised workpieces, then lower the blade in stages to cut equally spaced fingers on all four components simultaneously.



MOCK FINGER JOINT

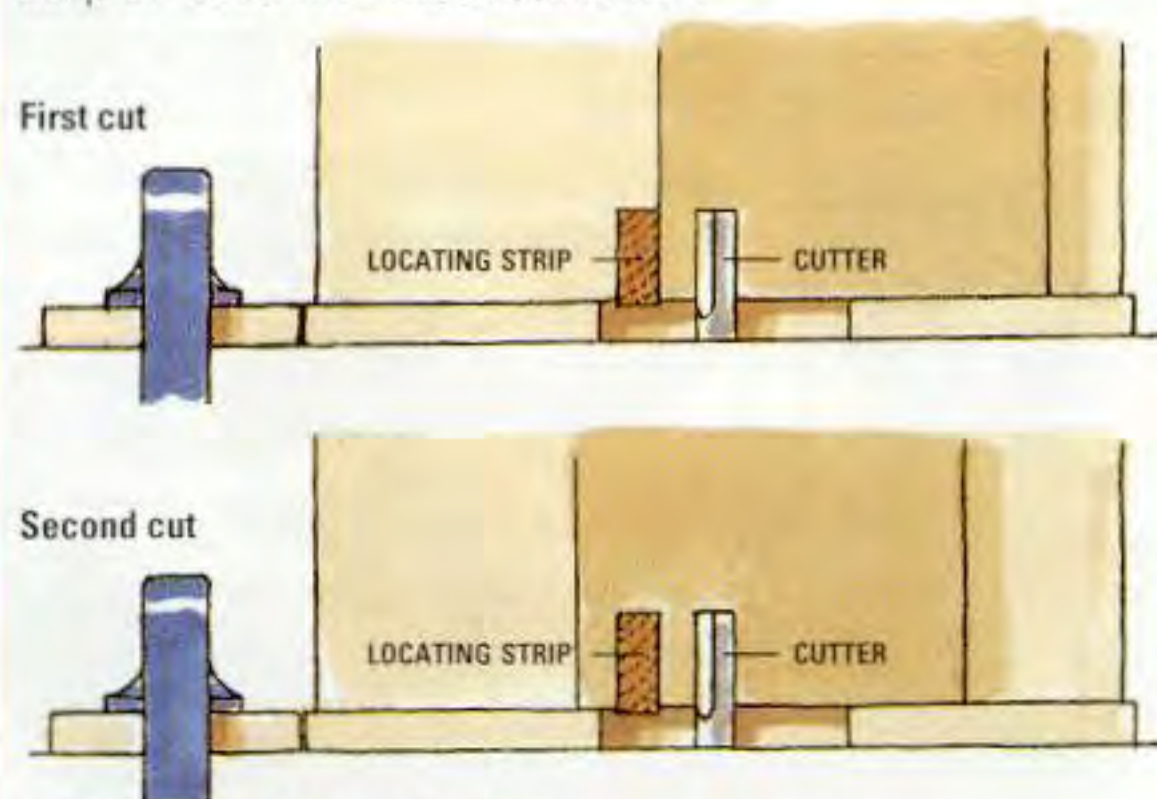
MACHINE CUT

At first sight, the mock finger joint looks identical to the genuine article; on closer inspection, however, you notice the fingers are not staggered. It is actually a mitre joint with 6mm ($\frac{1}{4}$ in) reinforcing splines planed flush. It can be cut with a power router or on a table saw. Whichever method you adopt, first construct the workpiece with glued mitre joints.



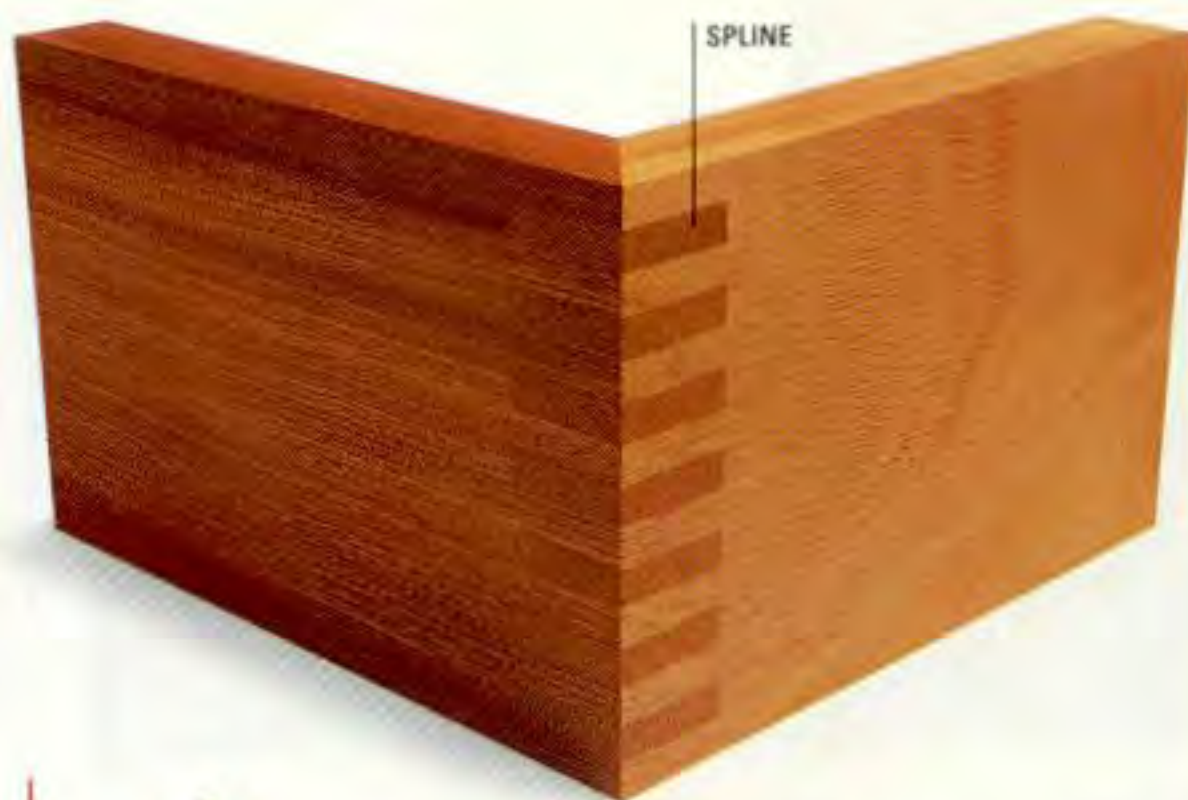
Making a router jig

Make a cradle jig as described for a mock dovetail (see page 94), but rout a straight 6mm ($\frac{1}{4}$ in) wide slot in the centre of the cradle and another identical slot for the locating strip 6mm ($\frac{1}{4}$ in) to one side. Glue a snug-fitting strip of wood into the second slot.



1 Slotting the workpiece

Place the assembled workpiece in the cradle, with one edge butted against the locating strip. Feed the work into the router cutter to machine the first slot. Place the slot over the locating strip to reposition the workpiece for cutting the next slot. Continue in a similar way until you have machined the row of slots.



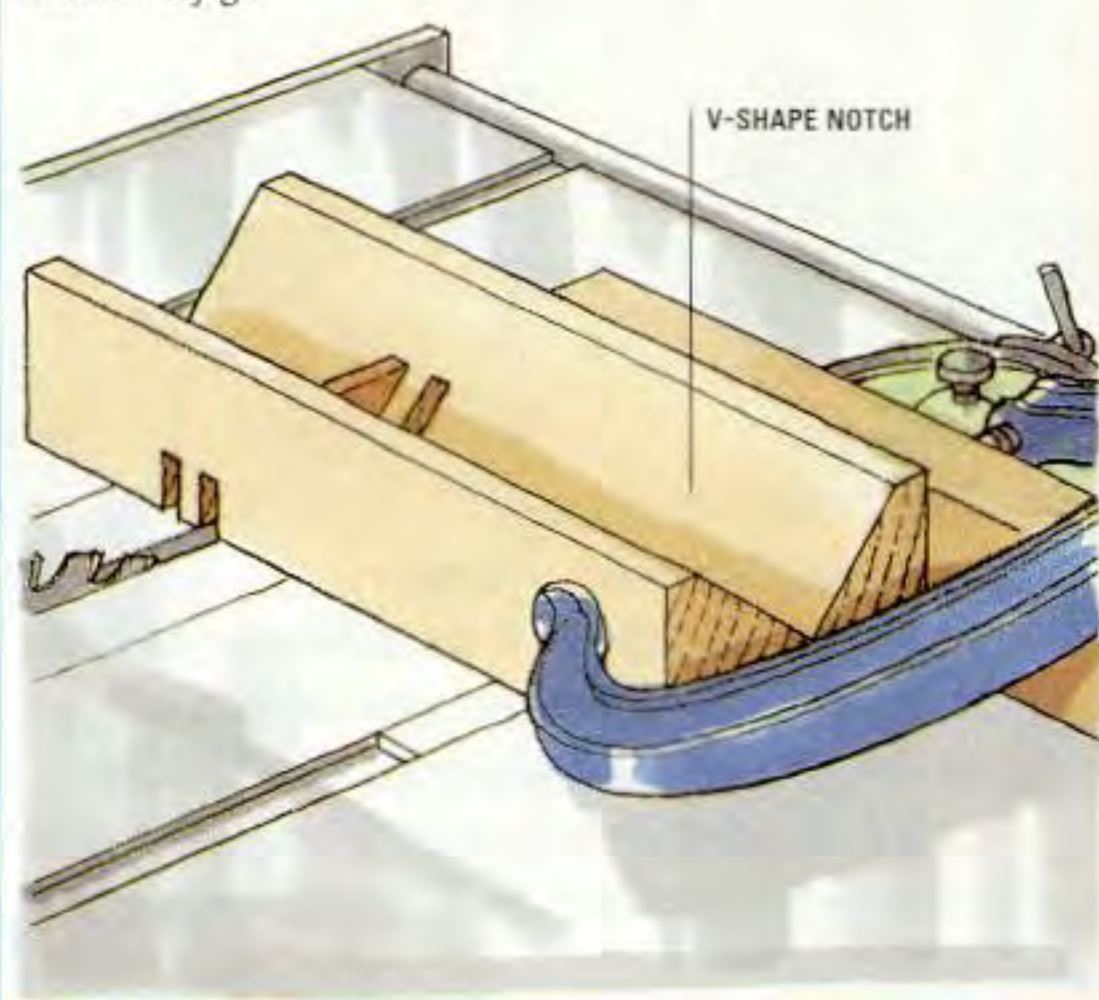
2 Fitting the splines

Plane a strip of wood to be a snug fit in the slots and cut it into 90-degree triangles to make slightly oversize splines. Glue them in place and, when the adhesive has set, plane them flush.

USING A TABLE SAW

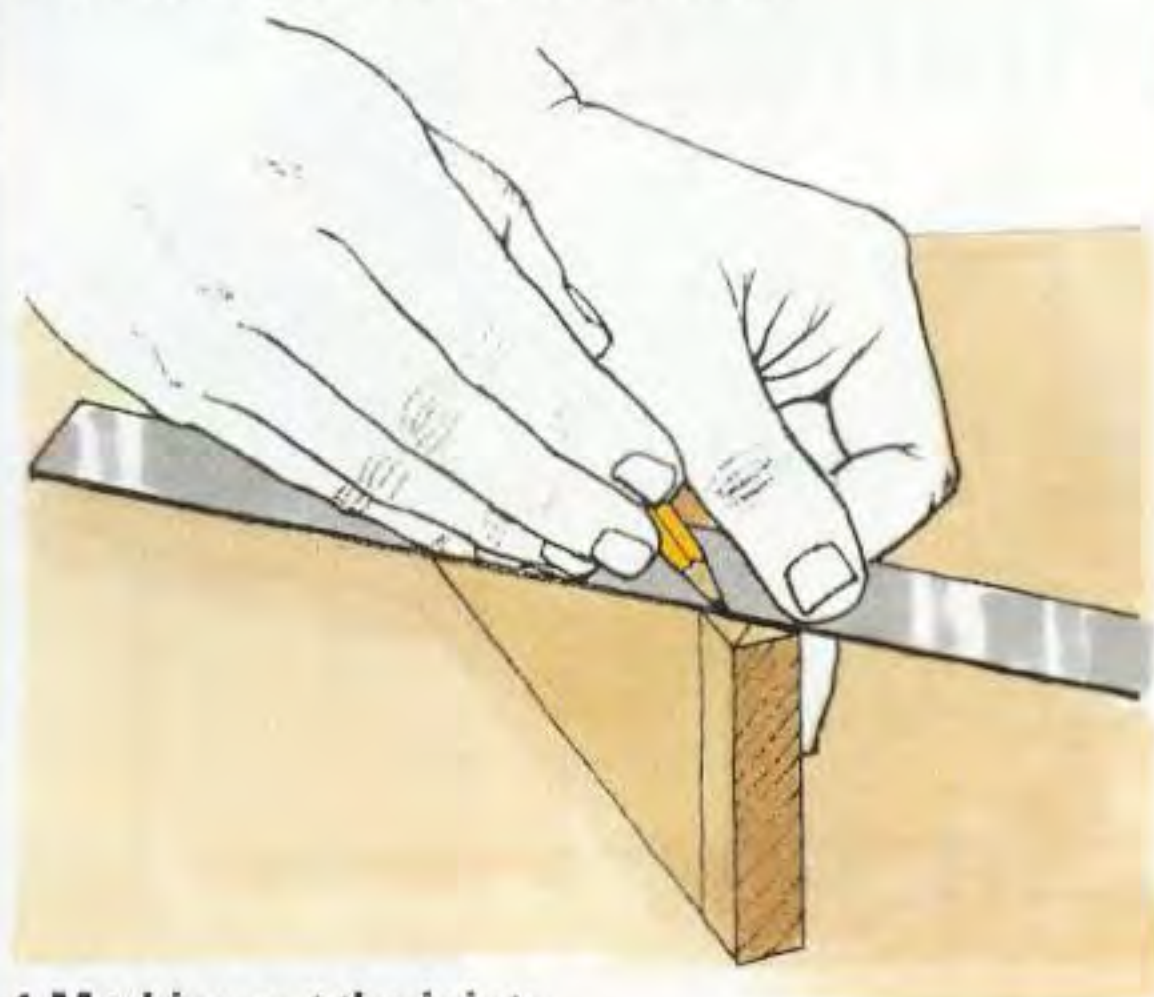
Make a simple jig by tilting the saw blade to 45 degrees and ripping a 90-degree V-shape notch down the centre of a short length of 50 x 100mm (2 x 4in) softwood. Leave about 6mm ($\frac{1}{4}$ in) of wood just below the notch.

Set the blade upright and cut two slots across the base, about one third of the way along the jig. Space the slots to match the required interval between 'fingers', and if you want splines wider than the standard saw kerf, fit wobble washers. Glue a locating strip in one slot and proceed to cut the joint as described above, using the saw's mitre fence to feed the jig.



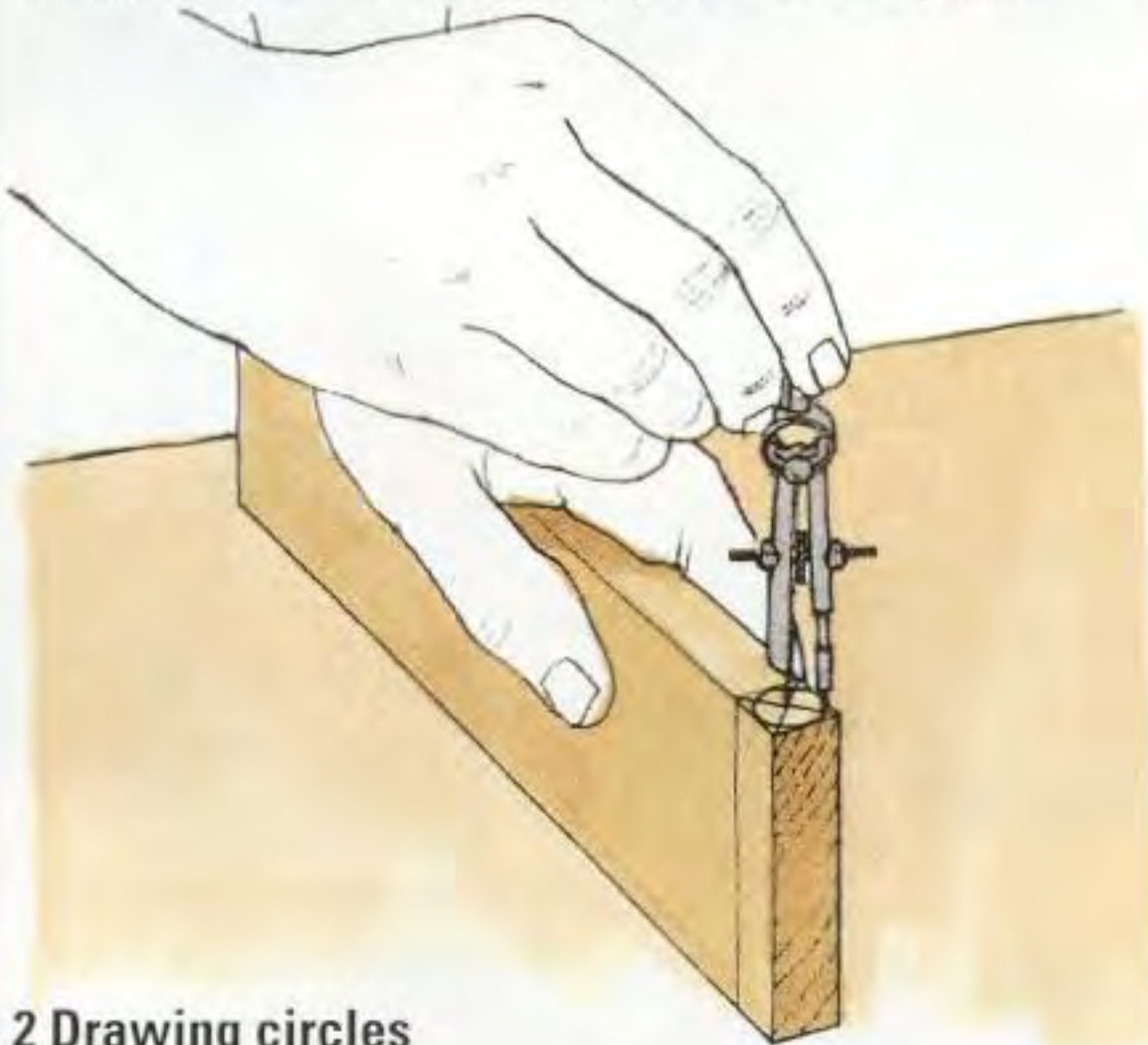
CHAPTER 12 All but the cheapest drop-leaf tables are made with sophisticated detailing, aimed at making the moving components attractive as well as functional. The joint between leaf and fixed top is invariably moulded to hide the actual hinges when the leaf is lowered; on smaller sofa and Pembroke tables, the leaves are supported on brackets fashioned with integral wooden-hinge mechanisms.

The pivoting wooden brackets that support the lightweight drop leaves of small tables are sometimes fixed to the side rails with metal butt hinges. However, they are traditionally made with stout, integral knuckle joints that are not only stronger but also more sympathetic to a finely made piece. The fixed part of each bracket is screwed to the side rail of the table.



