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Module 2

Practical Woodwork -

Basic Tools & Joining Techniques

2021

CPD for technical teachers & support staff in schools

2

Contents

2

2

Part 1 - Practical Woodwork Skills

2

1 AIMS AND OBJECTIVES

1.1 Aims

The aim of this course is to develop teaching skills needed to create a range of woodworking joints, as required as part of the SQA Practical woodworking courses.

This course is primarily suited to newly qualified teachers (NQT) and/or teachers who are new to teaching this SQA course.

1.2 Objectives

1.2.1 Work with a range of basic hand tools.

1.2.2 Prepare and properly mark out timber.

1.2.3 Demonstrate how to create a selection of woodworking joints.

1.2.4 Demonstarte an understanding of the theory behind different jointing techniques.

1.2.5 Develop skills and knowledge of safeworking practices.

2 PRACTICAL WOODWORKING

This is broken down into 'Flat Frame' and 'Car-case construction' units. In general however, candidates are required to;

- Prepare flat frame/carcase woodworking tasks.
- Selecting appropriate tools/equipment.
- Check tools and equipment is safe and in good condition.
- Using correct names and terminology
- Construct a range of basic flat-frame/car-case woodwork joints.
- Use tools and equipment safely and correctly

Teaching staff are required to be familiar and comfortable with the tools, processes and concepts in this woodworking area in order to deliver courses effectively.

3 INTRODUCTION TO WOOD JOINTS

Many people regard joint making a measure of woodworking skill, as the ability to cut fine joints takes practice and requires the mastering of a variety of tools such as saws, planes and chisels.

The majority of joints in timber construction have been designed to perform certain functions. From experience their proportions have become standard in order to maintain maximum strength with the pieces they connect.

Therefore, it is important to select wood joints appropriately, maintaining strength but also in keeping with the overall style of the project.

This course and booklet act as a basic help guide in helping teaching staff develop hand skills and knowledge of the different tools, joints and safety considerations required for delivering, BGE and National Qualifications in Practical Woodwork.

4 MARKING OUT TOOLS

4.1 Steel Rule

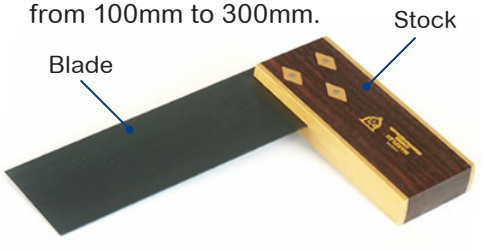
The steel rule is used to measure material such as wood, metal and plastics. It reads from zero to 300mm in 1mm steps. Rules are made from hardened and tempered tool steel in order to maintain their accuracy. They are often available in a satin or bright finish.

4.2 Marking Knife

When marking out joints etc on wood all marks should be primarily done using a pencil. A making knife is then used to sever the wood fibres to ensure a clean edge when you saw to the line. It consist of a hardened steel blade which is bevelled on one side only and a wooden handle. The knife should be used on the waste side of the line, running the flat face of the blade against a try square.

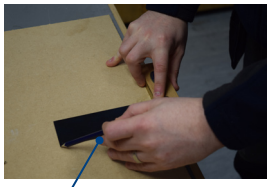
4.3 Try Square

The try square is used to test if material is square and to mark out lines at right angles to a given surface on wood. The stock is usually made from Rosewood (or sometimes plastic) and is faced with a brass plate to increase its accuracy. The blade is made from high carbon steel, hardened and tempered. Try squares sizes are based on the length of the blade and generally range from 100mm to 300mm.

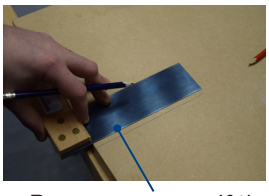


A try square with a wooden stock can react to humidity and the rivets holding the blade can work loose if the tool is dropped.

To check the accuracy of the square, first use it to draw a line at right angles to a surface. Then turn the blade over and align it with the marked line. The edge of the blade and the marked line should match up exactly.