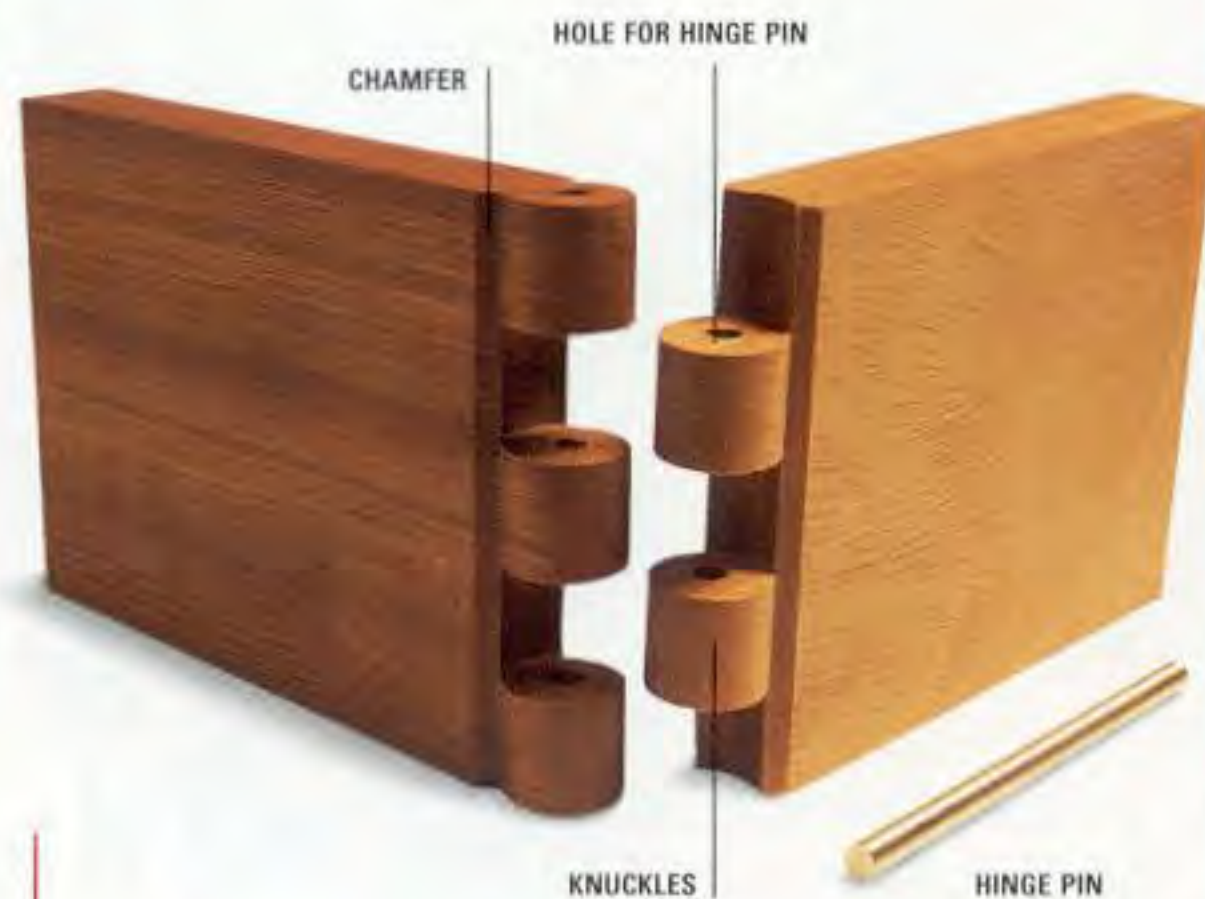
1 Marking out the joints

Set a cutting gauge to the thickness of the wood, and scribe a line all round both halves of the bracket, parallel with the jointed ends. Draw diagonals across the squares formed on each edge of the workpieces.



2 Drawing circles

With the point of a compass centred on the intersection of the diagonals, draw a circle in each square, equal to the thickness of the wood.



3 Marking the chamfers

Chamfers are cut along the knuckle shoulders to allow the pivoting half of the bracket to move freely. Mark out the chamfers by drawing lines through the points where each circle bisects the diagonals. Square these lines all round both workpieces.



4 Removing the waste

Saw along each marked chamfer line, down to the circumference of the circle, then chisel out the waste on the knuckle side of the kerf.



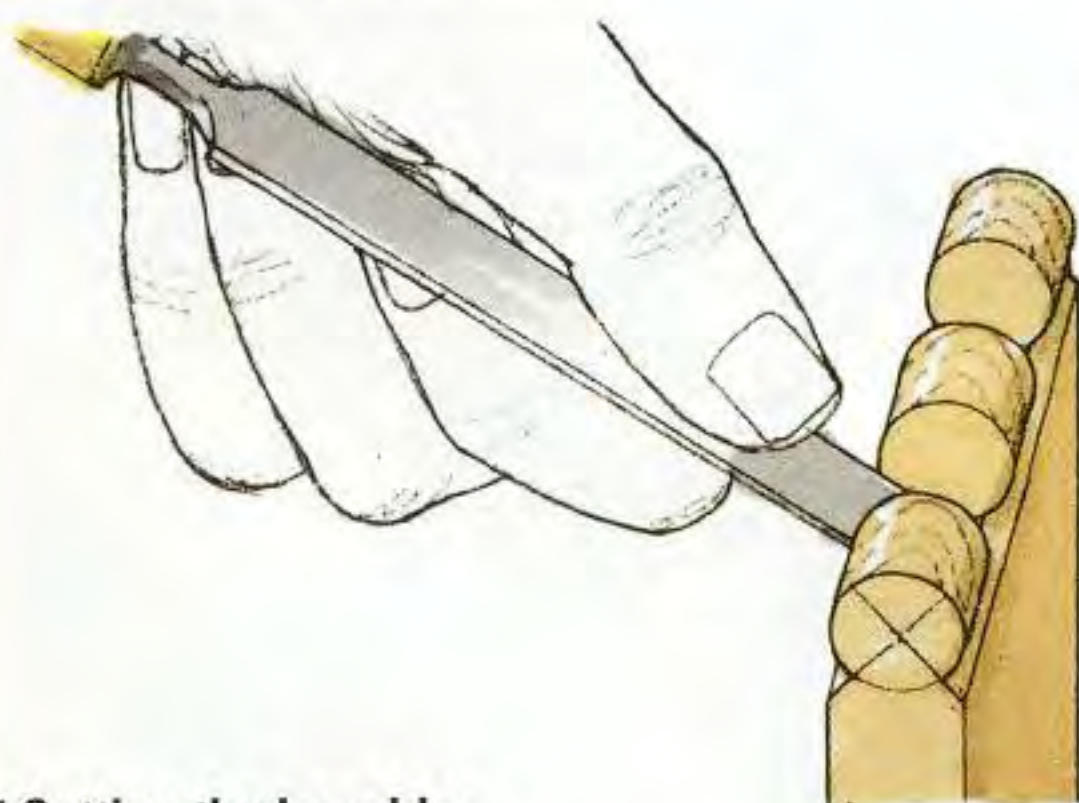
5 Planing the chamfer

Using a 45-degree guide block clamped to the work, accurately cut each chamfer with a shoulder plane.



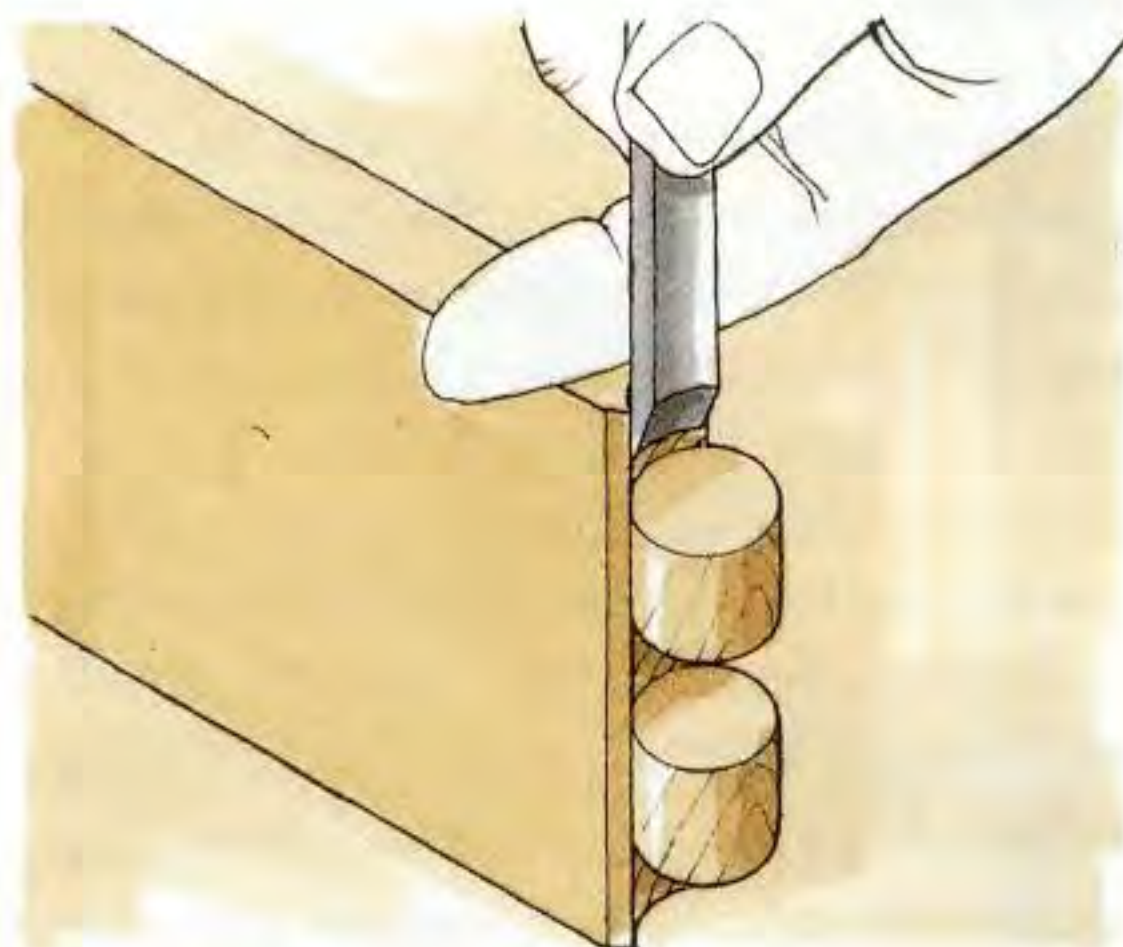
6 Marking the knuckles

Shape the knuckle end of each workpiece with a plane and wood files, then use a marking gauge to divide the rounded sections into five equal parts. Hatch the waste to define three knuckles on one end and two that interlock with them on the other.



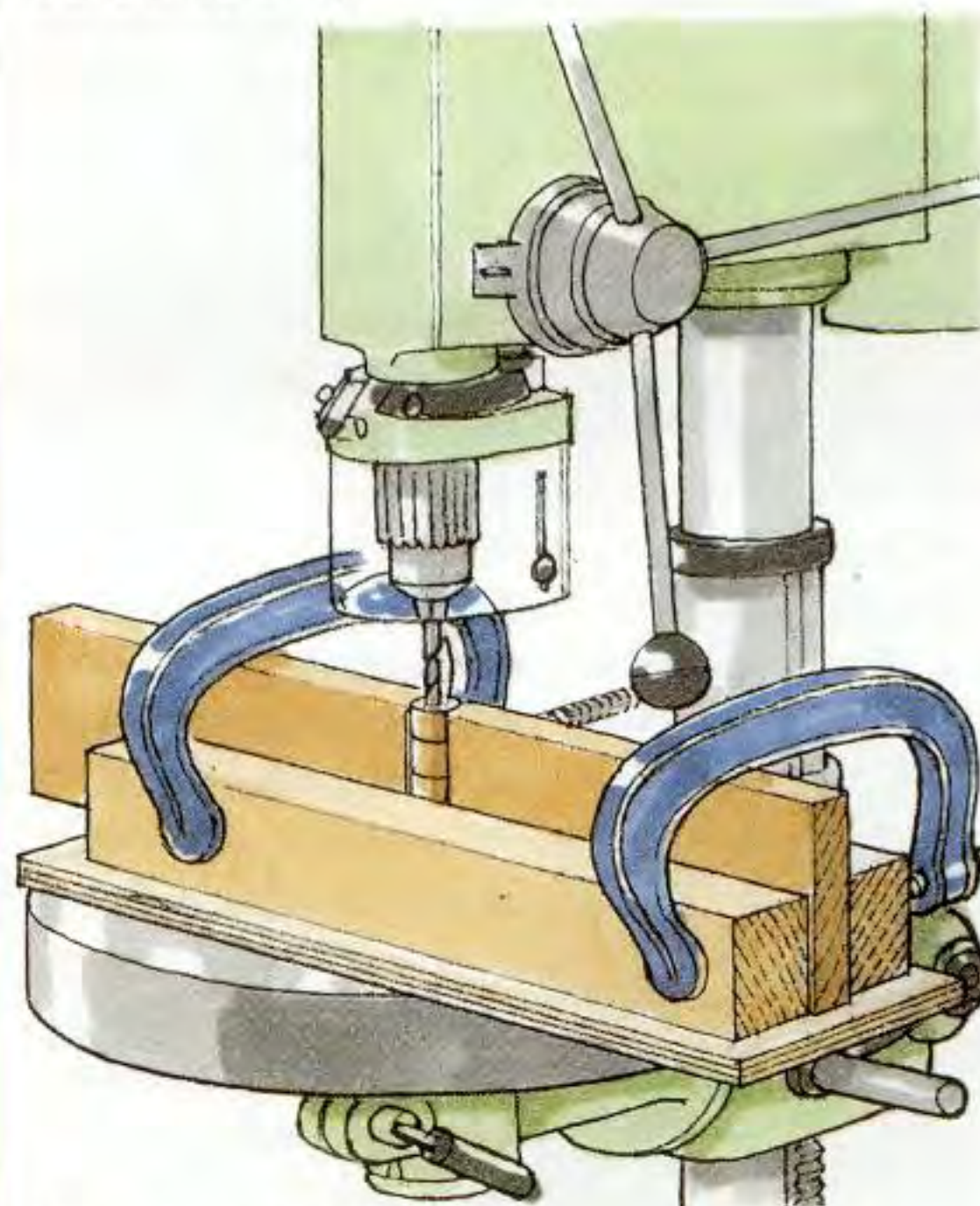
7 Cutting the knuckles

Saw alongside each knuckle down to the chamfer, and remove most of the waste with a coping saw. Working from each side towards the middle, shape the concave shoulder between the knuckles by scooping out the wood with a chisel held bevel-downwards.



8 Trimming the ends

Shape the open ends of the shoulder with an in-cannel gouge. Try the joint for fit, and relieve any tight spots with a chisel or file.



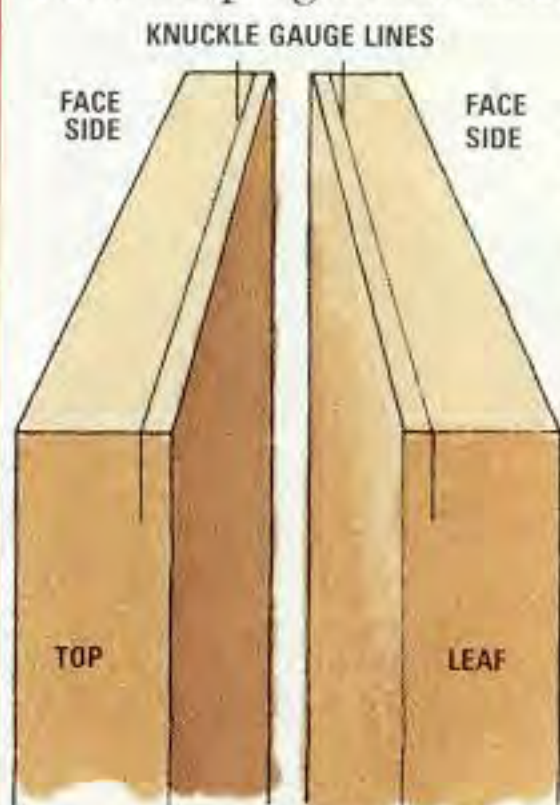
9 Inserting the hinge pin

Assemble the knuckle joint and clamp it between two stout battens to keep both components perfectly aligned. Using a drill press, bore a hole down the centre of the knuckles, to take a snug-fitting brass hinge pin. Tap the pin in place and file both ends flush.

RULE JOINT

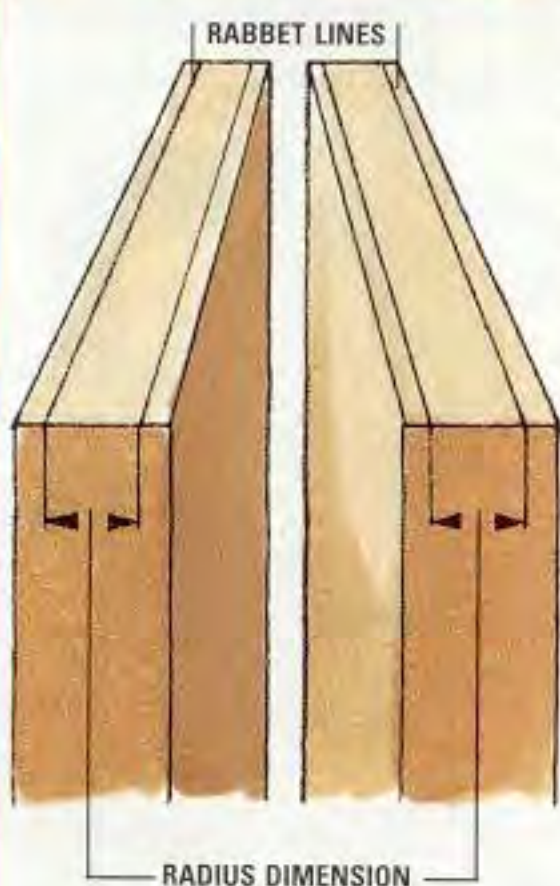
HAND CUT

This is not a true woodworking joint in the conventional sense, since it does not physically attach one component to another. The rule joint comprises two moulded edges, one on a fixed table top and the other on a hinged leaf, that are designed to pivot, one around the other, as the leaf is raised and lowered. Its function is to conceal special back-flap hinges screwed to the undersides of the top and leaf. This type of hinge has flaps of different length, the longer one being screwed to the leaf. Rule-joint mouldings are cut before the final shaping of the table top and leaves.



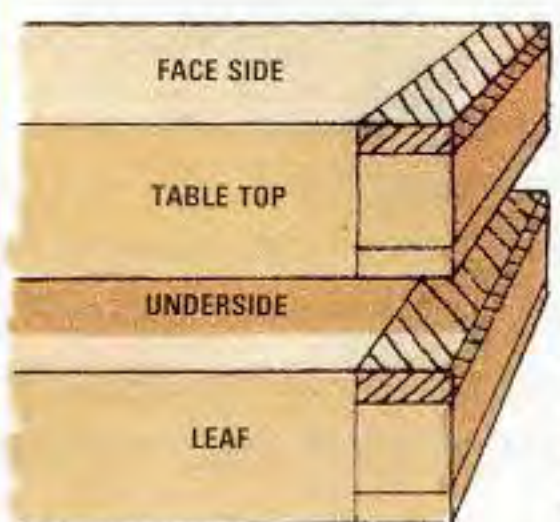
1 Gauging the edges

Set a marking gauge to match the radius of the hinge knuckle, and scribe a line along each edge to be moulded, working from the undersides of both components. Continue the lines just onto the neighbouring edges.



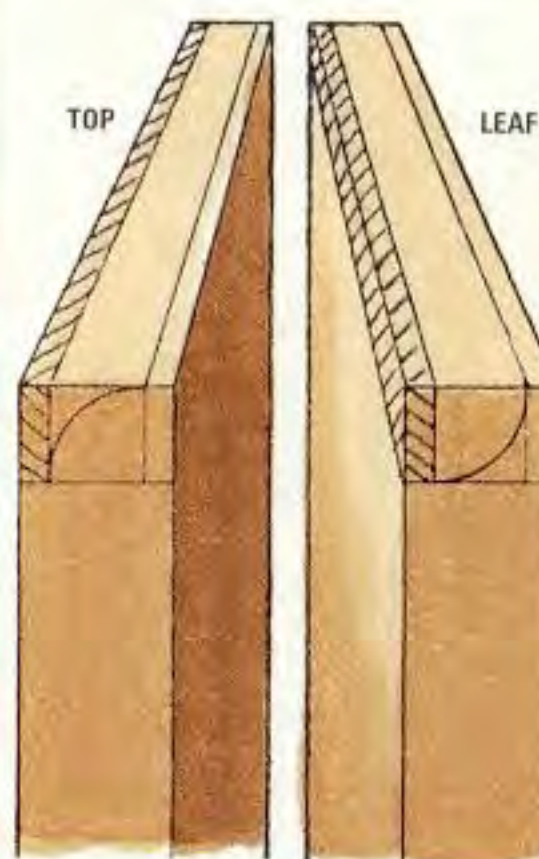
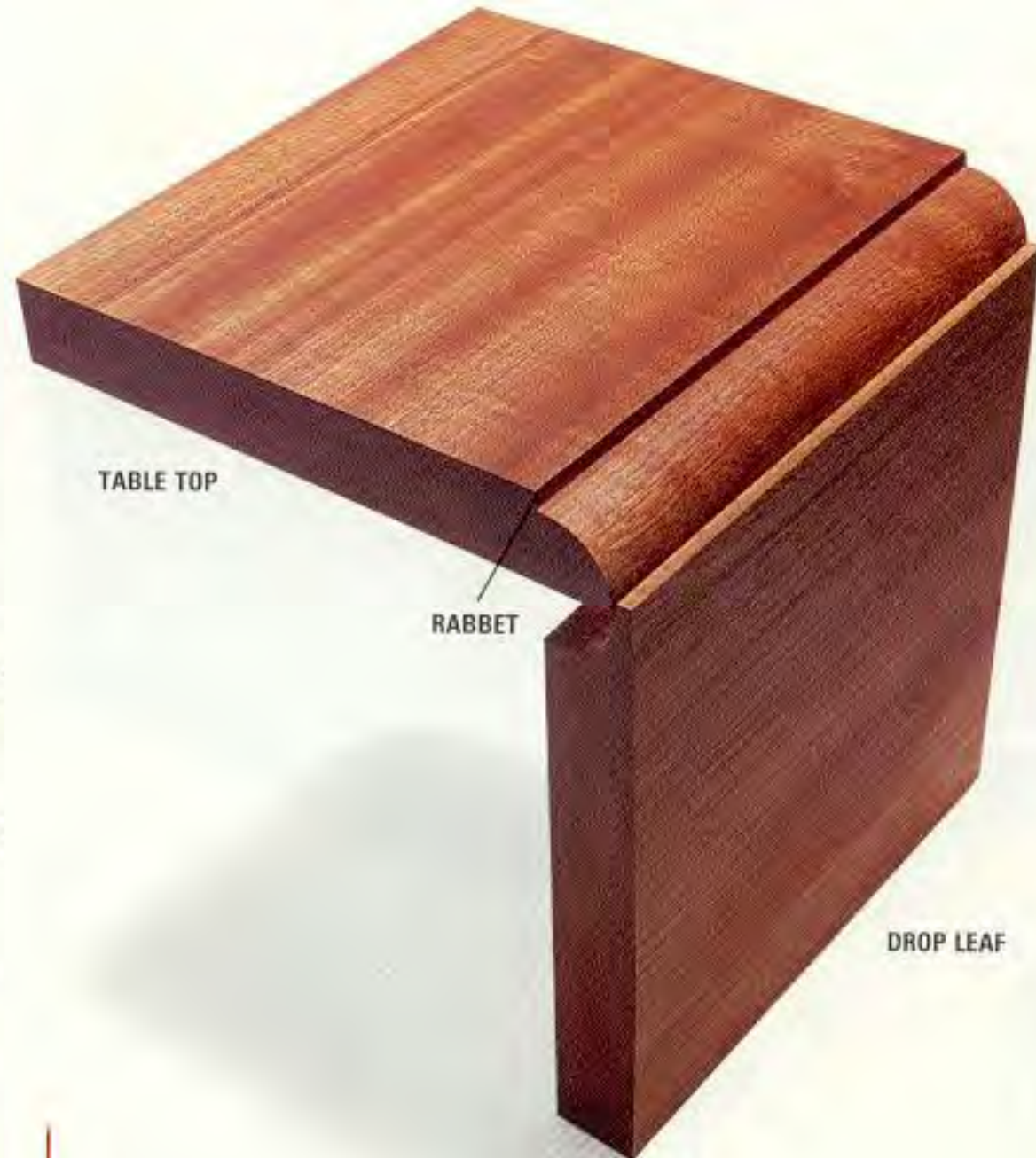
2 Marking the rabbet

Reset the gauge to the depth of the joint rabbet – about 3mm (1/8in) – and scribe similar parallel lines, working from the face side of each workpiece. The distance between the two gauged lines represents the radius of the rule joint.



3 Marking the width

With a cutting gauge set to this radius, scribe a line across the face side of the fixed top and across the underside of the leaf. Mark the edges similarly, and hatch the waste.

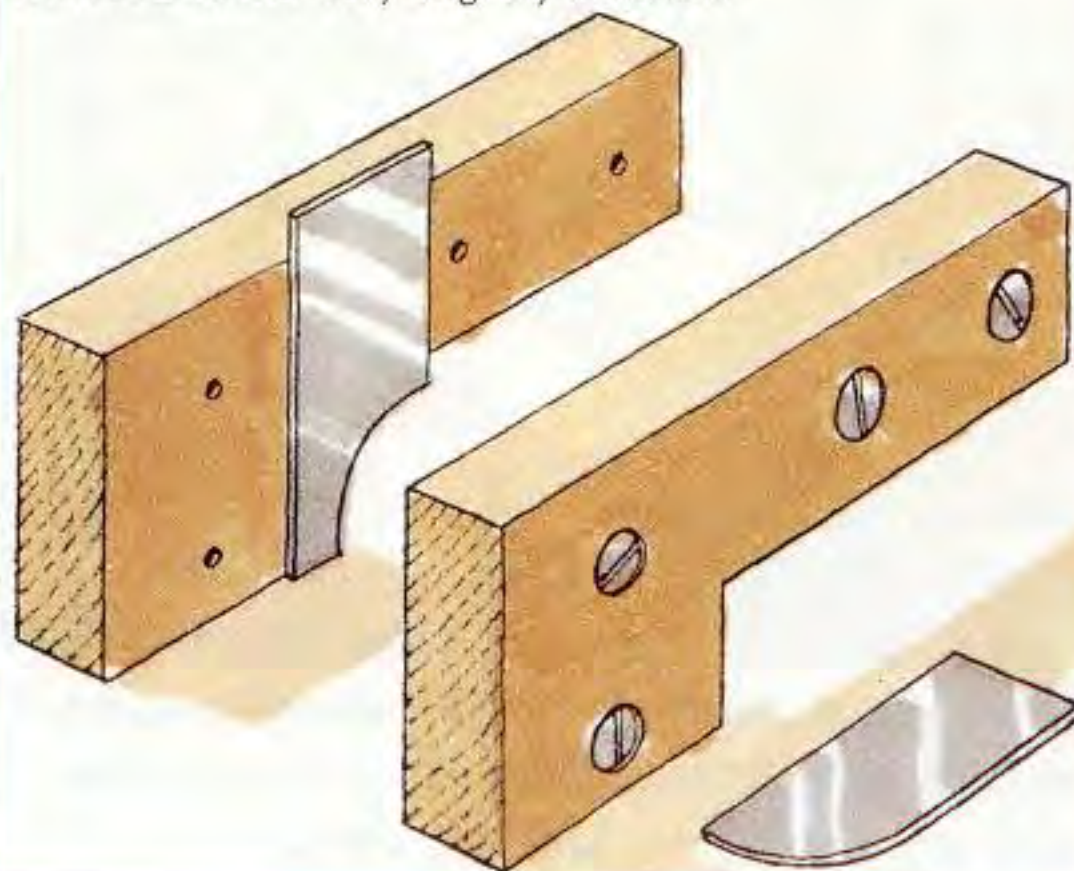


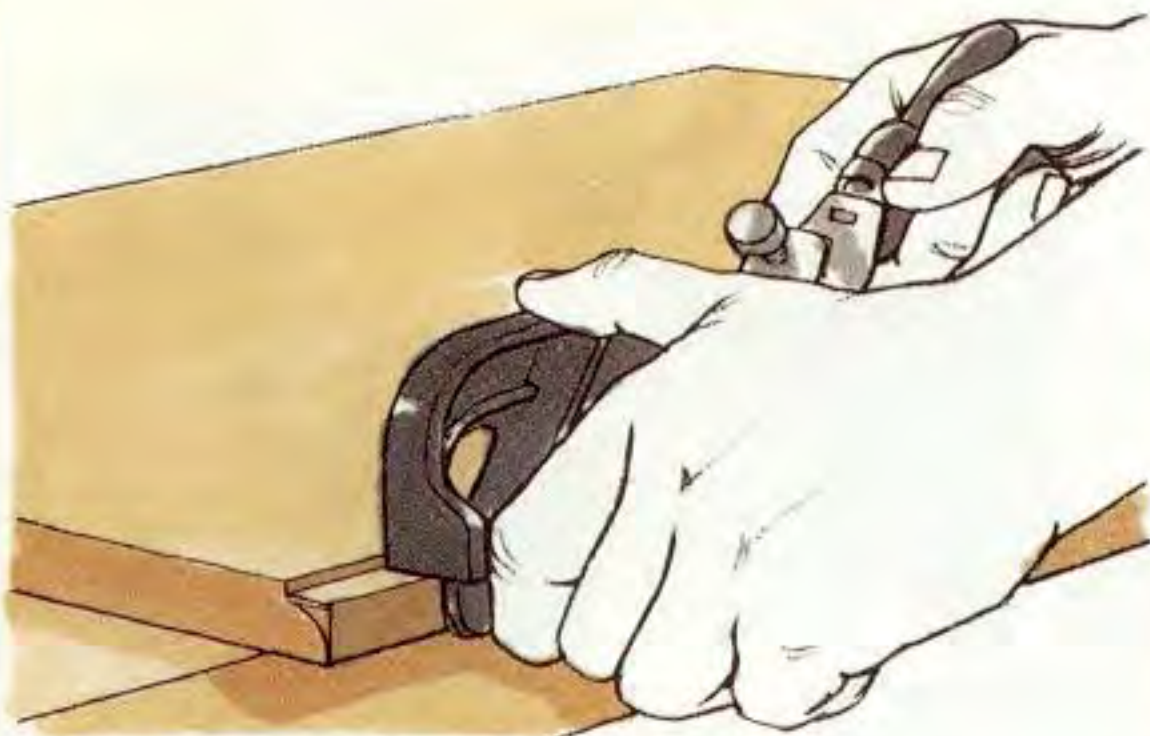
4 Marking the radius

Using the scribed lines as guides, draw the rule-joint radius on each edge. Cut a card template for marking the leaf.

MAKING A SCRATCH STOCK

To shape the edges of both workpieces, make a scratch stock from hardwood or plywood, and prepare a pair of matched cutters from steel sheet. File the exact radius curve on the convex cutter, but make the concave cutter very slightly smaller.





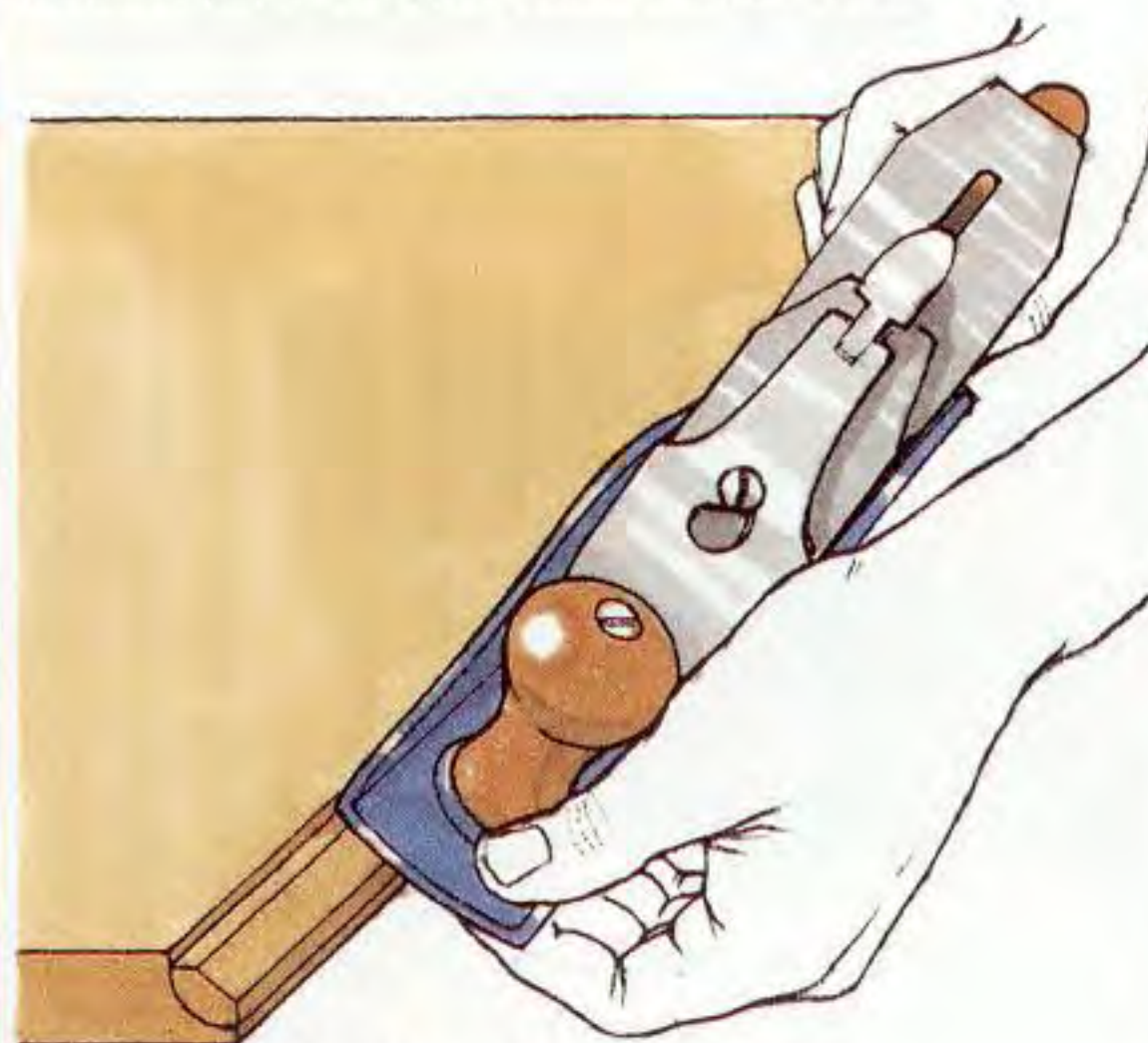
1 Cutting the rabbet

Clamp the table top face-side up on the bench, and cut the joint rabbet down to the marked lines, using a rabbet plane.



2 Shaping the convex moulding

Shape the moulding roughly with a plane before finishing with the appropriate cutter clamped in the scratch stock. A sharp cutter should leave a perfectly smooth surface – if necessary, smooth the curve with abrasive paper wrapped round a shaped block.



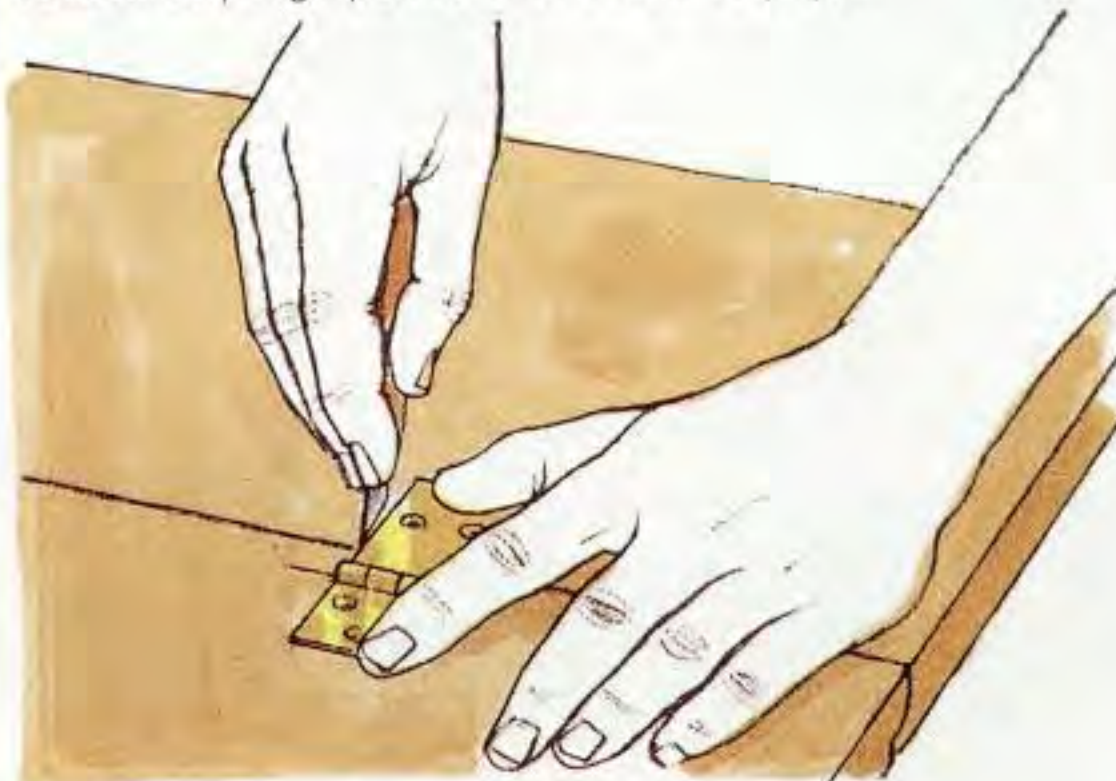
3 Preparing the leaf edge

Clamp the leaf face-side down and cut a rabbet as described above, then plane down the waste as close as possible to the marked radius.



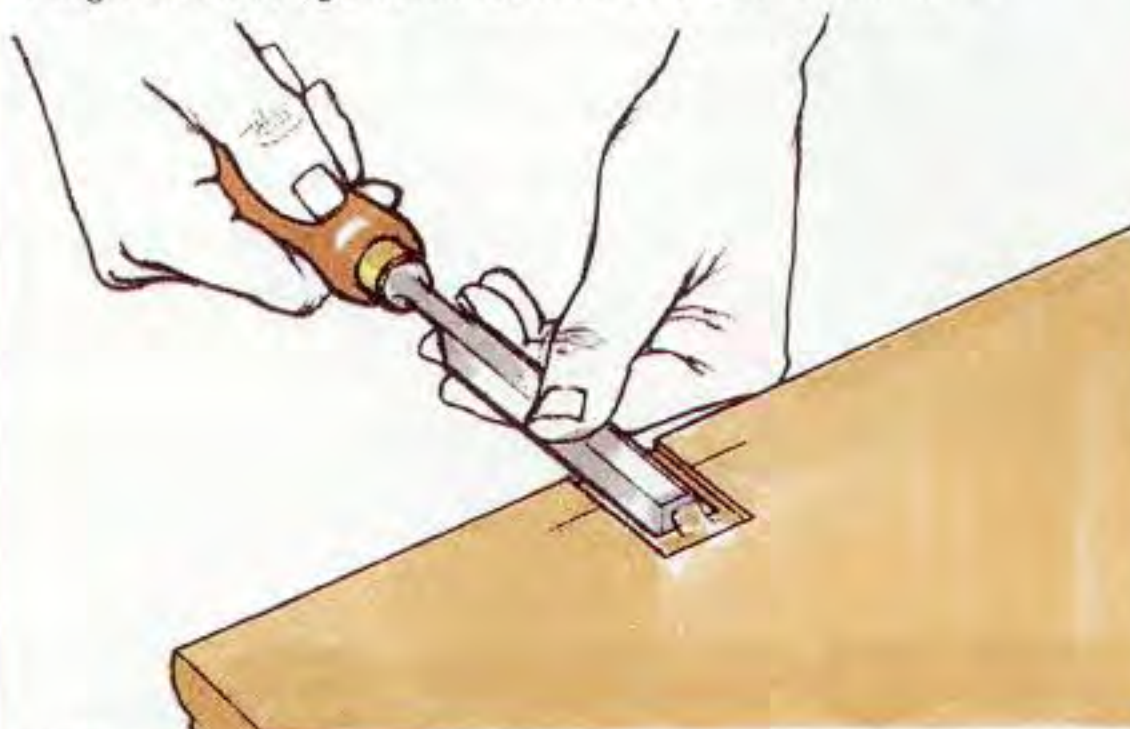
4 Shaping the concave moulding

Using a moulding plane, remove the waste almost to the marked radius, then finish shaping with the scratch stock. Check both halves of the moulding for fit, and reduce any high points with abrasive paper.