Hold the square against a true edge and draw a line



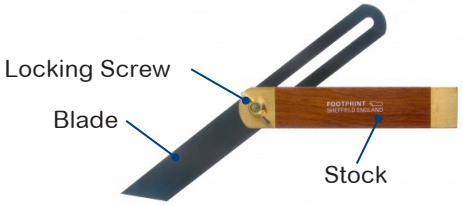
Reverse square, if the blade lines up with the drawn line then try square is accurate

4.4 Combination Sqaure

The combination has one face set at 90° and one face set at 45° to the blade. This type of square is useful for marking out mitres. The stock is made from machined cast metal and the blade from high carbon steel, hardened and tempered. The blade is also calibrated like a steel rule which means it can be set to any size and used as a depth gauge to test mortises or rebates. Some combination squares also feature a sprit level and small scriber screwed into the stock.

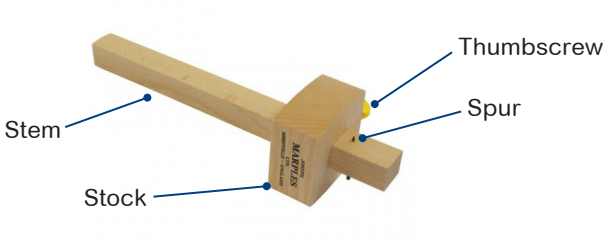
4.5 Sliding Bevel

The sliding bevel is used for marking out and testing angles other than 90°. The stock pivots on and slides along a slot cut in the centre of the blade and it can be locked in any position by means of a locking screw. The blade and stock are made from the same materials as a try square.



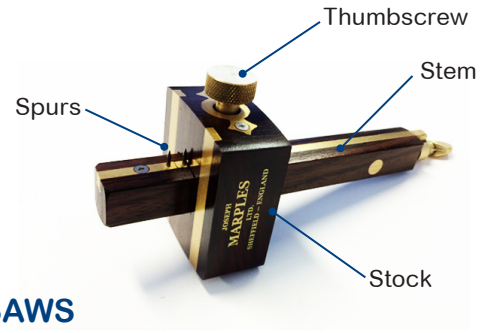
4.6 Marking Gauge

The marking gauge is used for marking lines parallel to an edge, on timber. The stock and stem are made from beech, because beech is a very hard wearing wood, whilst the spur is made from tool steel sharpened to a point. The thumb screw is made from plastic or box wood and then threaded into the stock.



4.7 Mortise Gauge

The mortise gauge is used to mark out mortise and tenon joints by marking 2 lines parallel to an edge. It is of similar construction to a conventional marking gauge with the exception of an extra movable spur fitted on to a sliding brass rod. The stock and stem are generally made from rosewood with the stock having two brass strips recessed into the working faces to minimise wear.

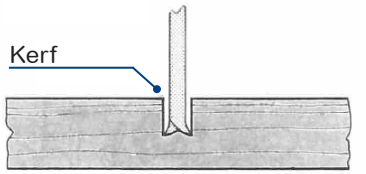


5 SAWS

5.1 Tenon Saw

The tenon saw is used for general bench work and joint construction in wood. The fine teeth, 12 to 14 teeth per 25mm, ensure a fine saw cut or KERF. To help prevent the saw blade jamming when sawing, the teeth are SET, i.e. the first tooth is bent to the right and the second to the left and then right and so on. The purpose of this is to make a bigger gap than the thickness of the blade, this will

allow the blade to cut without jamming. The tenon saw has a brass or steel stiffening rib which strengthens the back of the blade and prevents it from being too flexible.



5.2 Dovetail Saw

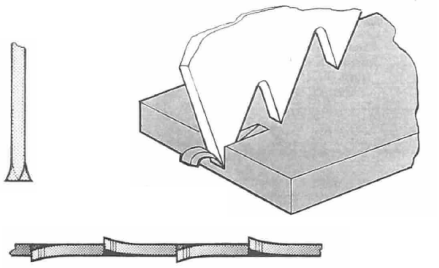
The dovetail is a smaller type of tenon saw and can have a closed or open handle. The blade is usually 150mm long with 18 to 22 points per 25mm of its length. This saw is used mainly for cutting dovetails when making cabinet drawers or when cutting other fine work.