5 Marking the hinge recesses

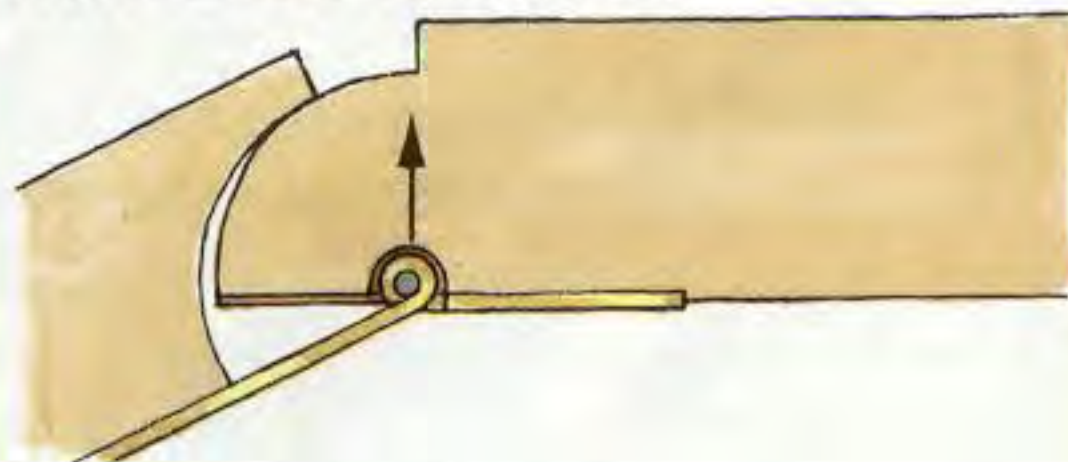
With a cutting gauge set to the rule-joint radius, scribe the centre line for each hinge knuckle on the underside of the top, about 150mm (6in) in from the side edges. Lay the leaf and top together, face-down on the bench. Align each hinge with its line and score round it.



6 Fitting the hinges

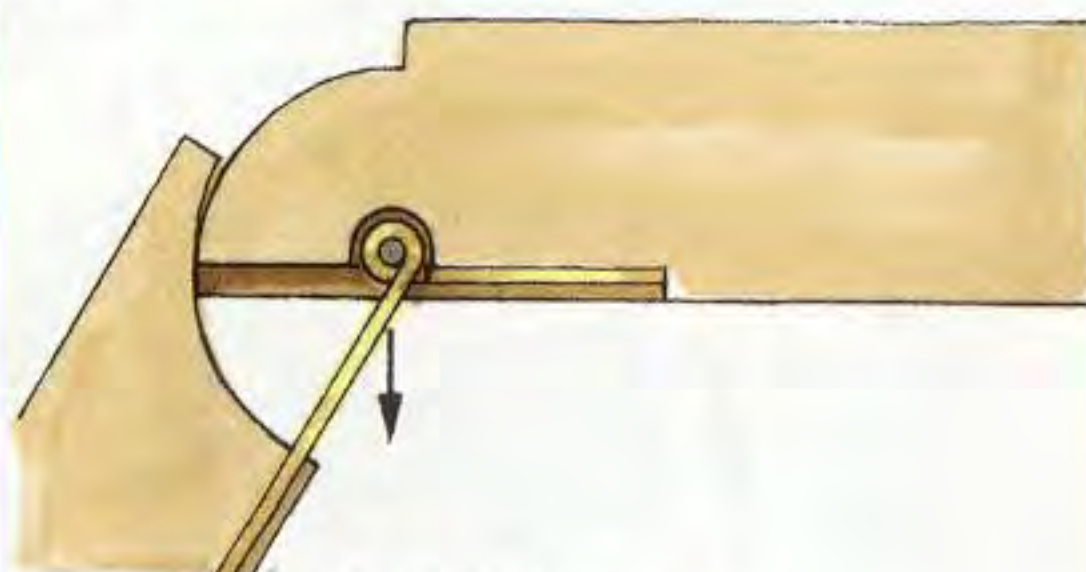
Chisel the hinge recesses to set the flaps flush with the surfaces, cutting a slightly deeper recess for each knuckle. Drill a pilot hole for the one screw nearest to the knuckle in each flap, and temporarily screw the hinges in place. Check the movement of the leaf and, if all is well (see page 104), insert the remaining screws.

CORRECTING A MISALIGNED RULE JOINT



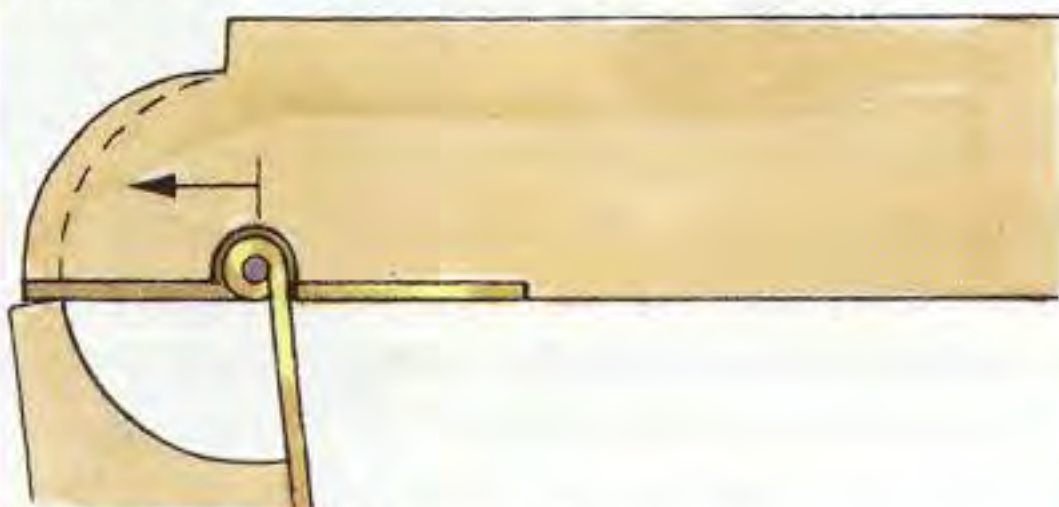
Binding near the rabbet

If the joint binds just before the leaf is level, remove the hinges and pare the hinge recesses until they are slightly deeper.



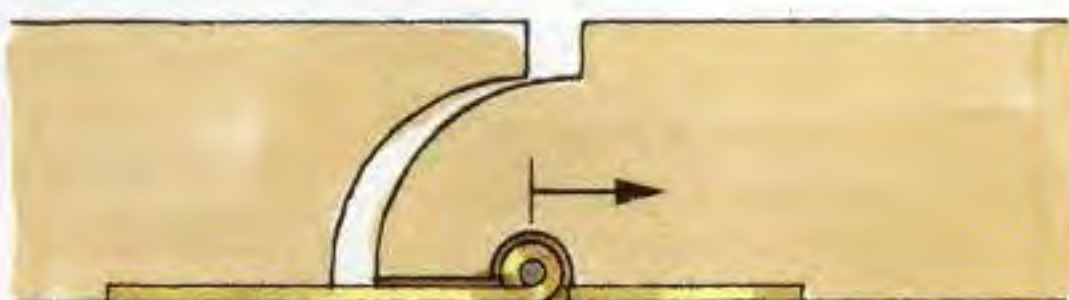
Binding towards the bottom

If the rule joint binds when the leaf is nearly vertical, pack out the hinge flaps with thin card or veneer.



Catching on the lower edge

If the edge of the leaf catches on the underside of the fixed top, the hinges are set too far from the moulded edge. Cut the knuckle recesses slightly wider so that you can move the hinges, in order to place the centre of each knuckle directly below the rabbet. Plug the old screw holes.



Unsightly gap

If there is an excessive gap between leaf and top when they are level, the hinge knuckles are set too close to the moulded edge. Cut the knuckle recesses slightly wider, and extend the flap recesses so that you can reposition both hinges.

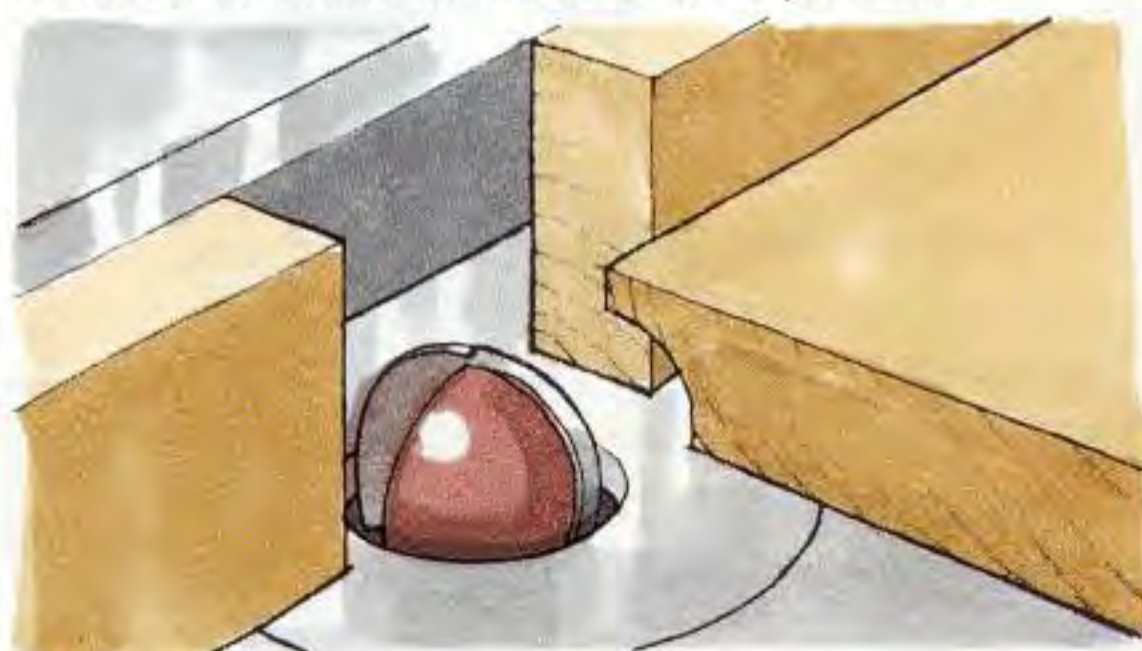


Rounding-over cutter

Cove cutter

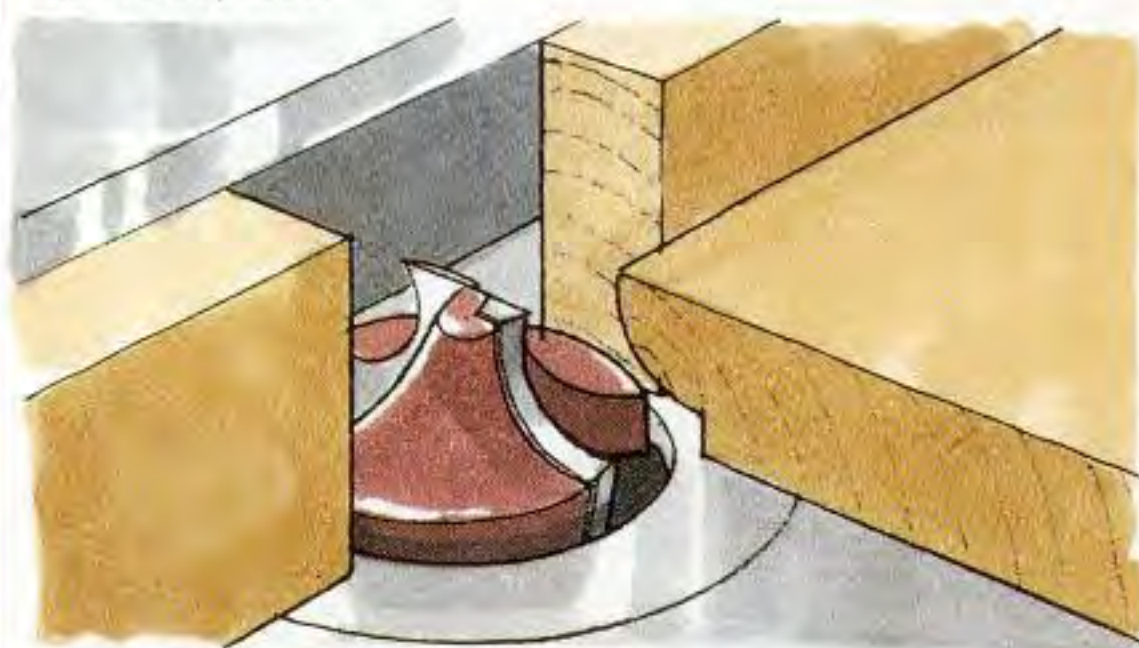
Machining a rule joint

A power router is the ideal tool for cutting a rule joint. Matching cutters ensure that the two profiles mate perfectly. Select cutters that will suit the thickness of the table-top panels, and refer to how to establish the radius (see page 102). Typically, 12mm (1/2in) cutters are used to machine 18mm (3/4in) panels. You can cut both profiles with a hand-held router fitted with self-guiding cutters, but a table-mounted router is preferable.



Cutting the concave moulding

Fit the cove cutter in the router and then set the guide fence until it is centred accurately on the cutter. Always machine the profile of the moulding in stages, raising the cutter between each pass, so that you leave not less than 3mm (1/8in) of wood along the top edge of the workpiece.



Cutting the convex moulding

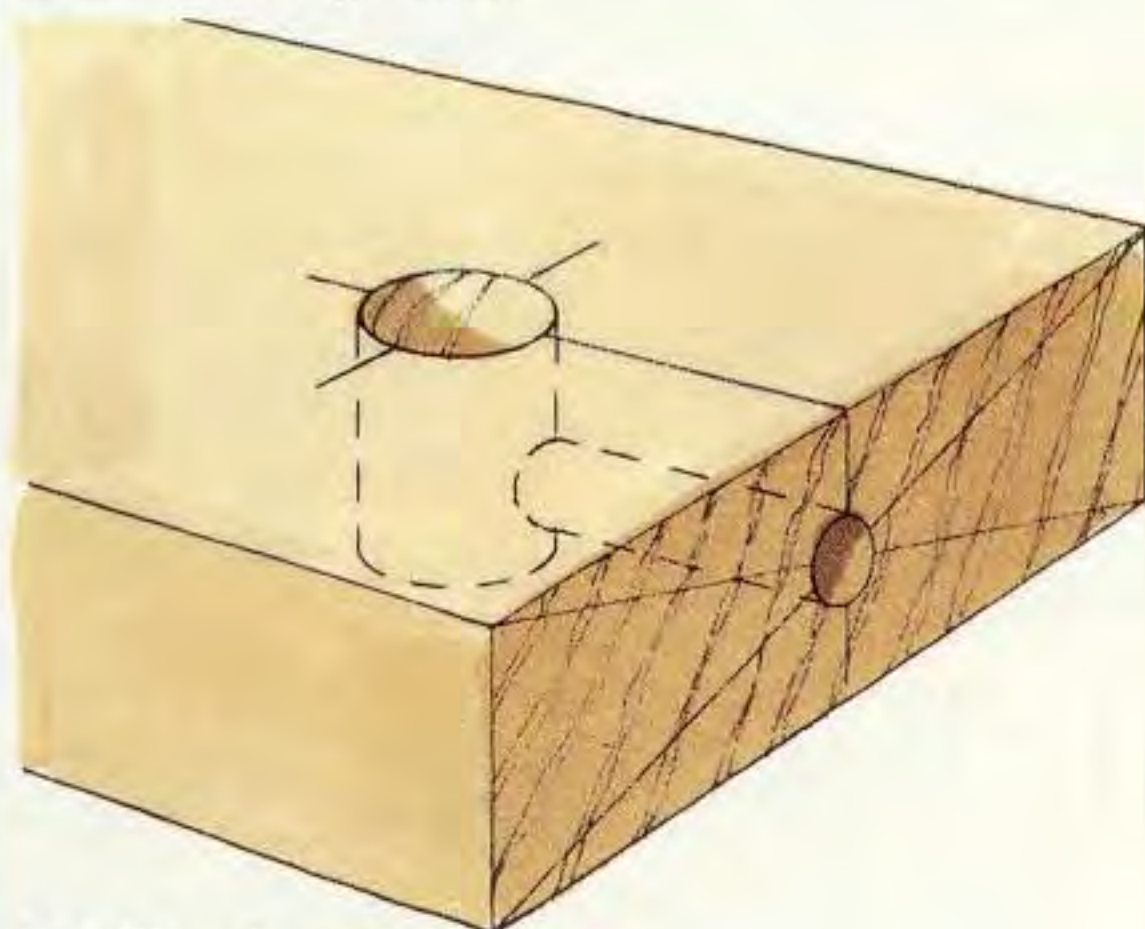
Swap cutters, and machine the matching profile along the top panel in similar stages. Gradually raise the cutter until the moulded edge includes a rabbet that allows the leaf and top to lie flush.

CHAPTER 13 Knock-down joints use a mechanical fitting to hold components together. Manufacturers produce a wide range of ingenious connectors with which you can assemble rigid joints, using little more than a drill and a screwdriver. Chairs, tables, cabinets and bed frames can all be constructed simply from solid wood or man-made boards, utilizing knock-down fittings.

KNOCK-DOWN JOINTS

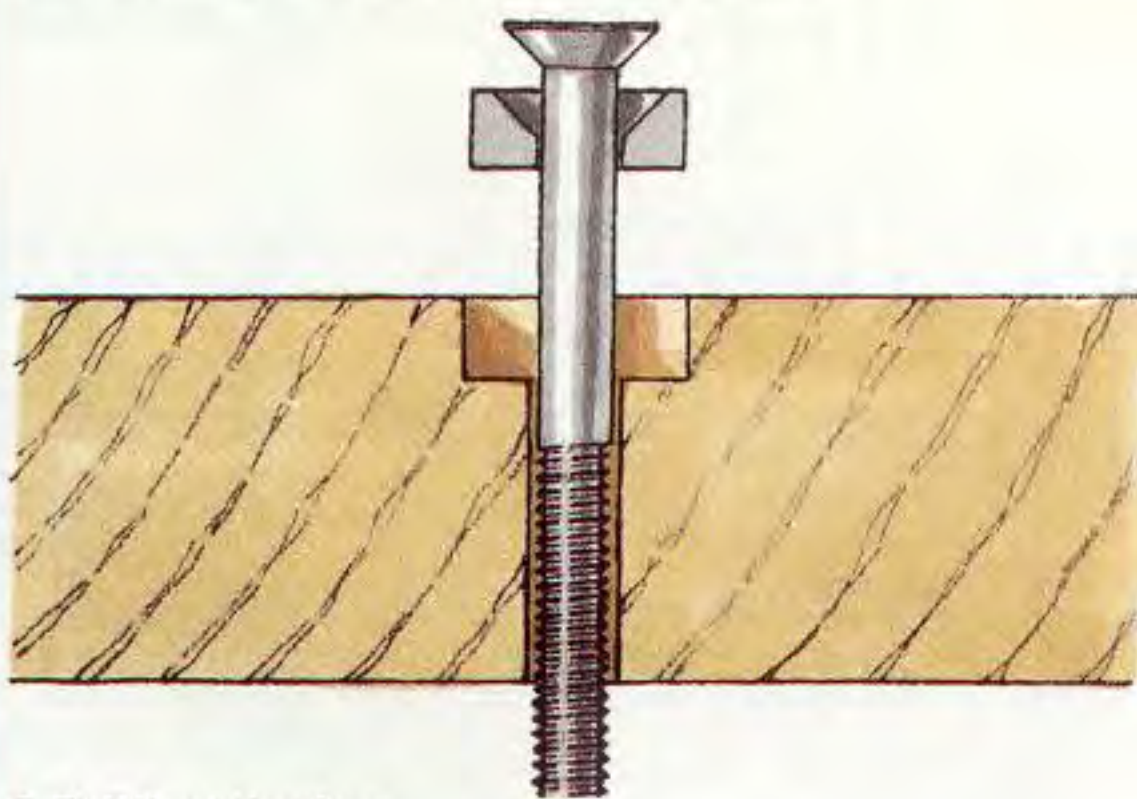
BOLT AND BARREL NUT

This is a strong and positive fitting for all types of frame construction where the end of a rail meets the side of a leg or other vertical member. The bolt passes through a counterbored hole in the leg and into the end of the rail, where it is then screwed into a threaded barrel nut located in a stopped hole. A screw slot in the end of the nut allows you to align the threaded hole with the bolt. A wooden locating dowel fitted in the end of the rail makes assembly easier and prevents the rail from turning as the bolt is tightened.



1 Drilling the rail

Draw diagonals across the end of the rail to find the centre, and bore a clearance hole for the bolt where the lines cross. Calculate the distance from the end of the rail for the barrel nut, and drill a stopped hole in the side of the rail to intercept the bolt hole.



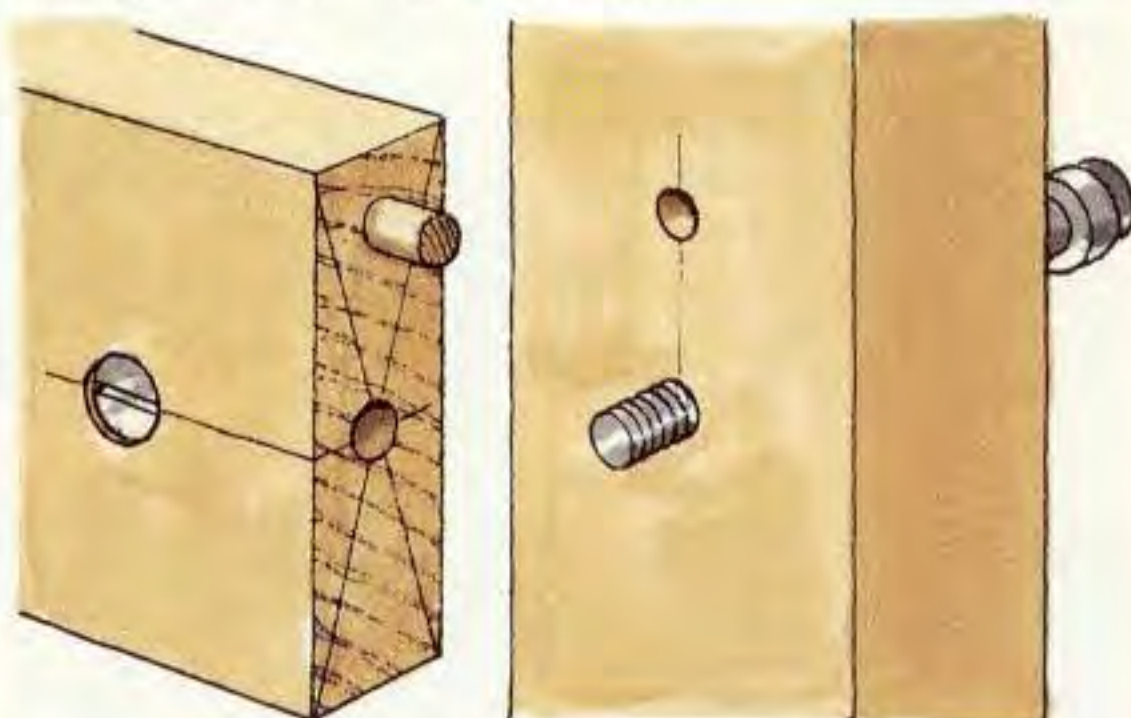
2 Drilling the leg

Mark and drill a counterbored clearance hole for the bolt and collar in the leg.



3 Fitting the locating dowel

Tap a panel pin into the end of the rail on its centre line, about 12mm (½in) from one edge. Crop the head off the pin, then assemble and tighten the fitting. Dismantle the joint, and drill a 6mm (¼in) stopped hole in the leg where the cropped pin left a mark. Remove the pin and drill the rail in the same way as the leg, then glue a short dowel in the hole.



TEE NUTS AND BOLTS

A tee nut is an internally threaded collar with an integral spiked washer that provides a firm anchor for a bolt fixing. A relatively crude fitting, it is probably best reserved for upholstered frames.



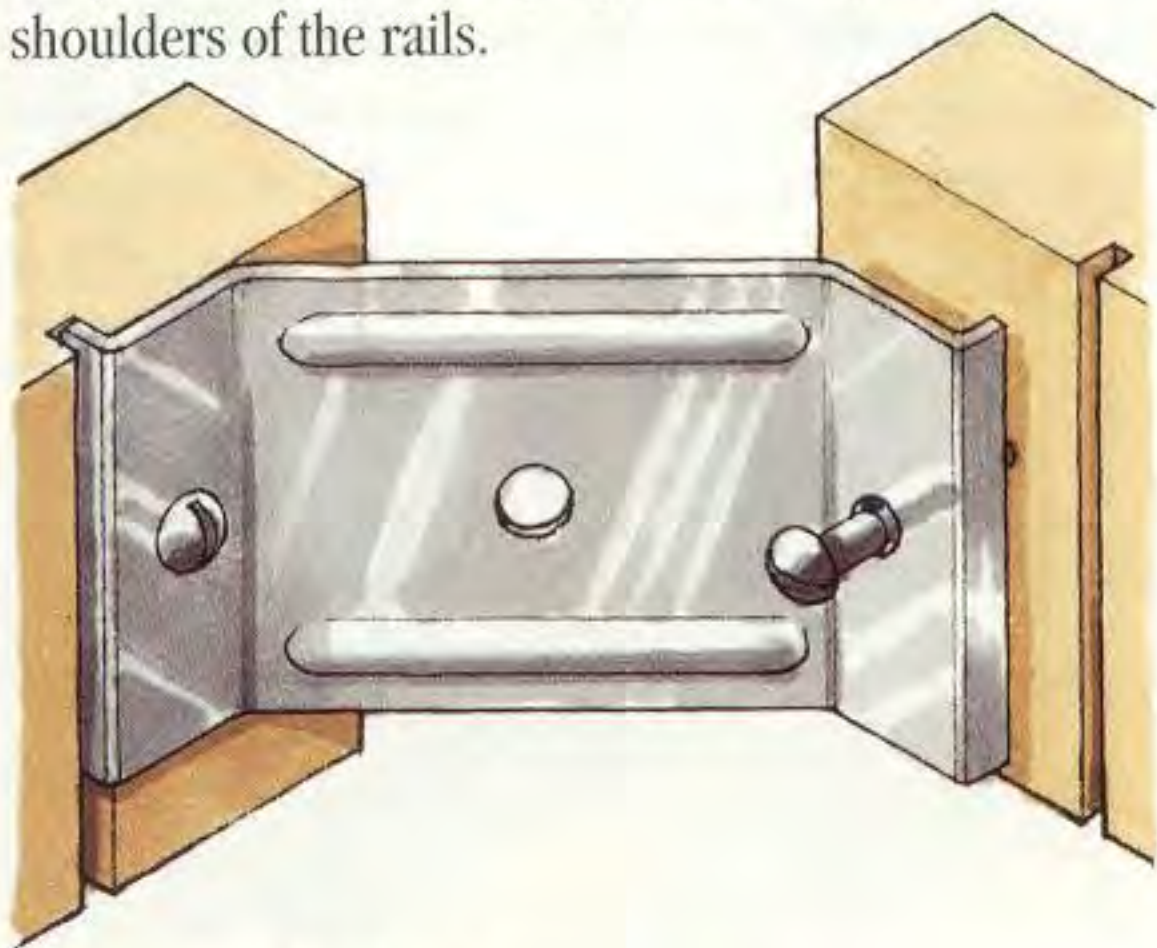
Fitting a tee nut

Clamp the components together and drill an 8mm (5/16in) clearance hole through both parts. Tap the nut into the back of one component and pass the bolt through the other. Tighten the bolt to pull the parts together, and seat the nut securely in the wood.



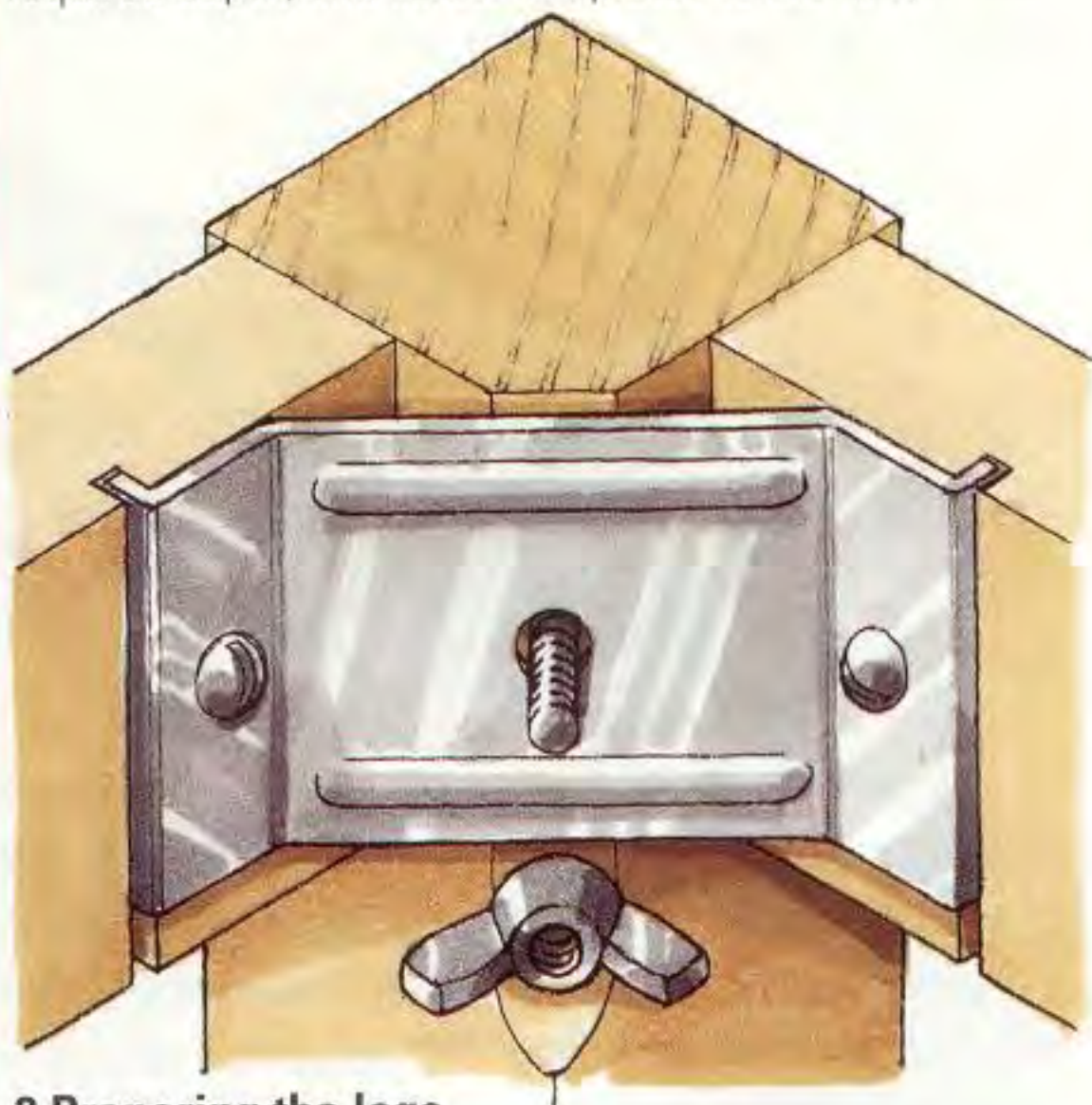
CORNER PLATES

Pressed-metal corner plates form demountable joints between table legs and rails. The flanges are located in shallow slots cut across the inside of each rail, and the plate is held in place by wood-screws. A threaded hanger bolt, screwed into a chamfer planed on the inner corner of the leg, is fixed to the plate with a wing nut. Tightening the nut pulls the leg hard up against the square-cut shoulders of the rails.



1 Preparing the rails

Cut the rails to length. Calculate the flange-slot positions from the size of the legs and plates, and draw squared guide lines across the rails. Cut the slots to the required depth, and screw the plates to the rails.



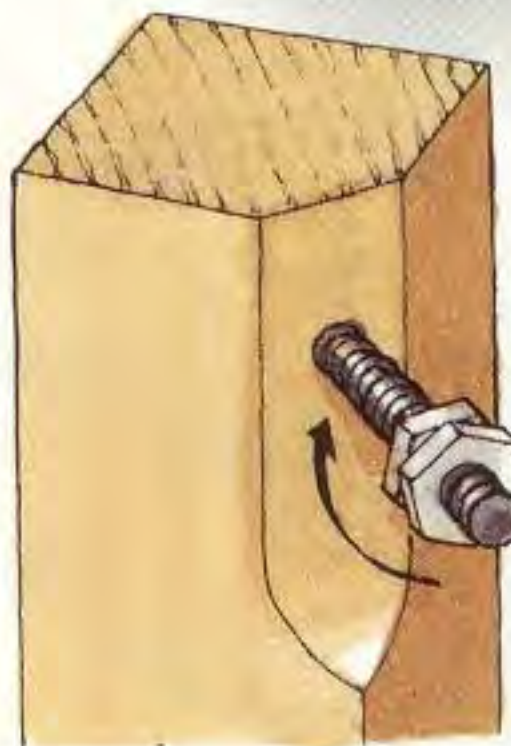
2 Preparing the legs

Cut the legs to length, and plane or chisel a stopped chamfer on the inside of each one. Screw a hanger bolt into the leg (see top right) so that it mates with the plate-fixing hole. Clamp each leg with a wing nut.



Inserting hanger bolts

Fit two hexagonal nuts on a bolt and lock them together by turning them in opposite directions with a pair of spanners. Drive the bolt into a pilot hole drilled in the leg, using one spanner located on the nuts. When the bolt is fully in place, remove the nuts.



CABINET CONNECTORS

Cabinet connectors bolt together adjoining cupboards and help keep them aligned. The bolt passes through a hole in one side panel into the ribbed 'nut', which fits tightly in a hole drilled in the neighbouring panel. The fitting is removable.



Fitting the connectors

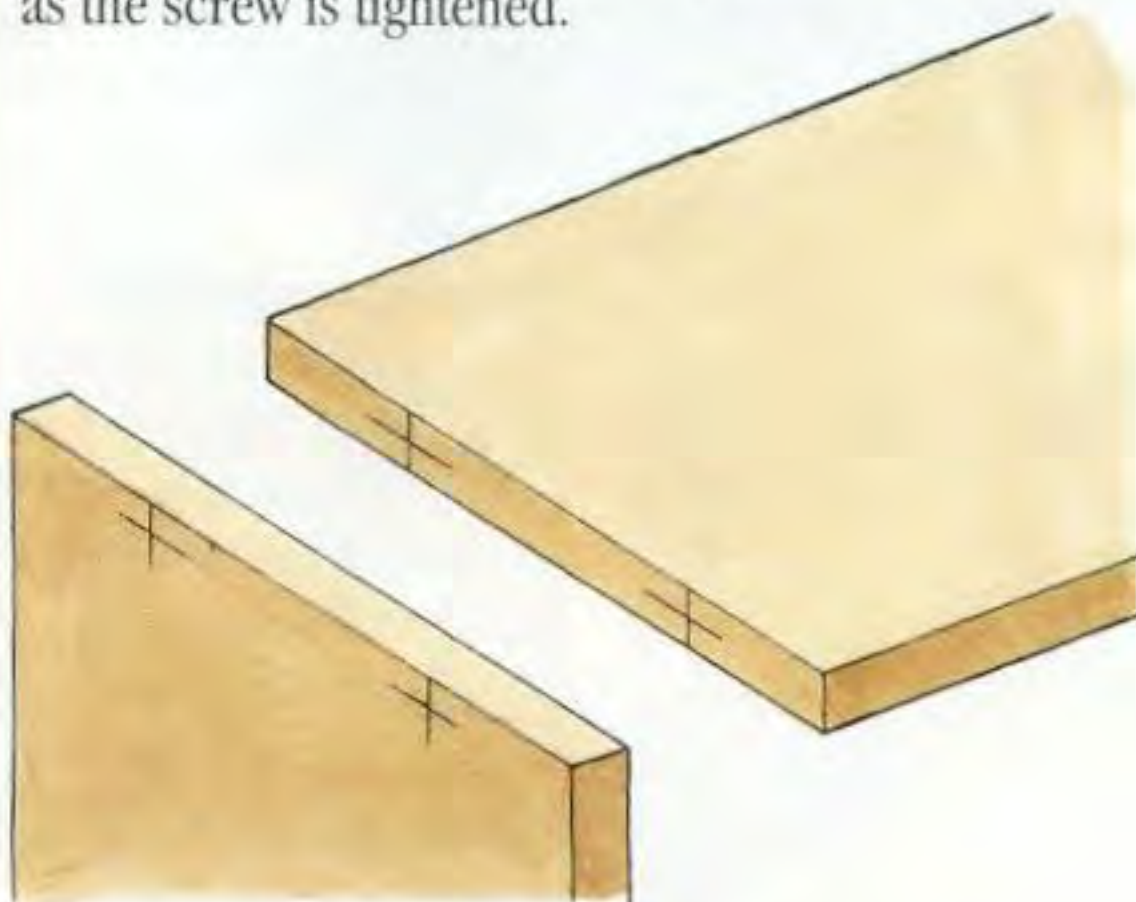
Mount the cabinets side-by-side and drill two 8mm ($\frac{5}{16}$ in) holes through both adjoining side panels, one near the base of the cupboard and the other near the top. Insert the connectors and tighten both bolts.



CHIPBOARD FASTENERS

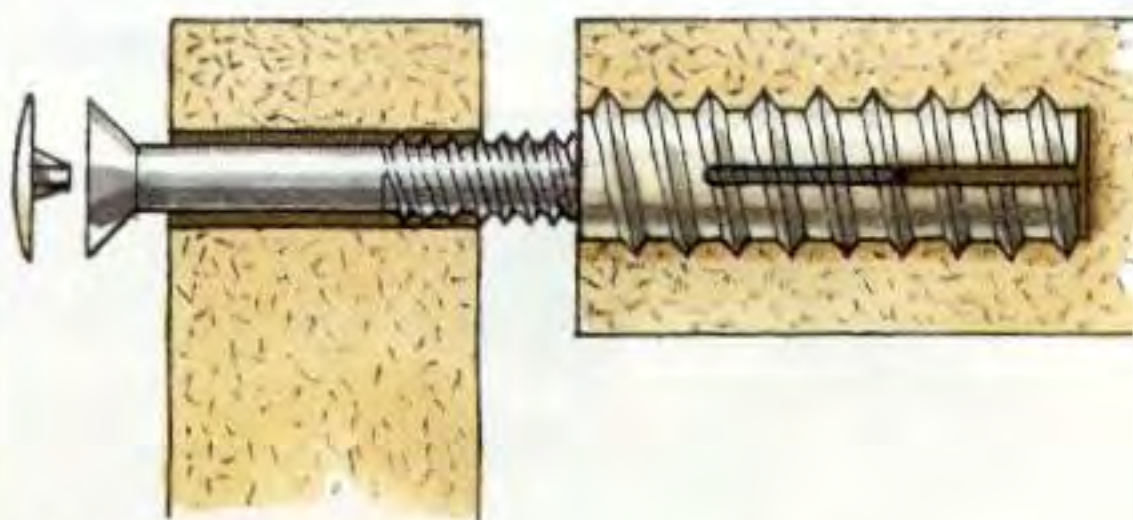


You can improve the strength of screwed joints in chipboard by fitting nylon inserts into the square-cut edges. These chipboard fasteners plug into pre-drilled holes and expand to grip the material as the screw is tightened.