5.3 Gents Saw

The gents saw has a very small blade with a strengthening rib and a plain round handle. It is used for super fine work in timber such as very small dovetails and cutting fine mouldings. The length of this saw varies from 100 to 200mm with 24 to 32 points per 25mm

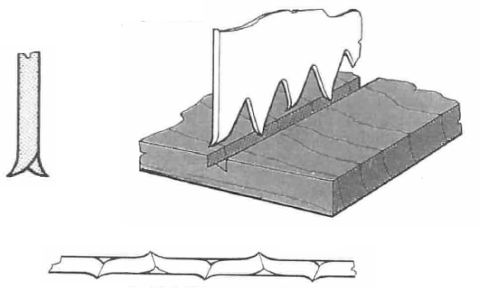
5.4 Rip Saw

A rip saw is used for cutting timber in the direction of the grain and has 3 ½ to 4 points per 25mm. The blade length range from 500 to 750mm. The length of the blade is selected depending on the height or the user. The cutting action is similar to a row of chisels placed directly one behind the other, each tooth removing a shaving the full width of its cutting edge.



5.5 Cross Cut Saw

The cross cut saw is used for cutting across the grain of the timber and has 5 to 7 points per 25mm if its length. Blade length varies from 550 to 700mm. The teeth are beveled on the front of their cutting edges, giving a cutting action similar to a series of knife –edges which sever the fibres of the wood, first on one side, then on the other. The wood between the points crumbles away and is ejected by the gullets of the teeth.



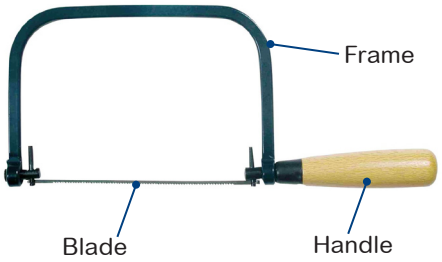
5.6 Panel Saw

A panel saw is used mainly for sawing thin timber across the grain. It is also used for cutting plywood, hardboard and “soft” plastics such as

PVC. The teeth of the panel saw are the same shape as those of the crosscut saw, but much smaller, thus giving a finer cut. The length of the saw varies from 450 to 550mm with 10 to 12 points per 25mm.

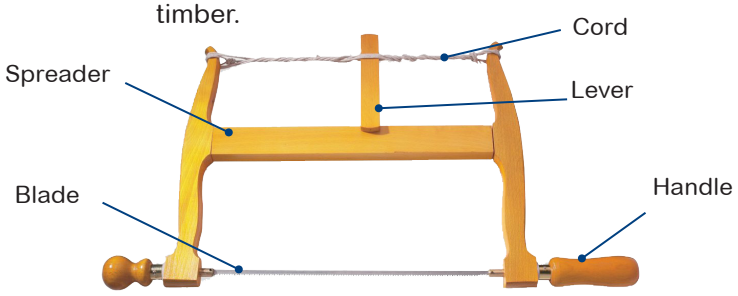
5.7 Coping Saw

The coping saw is used to cut curves and other awkward cuts in wood.
It has a narrow blade to enable it to turn in the saw cut or "kerf". It is also unique as it is one of only a few saws which has its teeth facing back-wards towards the handle. In normal sawing the cut is made in the forward stroke, but with the coping saw, the cut is made on the backward stroke.



5.8 Bow Saw

The bow saw has a blade, usually 6mm wide and 300mm long, held in a beech frame. Tension is applied to the blade by means of a cord and a winding lever. The blade is secured by means of a knob at one end and by the handle at the other. Both these are free to revolve in the frame so the saw can be set to cut in any direction. The bow saw is used for external curve cutting on fairly thick timber.



5.9 Pad Saw

This type of saw has a narrow blade about 300mm long and is fitted with a round handle. Mainly used for cutting internal curves in timber where the bow saw, or coping saw cannot be used.

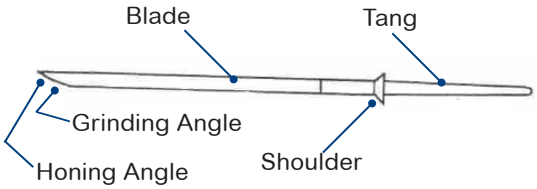
5.9 Compass Saw

The compass saw has a narrow tapering blade from 300 to 400mm long and is fitted with an open handle. The teeth are sharpened like a crosscut saw. It is used for cutting large interior or exterior curves in timber. Like the keyhole saw it may be necessary to bore a hole in the timber through which to start the saw for internal curves.