1 Marking the panels

Cut the boards square and, using a marking gauge, scribe a centre line on the end of one component. Depending on the width of the boards, mark off two or more screw centres. Mark matching centres on the face of the other component.



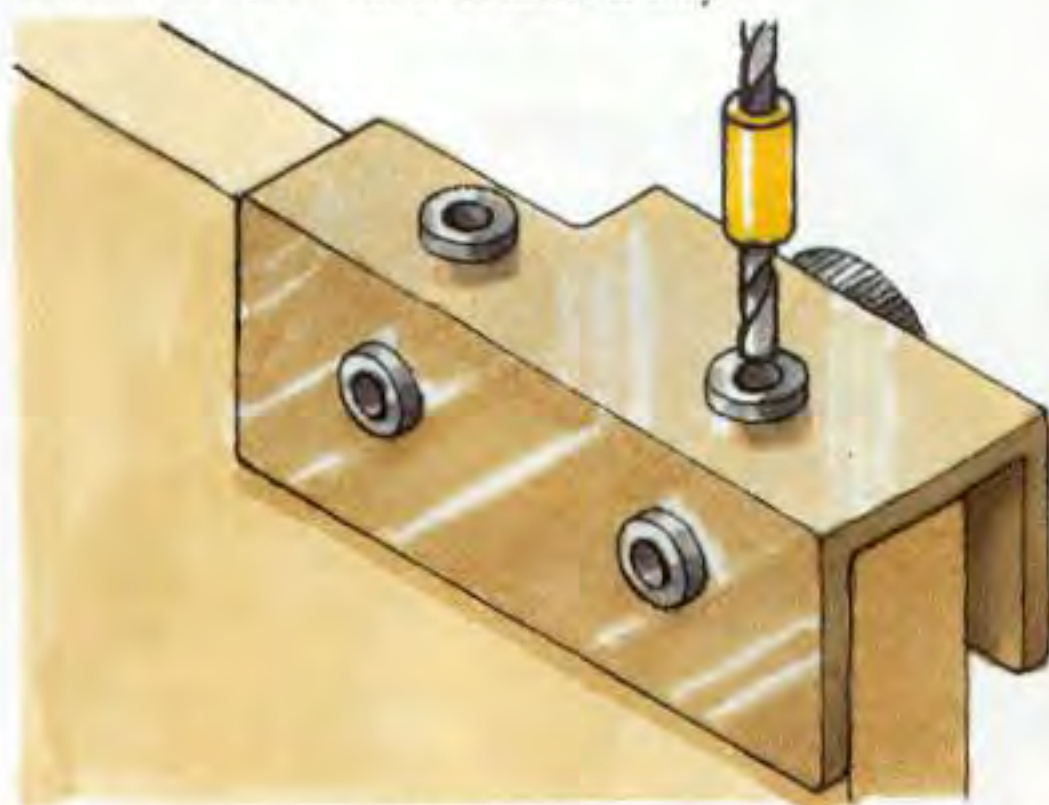
2 Making the joint

Bore screw-shank clearance holes through the side panel, and larger stopped holes for the nylon fasteners in the edge of the other component. Countersink the clearance holes, if necessary, then insert the fasteners and assemble the joint.

SCREW CONNECTORS

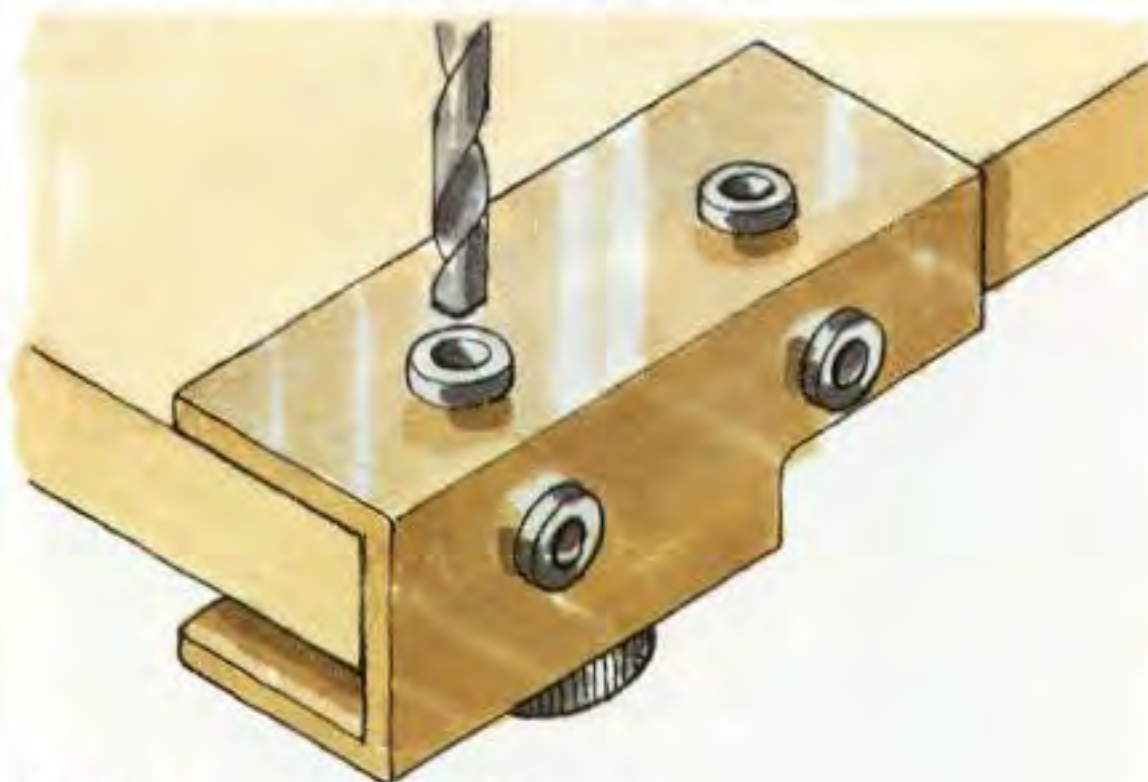


These bright-galvanized or black-finished screw fittings have coarse threads that make secure butt joints without inserts. The shallow, countersunk heads are cross-slotted or have a hexagonal socket that is driven with a cranked key.



1 Drilling stopped holes in the edge

A special jig holds the drill bit perpendicular to the surface. Mount the jig on the end of the horizontal component and align it with screw centres marked across the workpiece. Clamp the jig, and drill stopped holes for the threaded screw shanks.



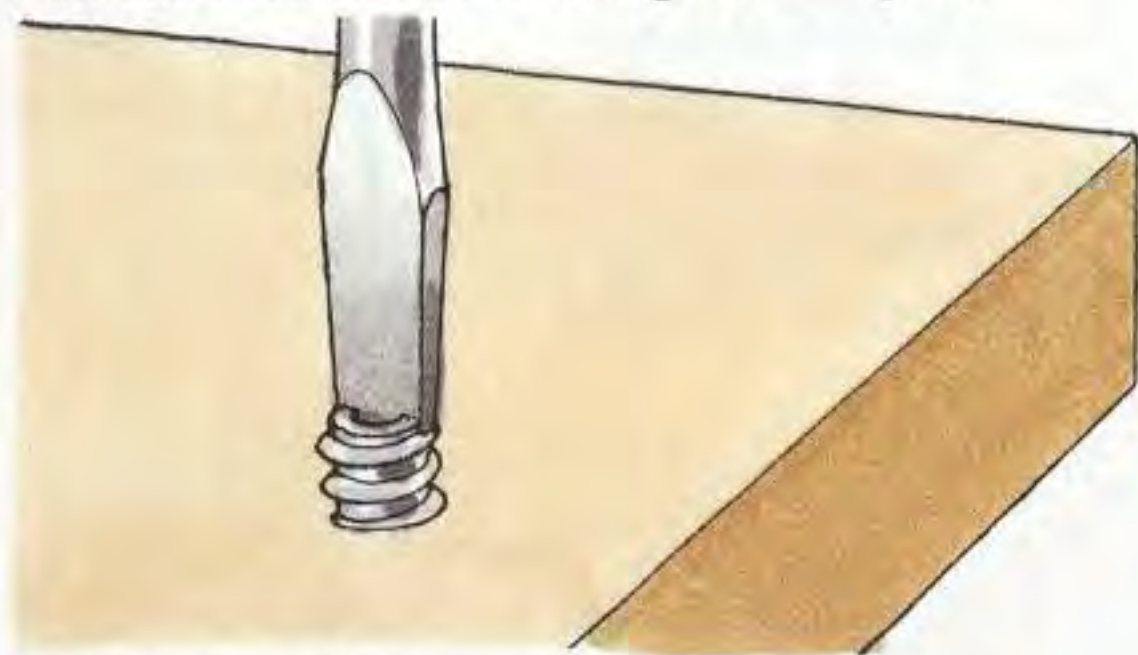
2 Drilling clearance holes

Clamp the jig over the end of the upright component, aligning it with similar screw centres. Bore clearance holes through the panel, using the boss on the side of the jig to guide the drill bit. Screw the joint together – only hard plastic-faced materials need countersinking.

SCREW SOCKETS

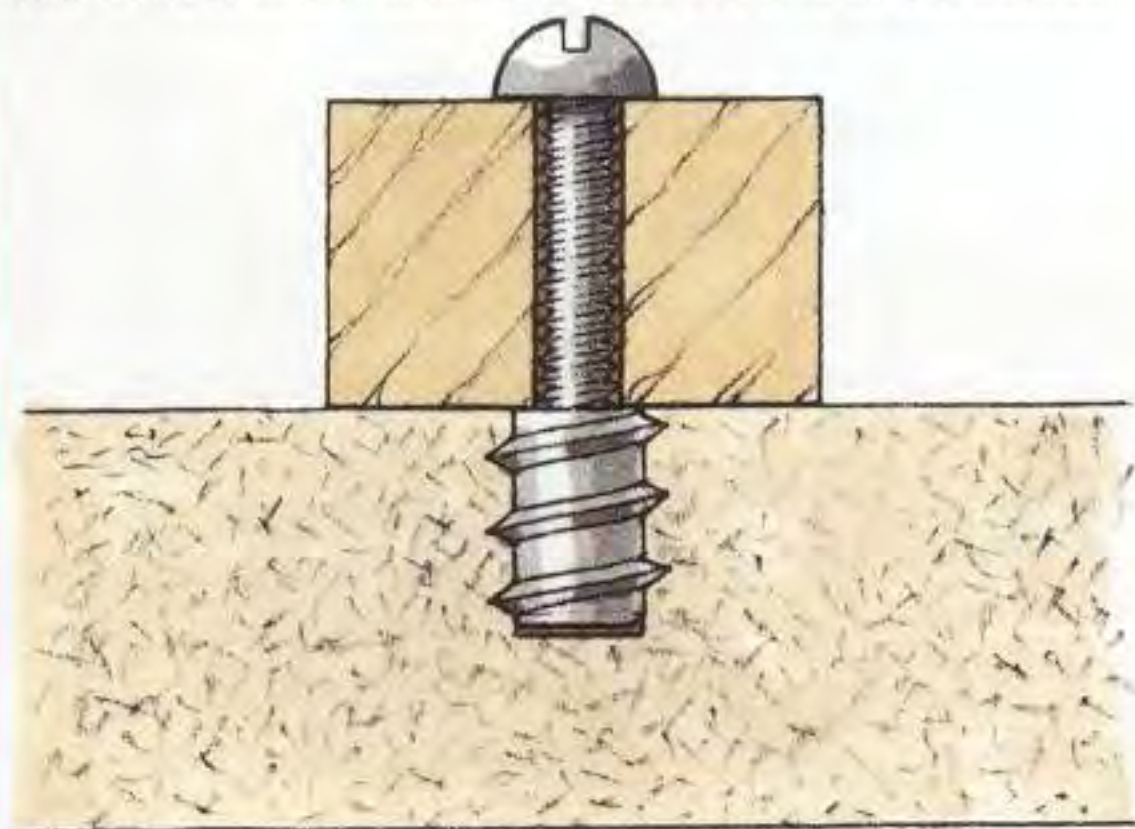


Threaded-metal screw sockets provide secure fixing points for bolting together wood frames or man-made boards. A coarse thread on the outside of each fitting pulls the socket into a stopped hole drilled in the face of one component. A finer thread on the inside of the fitting receives a metal bolt that holds the other component in place.



1 Fitting a socket

Bore an 8mm ($\frac{5}{16}$ in) diameter stopped hole deep enough to set the socket just below the surface of the workpiece. Drive the fitting into the hole, using a screwdriver in the slot cut across the end of the socket.



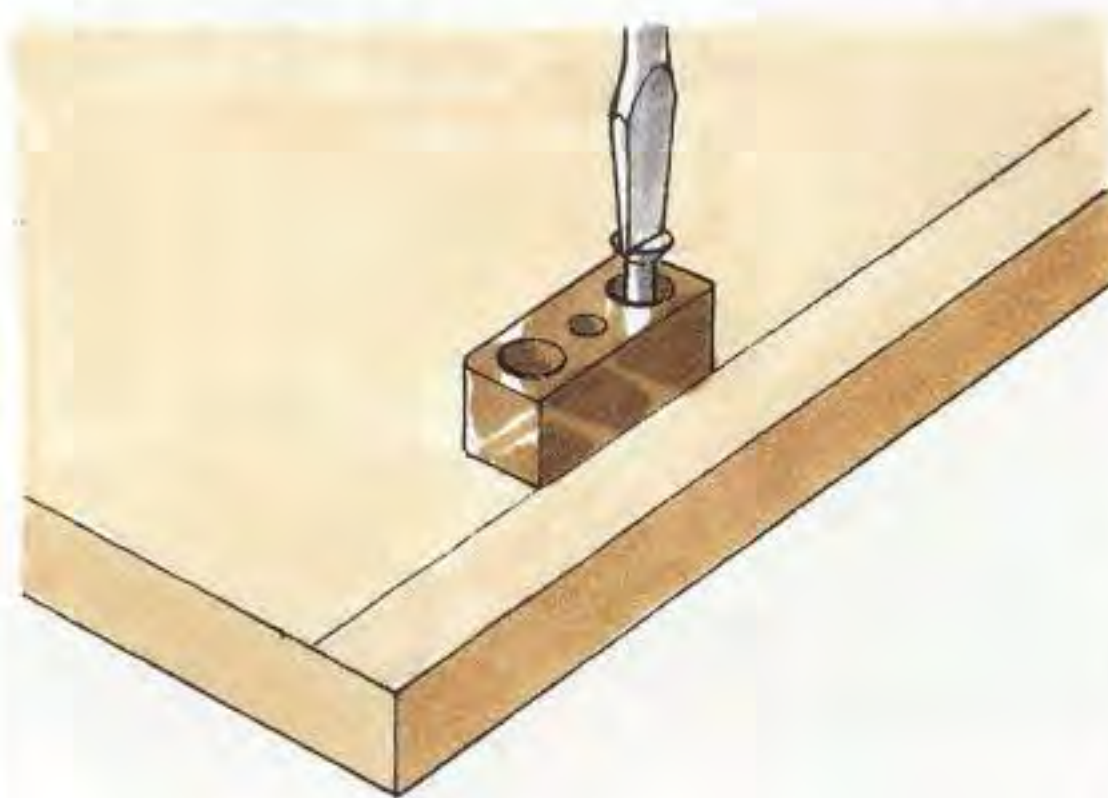
2 Assembling the components

Mark the centre of a clearance hole for the bolt in the other component and drill right through it, taking care not to splinter the wood fibres on the underside. Assemble the two halves of the joint, clamping them tightly with the bolt.

BLOCK JOINTS

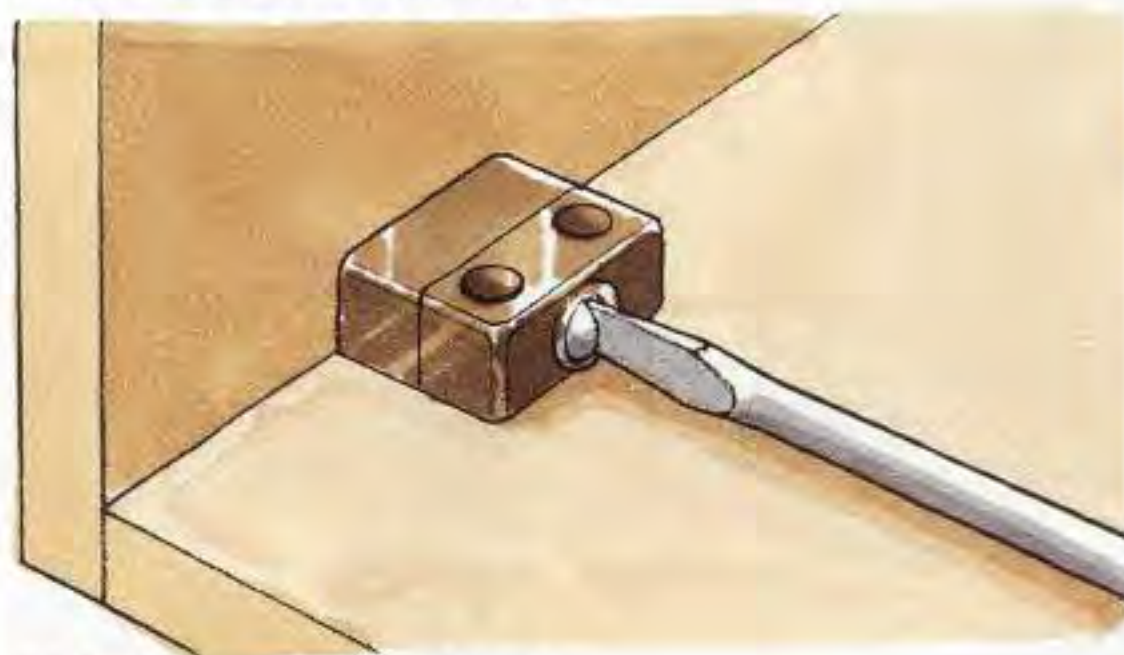


This inexpensive, surface-mounted fitting consists of interlocking plastic blocks screwed on the inside of cabinet corners. Moulded dowels on one half of the joint locate with sockets in the other. When two panels have been joined at right angles, the block fittings are clamped together with a bolt.



1 Fitting the socket blocks

Mark the thickness of the board on the inside of the carcass side panel. Mark the positions of two block joints about 50mm (2in) from the front and back edges. Align the base of each socket block with the marked lines, and screw it to the panel.

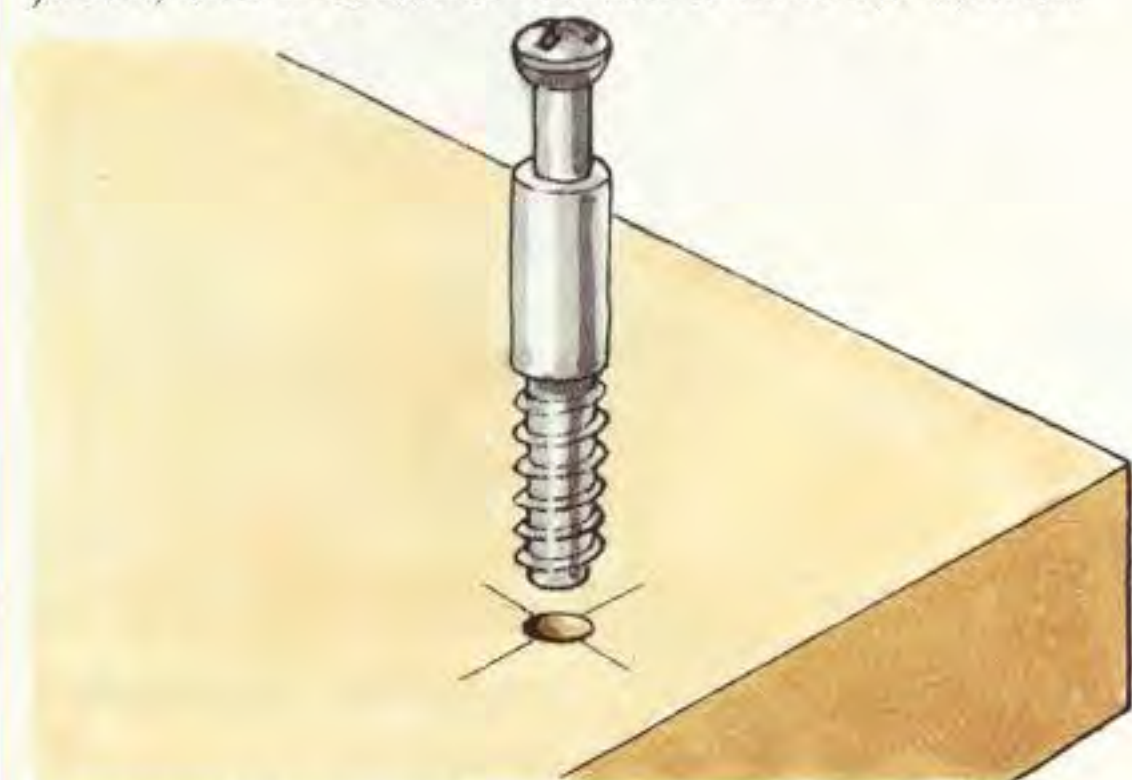


2 Fitting the dowel blocks

Holding the panels together at right angles, fit the mating dowel blocks and mark their fixing holes on the other board. Screw the blocks in place, and assemble the joint with the clamping bolts.

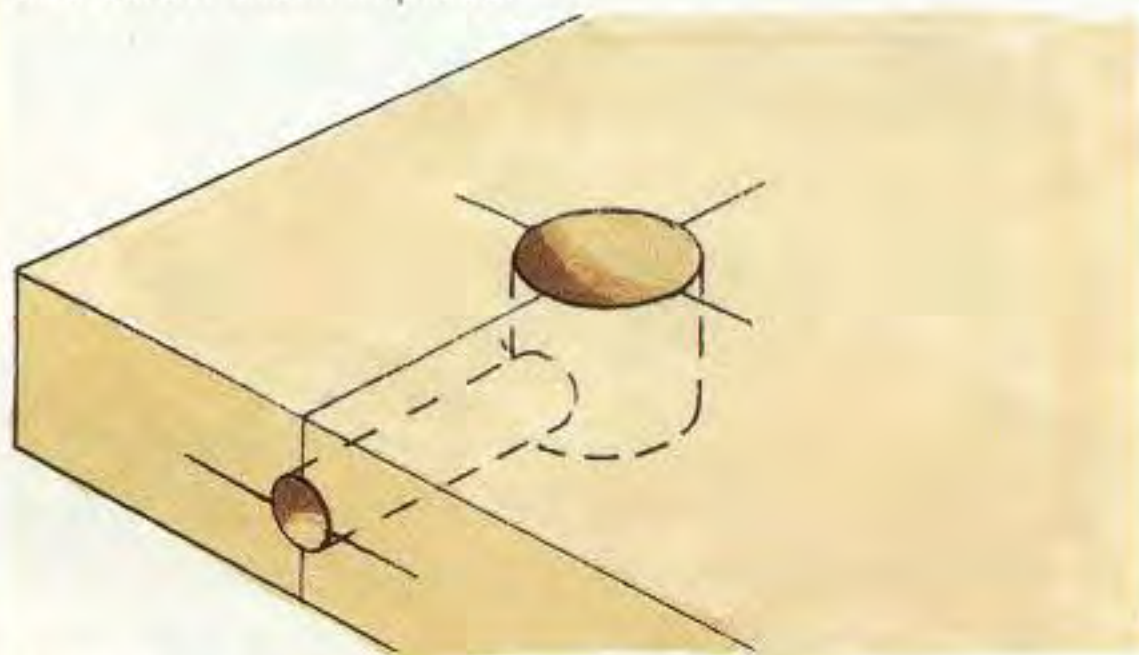
CAM FITTINGS

The cam fitting is a discreet knock-down joint for carcasses constructed from man-made boards. It is used to make corner joints, or for holding shelves and vertical dividers. A round-head metal dowel screwed into the vertical component or side panel locates with a cam-action boss set in the underside of the horizontal component or shelf. Turning the boss with a screwdriver pulls the joint tight. The standard straight dowel is made with a coarse thread that screws directly into the board. Another type of dowel screws into a plastic or metal insert. Double-ended dowels secure straight end-to-end joints, and a cranked version is used for mitres.



1 Fitting the dowels

For a corner joint, set a marking gauge to half the thickness of the board and scribe a line on the inside of the side panel. Mark off two centres equidistant from each edge; a wide panel may require another dowel in the middle. Drill pilot holes for coarse-threaded dowels, and screw them in place.



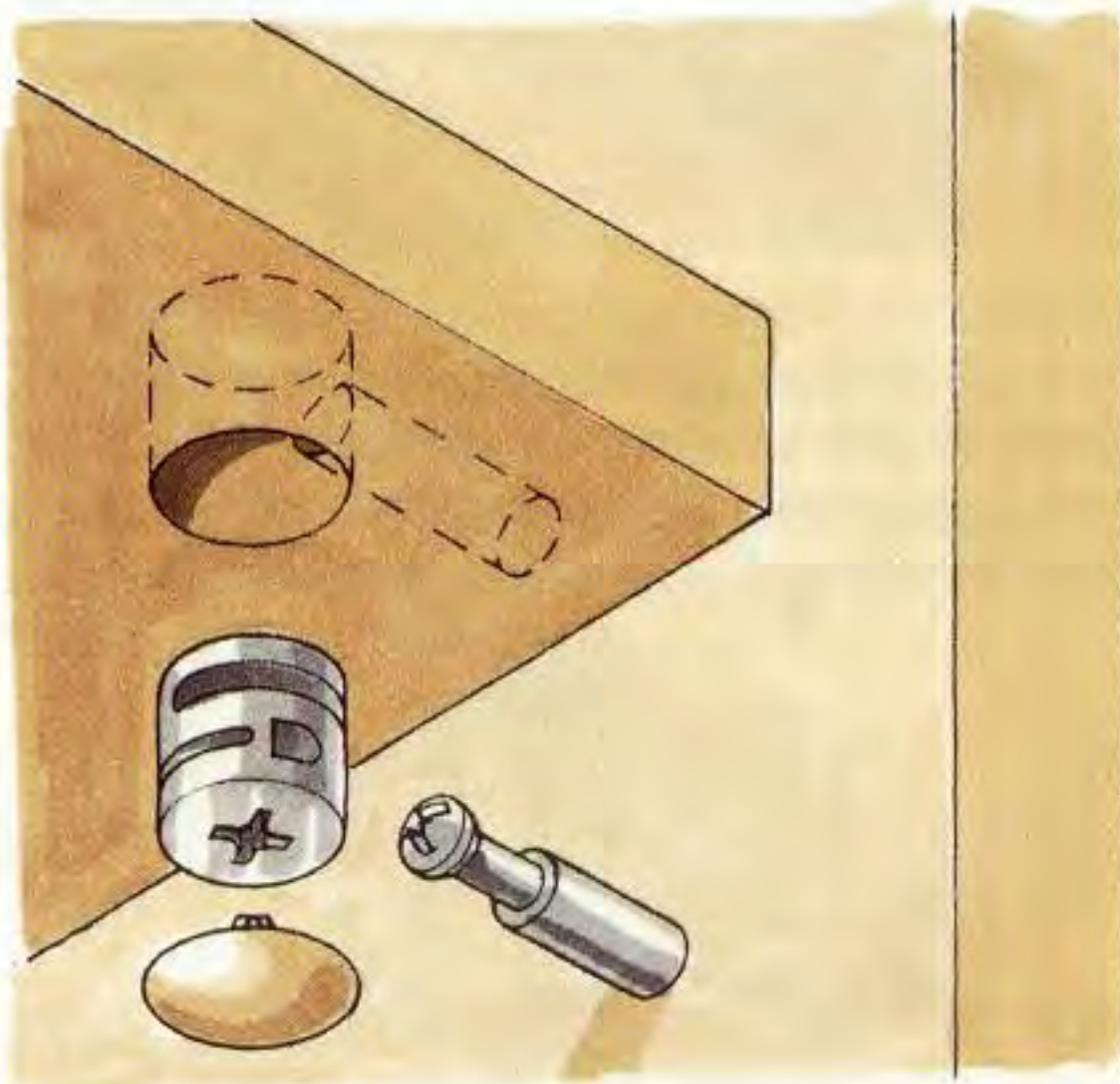
2 Inserting cam-action bosses

Scribe a line centrally on the end of the shelf and, using the side panel as a guide, mark out the positions of clearance holes for the dowels. Drill the holes to the required depth. On the underside, use a Forstner bit to drill stopped holes that intercept the centre of the dowel holes, and insert the bosses.



3 Assembling the joint

Each boss is marked with an arrow that should point towards the side panel. Assemble the joint with a dowel in each hole, then turn the bosses with a screwdriver to lock the components together.



CHAPTER 14 Although woodworking machinery produces work with ease and accuracy, handtools are still important in joint-making. It is often more convenient to hand-make a limited number of joints, and it is impossible to make certain joints with a power tool. This glossary lists joint-making handtools, power tools and machinery; special jigs and templates are found with the relevant joints.

MEASURING AND MARKING TOOLS

Accurate marking-out is the key to good joint-making. A few basic tools enable you to measure out workpieces and to scribe dimension lines on solid wood and man-made boards.



Steel rule

A metalworker's steel rule is useful for taking precise measurements, and doubles as a short straightedge for scribing dimension lines on a workpiece with a marking knife.

Straightedge

A strip of steel with one bevelled edge is useful for marking out long, straight lines, and is essential for checking that a surface is cut or planed flat.

Retractable tape measure

A good-quality, flexible steel tape measure is ideal for measuring all but the smallest workpieces. Choose one that is about 5m (16ft) long and is calibrated for both imperial and metric dimensions, so that you can convert one system to the other quickly and easily.

Try square

A necessary tool for checking the accuracy of right-angle joints and for marking lines at 90 degrees to an edge. Choose a square with a 300mm (1ft) blade.

Mitre square

The blade of a mitre square passes through the stock at an angle of 45 degrees. It is used to mark out and check the accuracy of mitre joints.

Sliding bevel

A sliding bevel is used for the same purpose as a mitre square, but its blade is adjustable to any angle.

Marking knife

The blade of a woodworker's marking knife is ground to a bevel on one side only, so that its flat face can be run against a steel rule or the blade of a square.

Dovetail template

A template designed for marking out standard dovetails. One blade is made for tails with a slope of 1:6, for softwoods, and the other slopes at 1:8, for hardwoods.

Marking gauge

Use a marking gauge to scribe a line parallel to a planed edge. It is made with a sharp steel pin fixed at one end of a wooden beam. A fence or 'stock' that slides along the beam is clamped at the required distance from the pin, using a brass or plastic thumbscrew. The stock on a good-quality gauge is made with inset brass strips, to prevent wear.

Cutting gauge

Similar to a marking gauge, this tool is fitted with a small blade that passes through the beam and is held in place by a shallow metal wedge. It is used for marking lines across grain, where the pin of a marking gauge would tear the wood fibres.

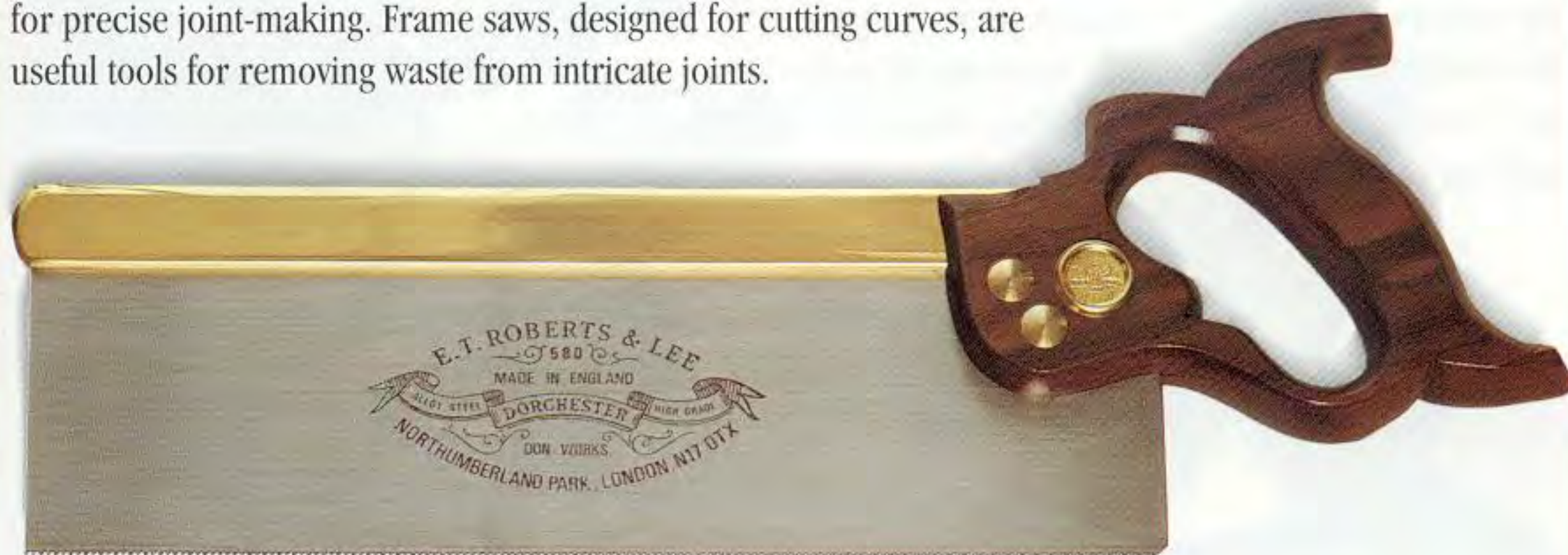
Mortise gauge

A marking gauge with a second, adjustable pin, used for scoring the two parallel sides of a mortise or tenon simultaneously. Most mortise gauges have another single pin on the opposite side of the beam, so that the tool can also be used as a standard marking gauge.



HANDSAWS

Backsaws, with their stiffened blades and relatively fine teeth, are ideal for precise joint-making. Frame saws, designed for cutting curves, are useful tools for removing waste from intricate joints.



Tenon saw (traditional pattern)

Tenon saw

The general-purpose tenon saw is perfect for cutting most workpieces square and for sawing comparatively large joints. A well-balanced tenon saw with a 250 to 300mm (10 to 12in) blade is comfortable to use for extended periods.



Dovetail saw (traditional pattern)

Dovetail saw

A dovetail saw has even smaller teeth than the tenon saw, and is reserved for cutting fine joints in hardwoods. You can get a 200mm (8in) dovetail saw with either a traditional-pattern closed grip or a straight handle and a longer blade.



Dovetail saw (modern pattern)

Coping saw

A lightweight frame saw with a 150mm (6in) blade held under tension, the coping saw is useful for removing the waste from between dovetails and similar joints. The very narrow blades are replaced when blunt or broken.



Coping saw

PLANES

Bench planes are general-purpose tools used to smooth the surfaces of timber and to plane it square and true. Wooden planes are still available, but nearly all planes are now made from metal. In addition, you will need a few specialized planes for shaping and trimming joints.



Jack plane



Metal smoothing plane



Wooden smoothing plane



Rabbet plane

This is no longer an essential tool, now that power routers are widespread, but rabbeting is surprisingly fast by hand. The plane has an adjustable fence and depth stop; with the blade mounted near the toe, you can cut stopped rabbets. The pointed spur mounted on the side of the plane scores the wood ahead of the blade when rabbeting across the grain.

Jack plane

The 350mm (1ft 2in) jack plane is long enough to plane most edges accurately. An even longer version, the try plane, is perfect for preparing edge-to-edge butt joints, but is expensive, so most woodworkers manage with the jack plane.

Smoothing plane

The smoothing plane is the smallest bench plane available, at 225mm (9in) long, and is ideal for final shaping and finishing of workpieces. Some woodworkers prefer the feel of a wooden smoothing plane, with its distinctive ergonomic grip and lignum-vitae sole.



Shoulder plane (top)

A dedicated joint-cutting tool, the all-metal shoulder plane is designed specifically for shaving square shoulders on larger joints. Its blade is set at a low angle to enable it to slice through end grain.

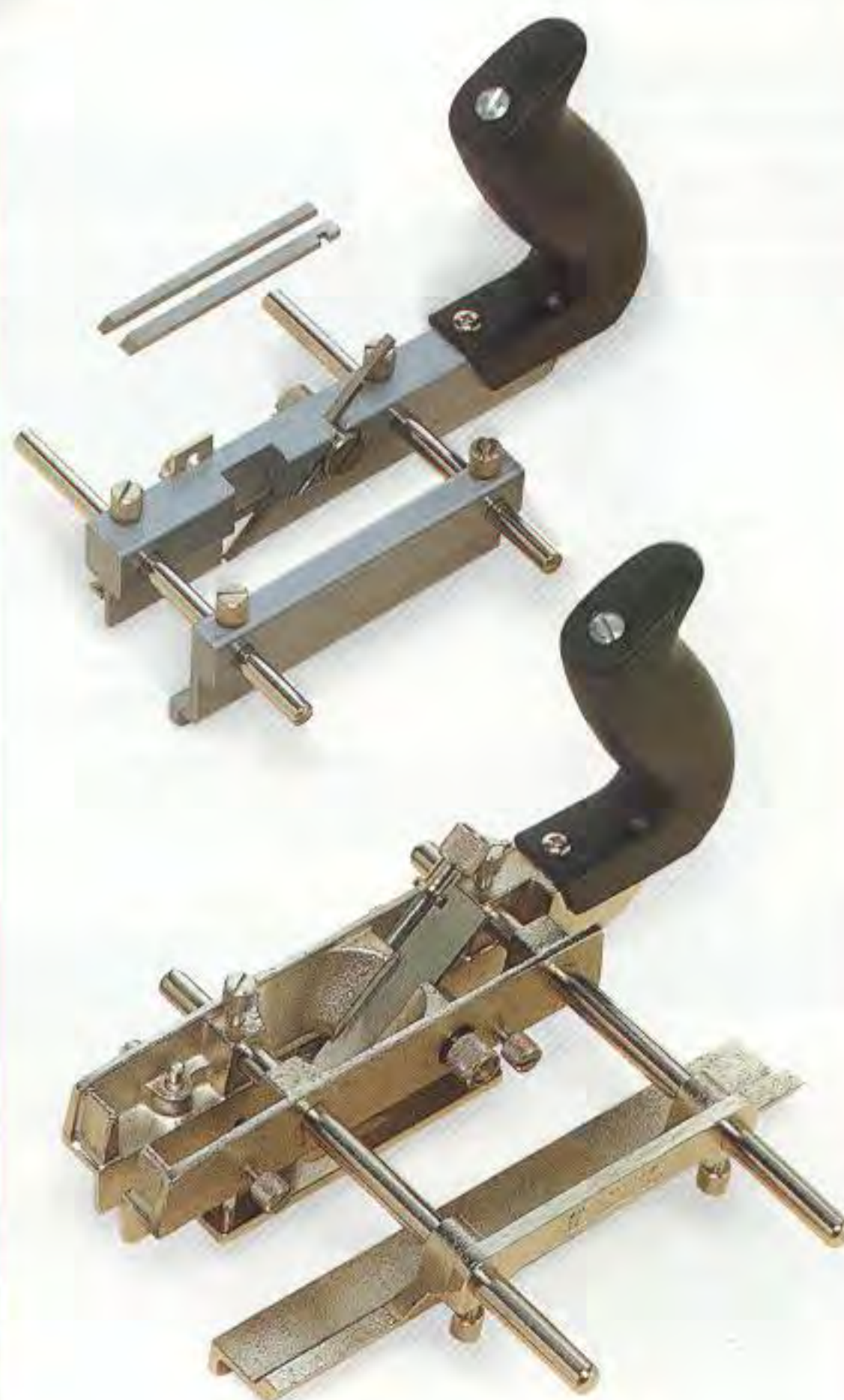
Bull-nose plane (above)

A miniature version of the shoulder plane, the bull-nose plane is useful for trimming small joints.