5.8 Sawing Board

A sawing board or bench hook is used for crosscutting short length of timber with a tenon saw (or other backsaw) A block of wood fixed to the underside rests against the front edge of the bench and the work is held against a second block fixed to the top. A sawing board is generally made from beech due to its hardwearing properties.

6 CHISELS



6.1 Parts of the chisel

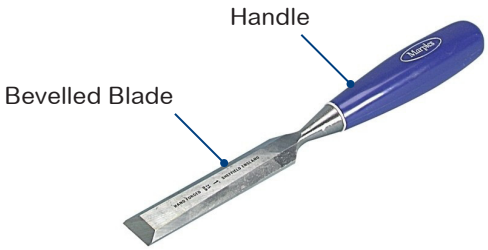
1. **Handle:** The handle is usually made from beech, ash or plastic
2. **Ferrule:** On wooden handles a ferrule is add to prevent the handle from splitting when the tang of the chisel is fitted into the handle. This is a ring of metal, usually made from brass or steel that is fitted tightly round the neck of the handle.
3. **Tang:** The tang is the end of the blade that is fitted into the handle. The tang is left softer than the blade of the chisel and it is shaped like a long thin square based pyramid.
4. **Blade:** The blade is made from high carbon steel which is then hardened and tempered. The cutting edge has two bevels, a grinding angle of 20˚ to 25˚ and a honing angle of about 30˚
5. **Shoulder:** Immediately behind the tang of the blade is the shoulder. Its function is to prevent the handle being driven to far into the handle.
6. **Size:** The size of chisels are specified by the width of the blade. This can range from 3mm to 50mm.

6.2 Firmer Chisel

The firmer chisel is used for general chiseling purposes in wood. Its sturdy construction means that it can be used for light chiseling with a mallet. It has a rectangular blade with a tang at one end. A brass ferrule prevents the handle from splitting where the tang enters. More modern chisels have plastic handles, this type of handle should still not be struck with a metal faced hammer to prevent damage to the handle.

6.3 Bevelled Edge Chisel

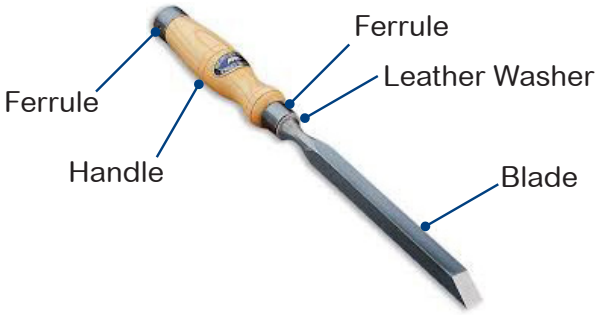
The bevelled edged chisel is used for paring and general chiselling of wood. Two edges of the blade are bevelled along their length and this makes it suitable for accurate joint work. The size of the chisel is indicated by the width of the blade (3mm - 50mm)



6.4 Mortise Chisel

A mortise chisel is used with a mallet for heavy work such as mortising. The mortise chisel is much stronger than the firmer chisel. It has a thicker blade and a steel ferrule at each end of the handle. A leather washer between the shoulder

of the blade and handle act as a shock absorber when the chisel is used with a mallet.



Safety Note: When working with the bevelled edge chisel (or any other type of wood chisel) ALWAYS keep both hands behind the cutting edge.

6.4 Firmer Gouge

The firmer gouge (or carving gouge) is used for grooving, fluting and general carving work. Ground and sharpened on the outside or convex edge.

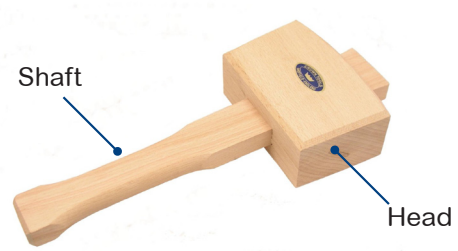
6.5 Scribing gouge

The scribing gouge (or paring gouge) is used for scribing mouldings to one another and for chiselling internally curved or concave surfaces. Ground and sharpened on the inside.

7 STRIKING TOOLS

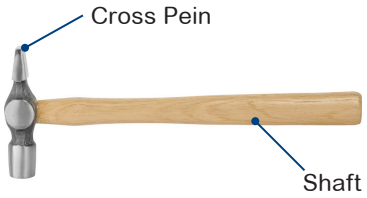
7.1 Mallet

The carpenter's mallet is used in wood work for striking chisel handles when heavy cuts such as chiseling out mortises, is required. The head and shaft are made from beech with the shaft entering the head through a tapered hole. The striking faces of the head are shaped to ensure that mallet blows land square on the chisel handle.



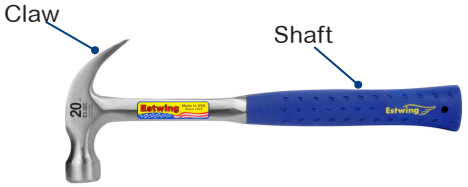
7.2 Cross Pein Hammer

Cross pein hammers are used for light work with the cross pein part used to start short nails or panel pins. Sizes run in numbers from 00 – 12 with number 3 (about 0.35Kg) being the most common size of head.



7.3 Claw Hammer

The claw hammer has a forged steel head, the mass of which determines the hammer size. These sizes range from 0.2 to 0.9kg. Common sizes are 0.45 to 0.57kg. Steel wedges are used to secure wooden shafted hammers to the head. The claw part of the head is used to extract nails.



7.4 Nail Punch

Punches are made from high carbon steel hardened and tempered at the point with the body knurled to ensure good grip. Nail punches are used to drive nails or pins below the surface of the wood.

8 BENCH PLANES

Bench planes are used to produce smooth, flat surfaces and edges on wood by the removal of a series of thin shavings. Metal bench planes all have the same basic construction with the major difference being in their respective lengths. The size of a plane, i.e. the length of the sole and width of cutting iron is specified by a number.
The following bench planes are generally found in school workshops.

8.1 Smoothing Plane

Smoothing planes are used of "cleaning up" surfaces prior to sanding and varnishing. The length of the body is 240-260mm and the width of the blade is 45-50mm. These range from No.1 to No.4

8.2 Jack Plane

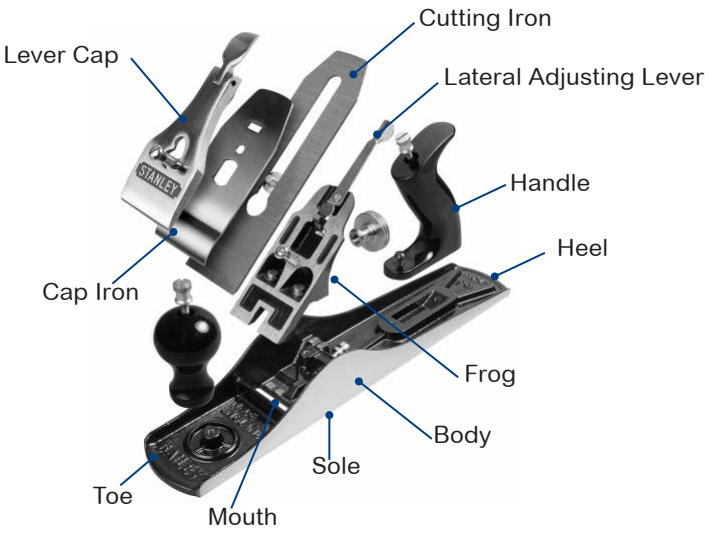
The name "jack plane" is derived from the fact this plane is used for a wide variety of work. It is used to remove marks left on the timber by the saw, to bring timber down to size, to make the surfaces flat and square and for all other planning operations. The length of these planes vary from 350-380mm with a cutting iron width of 50-60mm.
This is commonly known as a No.5 plane.