Block plane

A block plane is small enough to be used single-handedly, yet strong enough to take generous shavings for fast shaping and trimming. It is a good general-purpose plane, much used for cutting end grain.



Plough plane (top)

An inexpensive plane, used for cutting narrow grooves parallel with an edge, this comes with a range of interchangeable cutters, from 3 to 12mm ($\frac{1}{8}$ to $\frac{1}{2}$ in) wide. Plough planes are fitted with a strong side fence and a depth stop.

Combination plane (above)

The sophisticated combination plane cuts even wider grooves than a plough plane, and can be used to shape a matching tongue along the edge of another component. The tool can also be modified to plane a raised bead along a tongued edge.

Router plane (left)

Once the preferred tool for levelling housings and hinge recesses, the hand router plane has largely been superseded by the power router. Nevertheless, because of its relative cheapness and simplicity, it is still a worthy tool, and is capable of very accurate work. Special adjustable cutters are made for levelling square and dovetail housings.

CHISELS AND GOUGES

Woodworking of any kind is impossible without at least a small range of well-made chisels and gouges. In joint-making, they are especially useful for removing waste wood and for paring components to make a snug fit.



Firmer chisel



Bevel-edge chisel



Cranked paring chisel



Paring chisel



Sash-mortise chisel

Firmer chisel

The standard woodworking chisel has a strong rectangular-section blade which you can confidently drive with a mallet through pine or hardwoods, without fear of it breaking. Firmer chisels range from 3 to 38mm ($\frac{1}{8}$ to $1\frac{1}{2}$ in) wide.

Bevel-edge chisel

The slim-bladed bevel-edge chisel is designed for more delicate work, using hand pressure only. It is used primarily for shaping and trimming joints, and the bevels ground along both sides of the blade make the chisel suitable for working dovetail undercuts. Bevel-edge chisels are made to the same widths as firmers.

Paring chisel

A paring chisel is a bevel-edge chisel with an extra-long blade for levelling housings. A cranked version makes it possible to pare waste from very wide joints.

Sash-mortise chisel

This is a specialized chisel for cutting deep mortises. It is made with a tapered blade that does not jam in the work, and which is thick enough to be used as a lever when chopping waste out of a joint. The deep blade sides help keep it square to the mortise. Mortise chisels are made up to 12mm ($\frac{1}{2}$ in) wide.

Firmer gouges

A gouge is a chisel with a blade curved in cross section. When the cutting-edge bevel is ground on the inside of the blade, it is known as an in-cannel gouge; the tip of an out-cannel blade is ground on the outside. Gouges are used to scoop waste wood out of hollows and to trim curved shoulders. They average from 6 to 25mm ($\frac{1}{4}$ to 1in) wide.



In-cannel gouge



Out-cannel gouge

HAMMERS AND MALLETS

Most workshops boast a range of hammers, even though they are rarely used in joint-making, except when reinforcing with pins or nails.



Cross-peen hammer

Cross-peen hammer (square pattern)

Pin hammer

Pin hammer (square pattern)

Claw hammer

Cross-peen hammer

One medium-weight cross-peen hammer will suffice for most needs. It is heavy enough to tap joints together and dismantle them again, yet sufficiently well-balanced so that you can perform precise operations, such as starting a nail or panel pin with the wedge-shape peen on the back of the hammer head.

Pin hammer

For delicate work, such as nailing small picture-frame mitres, use a lightweight cross-peen pin hammer.

Claw hammer

You will find a claw hammer convenient for making jigs and mock-ups from softwood. Not only can you drive in large nails with ease, but you can also extract them with the split peen, using the strong shaft as a lever. Though slightly more expensive, all-metal claw hammers are even stronger than those with wooden shafts.

Nail set

A nail set is a tapered metal punch that is used with a hammer to drive nail heads below a wood surface.



Carpenter's mallet

Although you can drive plastic-handle chisels and gouges with a metal hammer, you will need to use a mallet for those with wooden handles, to prevent them splitting. This tool is specially designed for the job; its wide head is tapered so that it will strike a chisel squarely each time, and will wedge itself even more securely on the tapered shaft with each blow.



WOODWORKING CRAMPS

Interlocking woodworking joints are designed to ensure optimum contact area between components, so that they bond well with adhesive. A well-cut joint requires the minimum of clamping pressure, the main purpose of using cramps being to help assemble the workpiece and hold the parts together while the glue sets. It is always useful to have plenty of cramps available, but pairs of each type in a couple of sizes should suffice. Complete sets of cramps are relatively expensive, but you can acquire them over a period of time or hire them as required.

- 1 Pipe clamp
- 2 Sash clamp
- 3 Fast-action clamp
- 4 G-clamp
- 5 Long-reach G-clamp
- 6 Short fast-action clamp
- 7 Handscrew



Mitre clamp

A special clamp holds glued mitre joints at right angles, preventing the components from slipping while reinforcing nails are inserted.

Fast-action cramps

Fast-action cramps are designed for speedy adjustment to fit the size of the work. Various versions are available. The sash type has two movable jaws, one of which is also screw-adjustable. On the smaller version of the clamp, only the screw-adjustable jaw is movable. A lightweight clamp has wooden jaws with a cam-action that provides clamping force.

Handscrews

A traditional clamp with wide wooden jaws that can be set to apply even pressure over a broad area. A handscrew is particularly useful when assembling out-of-square frames or for clamping tapered workpieces.

Sash clamps

Sash cramps are used for assembling large frames, panels and carcasses. A sash clamp has a screw-adjustable jaw attached to one end of a flat steel bar. To accommodate assemblies of different sizes, a second movable jaw slides along the bar and is secured at the required position with a tapered steel pin, that passes behind the jaw into one of a series of holes in the bar. The cramps range from 450 to 1200mm (1ft 6in to 4ft) in length.

G-cramps

The G-clamp is an excellent general-purpose clamp that is often used to hold wood to a bench while you work on it. Usually made from cast iron, the frame forms a fixed jaw. Clamping force is applied by a screw, fitted with a ball-jointed shoe. G-cramps are manufactured in many sizes.

Pipe cramps

Similar in most respects to sash cramps, the jaws are attached to a length of round steel pipe.

SETTING UP FOR CLAMPING

When gluing up any assembly, it pays to prepare the work area and rehearse the procedure in advance. This avoids delays that could lead to complications, especially when using a fast-setting adhesive.

Assemble the parts without glue, to work out how many cramps you need and to allow you to adjust them to fit the work. You will find a helper most useful when clamping large or complicated assemblies.

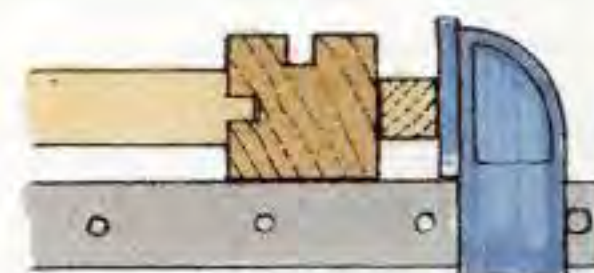
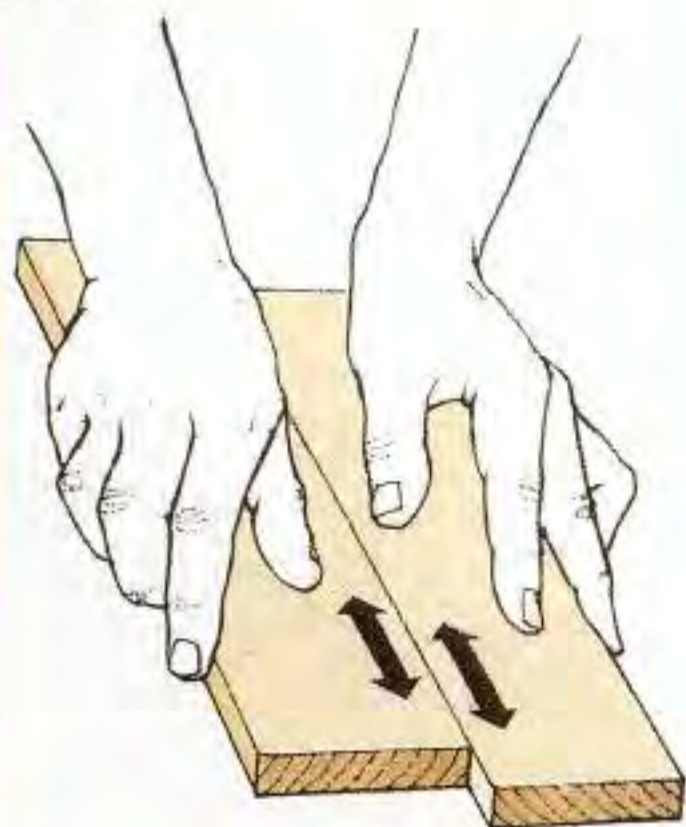
It isn't necessary to glue every joint at once. For example, glue the legs and end rails of a table frame first; when these are set, glue the side rails between them. (See page 26 for clamping a solid-wood panel, using edge-to-edge butt joints.)

CLAMPING A FRAME

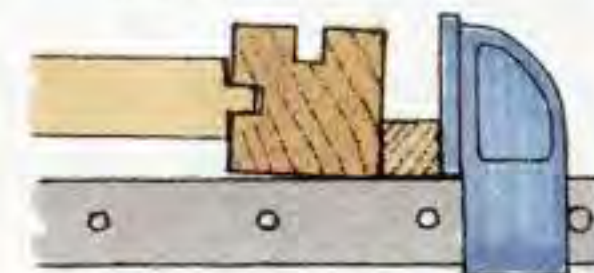
The majority of frame and carcass joints need clamping in order to hold the assembly square until the adhesive sets. Prepare a pair of sash or pipe cramps, adjusting them so that the assembled frame fits between the jaws, allowing for softwood blocks to protect the work from the metal cramp heads. Carefully position the blocks to align with each joint – a misplaced or undersize block can distort the joint and bruise the wood.

MAKING RUBBED JOINTS

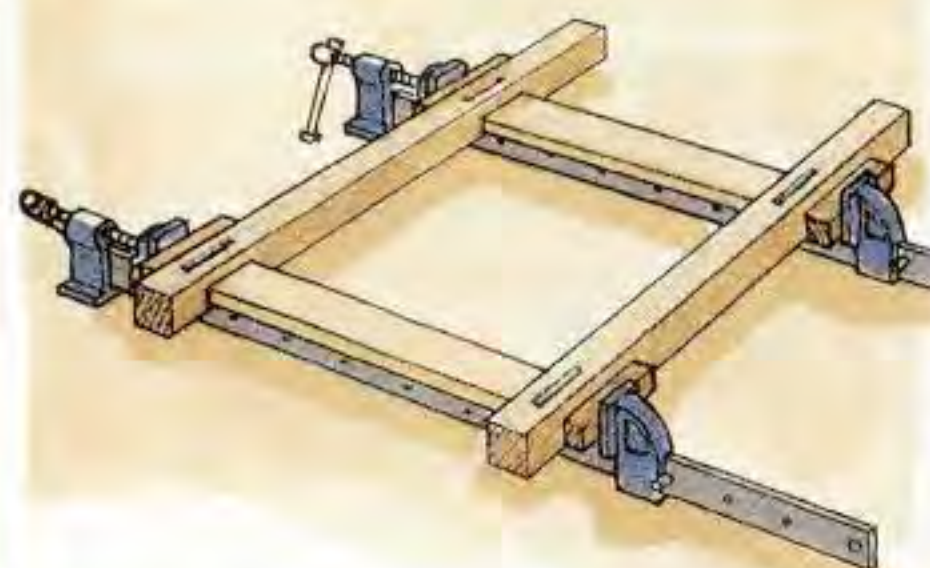
Small, accurately cut edge-to-edge joints can be assembled without cramps. Apply glue to both parts and rub them together, squeezing out air and adhesive until atmospheric pressure holds the surfaces in contact while the glue sets.



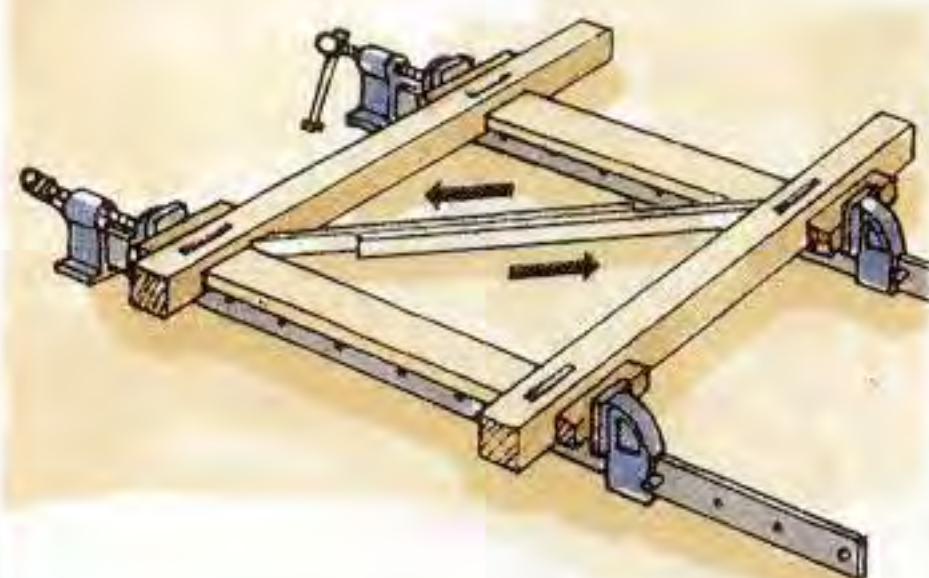
Block aligned



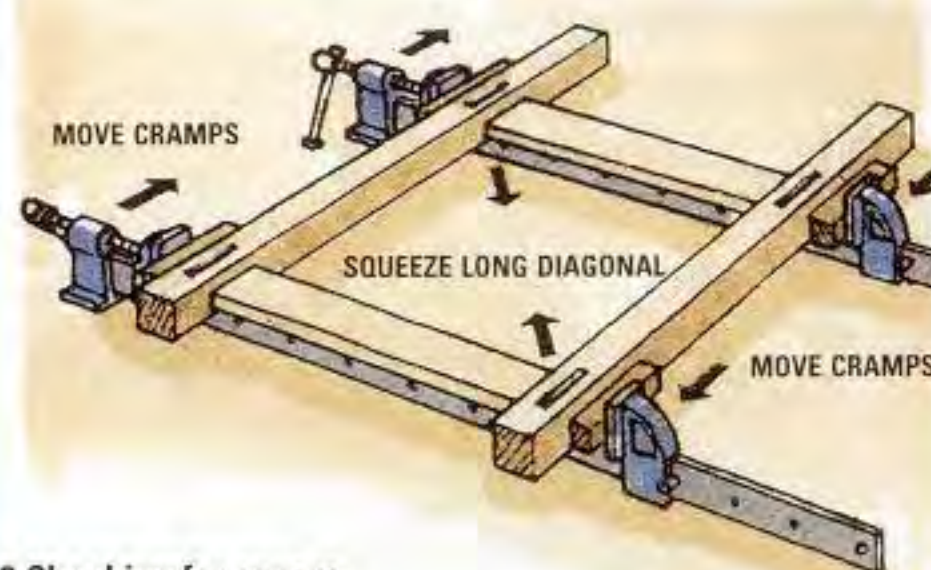
Block misaligned



1 Aligning the cramps



2 Making pinch rods



3 Checking for square

1 Aligning the cramps

Apply adhesive evenly to both parts of each joint. Assemble the frame, ensuring that the cramps are perfectly aligned with their respective rails, and gradually tighten the jaws to close the joints. Wipe off excess adhesive squeezed from the joints, using a damp cloth.

2 Making pinch rods

You can check the accuracy of a small frame with a try square at each corner, but for larger ones, measure the diagonals to ensure they are identical. Make a pair of pinch rods from thin strips of wood, planing a bevel on one end of each rod. Holding the rods back to back, slide them sideways until they fit diagonally across the frame, with a bevelled end tucked into each corner.

3 Checking for square

Holding the pinch rods together firmly, lift them out of the frame and check to see if they fit the other diagonal exactly. If the diagonals are different, slacken the cramps and set them at a slight angle to pull the frame square, then check the diagonals again.

WOODWORKING ADHESIVES

Supplied in liquid form, or as a powder or granules for mixing with water, woodworking glues can be applied with a brush, roller or spreader. All adhesives are absorbed into the wood's cell structure, forming a strong link between the fibres of both halves of a joint; however, those that set by evaporation are rarely water-resistant. For a bond in moist conditions, select one that cures by chemical reaction.



APPLYING WOODWORKING GLUE

Joints should be made to fit well, rather than relying on the gap-filling properties of adhesive. Make sure the gluing surfaces are clean and free from grease. Some woods, such as teak and rosewood, are best glued as soon after cutting as possible, before their natural resins form a surface film that prevents glue being absorbed properly.



Working in a warm, dry atmosphere, apply glue in a thin, even layer to both halves of a joint. Take care to coat the surfaces of a mortise, since most of the glue applied to the tenon is wiped off as the joint is assembled.

Don't rush when gluing up, but work as quickly as practicable, in order to assemble joints before the wood begins to swell and the glue starts to jell. For a large or complicated assembly, use a two-part glue that is applied separately to joining surfaces. Place glued components in cramps, and wipe off excess adhesive with a damp cloth.

PVA adhesive

Commonly known as white glue, polyvinyl-acetate (PVA) glue is a popular and convenient adhesive for joint-making. A ready-mixed emulsion supplied in plastic bottles, PVA sets by evaporation. It is a non-toxic glue that is easy to apply and is almost clear when set.

General-purpose PVA glue is only suitable for interior work. Although it forms a strong bond, the glue line remains relatively flexible and may creep (allow movement) when a joint is subjected to a prolonged heavy load. It does not sand well, as friction causes the glue to soften and clog abrasive paper.

Aliphatic-resin PVA glue is similar to the general-purpose version, but has improved moisture resistance and is less flexible.

Chemical-bonding, 'cross-linking' PVA glue is even more water-resistant, and forms an exceptionally strong bond.

Urea- and resorcinol-resin adhesives

Urea-formaldehyde-resin glue is a two-part adhesive that sets by chemical reaction. It is an excellent water-resistant adhesive that dries with a hard glue line. The resin and hardener are usually supplied pre-mixed as dry powders that are activated when mixed with water; the mixture remains workable for 20 minutes.

With some urea glues, the resin is packaged with a separate liquid

hardener. The resin is applied to one half of the joint, the hardener to the other, and the glue only begins to set when the joint is assembled.

For even greater strength coupled with superior water-resistance, choose a resorcinol-formaldehyde glue, a two-part adhesive that is mixed prior to application. Either a liquid resin is supplied with a powdered hardener, or both constituents are in liquid form. Resorcinol resin dries to a reddish-brown glue line.

When working with uncured glue that contains formaldehyde, always work in a well-ventilated workshop, and wear a face mask, gloves and eye protectors.

Hide glue

Traditional hide glue has been largely superseded by synthetic-resin adhesives, but still has advantages for furniture restoration and veneering. It is a strong-smelling, but non-toxic, glue made from animal skins and bone. It forms a strong bond that can be reversed by the application of heat and moisture. Hide glue is usually supplied in granular form for dissolving in water heated in a jacketed glue pot. When rendered to a smooth, runny consistency, the glue is applied hot to both joining surfaces. It sets, by cooling and evaporation, in about two hours.

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