8.3 Trying Plane

Trying planes are used when planning large lengths of wood and accuracy is important. It is longer than a Jack plane (No.5) and a fore plane (No.6) with a length of 460-560mm and 60mm blade, known as No.7. This extra length enables the plane to bridge depressions in the wood and remove shavings from high spots only, so producing a very accurate surface.

8.4 Bench Plane Parts

The Jack Plane consists of a number of different parts. A description of some of the main parts are listed.



8.4.1 **Cutting Iron/Blade** – This is normally set to 45˚ to the sole of the plane. It is

made from manganese chrome steel for long life and easy sharpening. It is held in positon on the cap iron by a large headed screw. For good results the cap irons position in relation to the blade varies according to the wood but in general the cutting edge of the blade should never be more than 2mm in advance of the edge of the cap iron.

8.4.2 **Cap Iron** - The function of the cap iron is to break the shavings and prevent the fibres of the wood from tearing. This enables smooth surfaces to be produced. It also stiffens the cutting iron and prevents vibration.

8.4.3 **Lever Cap** - This part of the jack plane holds the cutting iron or blade in position.

8.4.4 **Lateral Adjusting Lever** - This enables the blade to be moved from side to side, e.g. If the blade projects further out at one corner, the lever is moved in that direction to correct it.

8.4.5 **Adjusting Nut** - This is made from brass and controls the thickness of the shaving. Turning it clockwise moves, the blade down, giving a coarser cut. Turning it anti-clockwise, raises the blade, giving a finer cut.

8.4.6 **Frog** – The frog or bed of the plane can be removed by means of two slot screws. The frog is used to control the size of the mouth of the plane.

8.4.7 **Body** – The body is made from cast steel machines for squareness and accuracy

9 SPECIAL PURPOSE PLANES

9.2 Block Plane

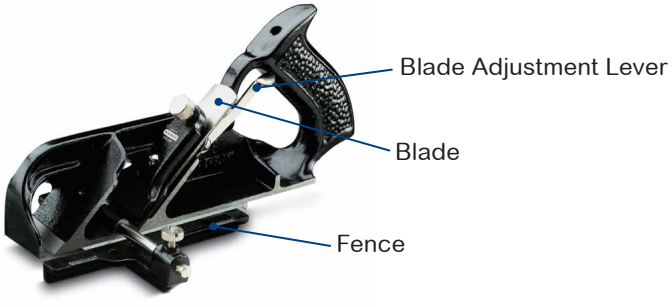
Block planes are primarily used for trimming end grain, planning mitres or for planning interlocking grain. The blade is set at 20˚ with the grinding bevel uppermost. In some types the blade can be adjusted and generally the blade adjustment is by a screw attachment at the rear.

9.3 Hand Router

The router is used for trimming the bottom of housings to the correct depth and for trimming recesses to depth. The cranked cutter projects through the base and has a screw adjustment for the depth. Two other sizes are available, 6mm and 13mm and these have straight blades for general use. A special 'V' shaped blade is available for smoothing cuts.

9.4 Rebate Plane

Rebate planes are used for forming rebates (a shoulder or step cut at the edge of timber and running parallel to the edge). The plane is fitted with a depth gauge and has a fence to control the rebate width. The blade should project slightly on either side of the body and a spur is fitted to sever the fibres when rebating across the grain. The blade has a lever or screw adjustment.



9.5 Plough Plane

The plough plane is used for ploughing grooves parallel to an edge and with the grain of the wood. The cutter projects on either side of the body and is fitted with a depth gauge and fence. Various shapes and sizes of cutters may be fitted and there are small spurs for cutting interlocking grain.

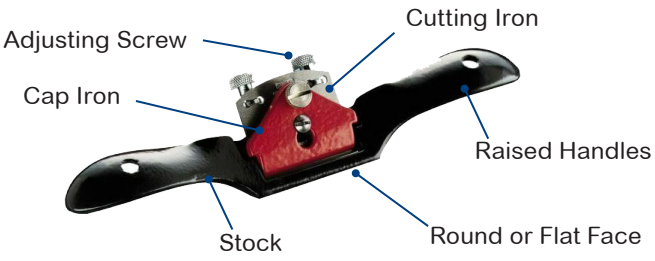
9.5 Bull Nose Rebate Plane

The bull nose rebate plane used in forming stopped rebates and chamfers. A smaller version of the shoulder plane which has a moveable front cover to enable it to get into corners.

9.6 Spokeshaves

The adjustable metal spokeshave is used for planing concave or convex edges and narrow surfaces of timber. Spokeshaves can also be used to plane stopped chamfers. The sections opposite show

1) a ROUND BOTTOMED STOCK - for planning concave surfaces.
2) a FLAT BOTTOMED STOCK - for planning convex surfaces.



9.7 Surform

The surform plane has an easily removable blade and can be used for cutting, shaping, smoothing and filing. Different blades and shaoes are available for working a wide variety of materials such as wood, metal, plastics, ceramics, etc.

9.7 Rasp

A rasp is used for rough shaping of wood and other soft materials. The teeth on a rasp are much rougher and larger than the teeth on a file and therefore tend to tear the grain of the wood leaving a very rough surface. This surface then has to be finished with Glasspaper. The most commonly shaped rasp is the half round.

9.8 Scraper

Scrapers, sometimes known as hand scrapers or cabinet scrapers, are made from a rectangular piece of hardened and tempered tool steel. Scrapers are used to remove plane marks and obtain a smooth finish on flat timber prior to sanding. Common sizes available are 50xl00, 60x120 and 75x150 with thicknesses varying from about 0.7 to 1.2mm.

10 DRILLING & BORING TOOLS

10.1 Hand Drill

The hand drill or wheel brace is used to hold and turn twist drills up to 8mm diameter. The chuck has three self centering jaws which securely grip the shanks of twist drills. The sketches show how the chuck jaws operate.

10.2 Ratchet Brace

The ratchet brace is used to hold and turn the various boring bits used in cutting a hole in timber. The head of the brace rotates on a ball-bearing washer to reduce friction. The other end of the crank has a chuck containing “alligator” jaws that hold the bit. The chuck is attached to the brace by means of a threaded core at the end of the crank. The ratchet enables the brace to be used in a confined space where it would be im possible to make a complete revolution of the crank. The sweep of the crank is usually about 250mm.

10.2.1 Auger Bit

The auger or twist bit is used for boring deep and accurate holes in timber. The threaded point draws the bit into the wood and the spur cuts the perimeter of the hole. The router, following after the spur, removes the waste wood. Useful when boring into end grain as the helical sides prevent drifting of the bit. Sizes vary from 6mm to 30mm.

10.2.2 Centre Bit

The centre bit is used for boring shallow holes. Unsuitable for boring deep holes or for boring endgrain due to its tendency to drift. Sizes vary from 6mm to 50mm.

10.2.3 Expansive Bit

Fitted with adjustable cutters enabling it to bore holes up to l00mm diameter. Cutting action is similar to that of the centre bit.

10.3 Twist Drill

Twist Drills are manufactured from high speed steel (H.S.S.) or carbon steel and are used for drilling circular holes in metal, wood and plastics.
Twist drills have three basic parts, a point, a parallel body and a shank that can either be parallel or “morse” tapered.
In use, twist drills with parallel shanks are securely held in an adjustable chuck. Drills with tapered shanks fit directly into lathe tailstock barrels and drilling machine spindles.

The parallel body of the twist drill is cut away to form two spiral or helical flutes. This allows lubricant to reach the cutting edges quickly and swarf (waste

material) to exit easily. To reduce friction during drilling the body of the twist drill is made with a slightly reduced diameter but leaving a thin band of metal at the leading edges of the flutes.

These thin bands are known as LANDS and are ground cylindrically true to form the drill diameter.

Twist drills are manufactured in a wide range of sizes, straight shanked drills from 0.3mm diameter to 13mm diameter and morse-taper shank drills from 10mm diameter to 100mm diameter.

10.4 Spur Point Bit

Also known as a wood or dowel bit, they have a central point and two raised spurs that help keep the bit drilling straight. The bit cuts timber very fast when used in a power drill and leaves a clean sided hole.
They are ideal for drilling holes for dowels as the sides of the holes are clean and parallel. Sizes range from 3 to 10mm. Spur point bits should only be used for drilling wood or some plastics.

10.5 Fostner Bit

A fostner bit bores a clean flat bottomed hole without the depression formed by the centre point of a twist drill or centre bit. This type of bit is used for boring out waste wood in a recess or housing. Sizes vary from 6mm to 50+mm.

10.6 Flat BIt

Flat Bits also known as spade bits have 2 main cutting edges, 2 cutting spurs and a centring point. This type of bit is available in a wide range of sizes from 6mm to 50mm plus. They are relatively cheap to purchase in comparison to twist drills as they use less material in their manufacture. However, the resultant hole is not a clean as other boring tools and care is required when drilling holes through material as splitting is likely.

10.7 Countersink bit

A countersink drill is used to counter sink holes in wood, metal and plastics to accommodate countersunk screw heads.

10.8 Hole Saws

A hole saw is used at slow speeds with powered drills to cut holes, ranging in size from 20mm to 80+mm diameter, in thin metal, plastics or wood. It has a circular saw blade fixed to the body of the drill as shown. The drill makes a pilot hole whilst the blade cuts a circular groove.

11 COMMON TOOLS

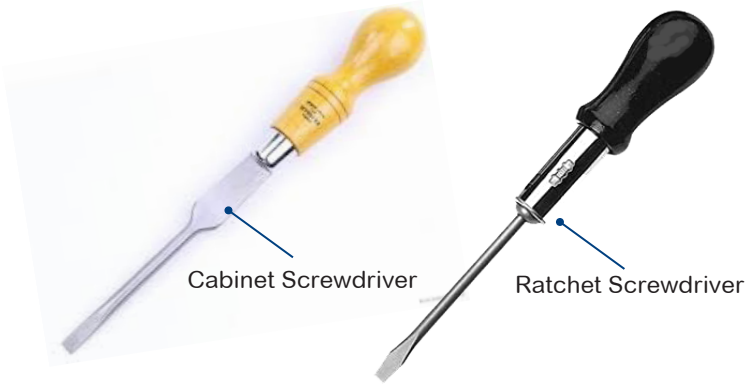
11.1 Screwdrivers

Screwdrivers consist of an alloy steel blade (flat. round or square) with one end ground to parallel sides to form a tip to fit the slots of the

screws. The other end is shaped to a tang that fits into a handle made of a tough hardwood such as beech, ash or hickory or a shatterproof plastic such as nylon or PVC.
The size of the screwdriver is determined by the length of the blade from the tip to the handle (35-250mm) and the width of the tip of the blade (5-11mm). Phillips screwdrivers have milled tips to fit the cross slots of Phillips headscrews. A No.1 for No.4 and smaller gauge screws; No.2 for Nos. 5 - 9 screws and No.3 for Nos.10 - 16 screws.
The 3 position shifters in a ratchet screwdriver allows either clockwise or anti-clockwise or a rigid blade action.
The engineer's screwdriver has a fluted handle designed to prevent the hand from slipping even when covered with oil or grease.

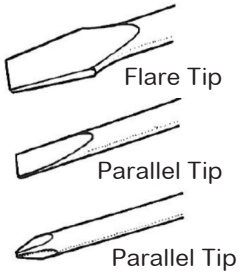

Engineer's Screwdriver


Phillips Screwdriver


Cabinet Screwdriver

Ratchet Screwdriver


Stubby Screwdriver


Flare Tip

Parallel Tip

Parallel Tip

11.2 Bradawl

The bradawl consists of a thin steel rod which is flattened to a cutting edge at one end, with a tang fitting into a wooden handle at the other end. The flat cutting edge is placed across the grain and forced into timber with a twisting action to cut the fibres and make a small hole, usually to start a wood screw.

11.3 Pincers

Pincers are used to pull out bent pins or nails from wood. They are used when a claw hammer cannot grip the nail, either because they are too thin or do not have a head. The small thin claw on the handle of the pincers will fit under the heads of small nails and lever them out far enough for the pincers to grip.

11.4 Pliers

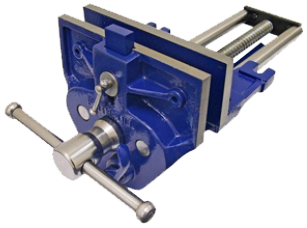
One of the most popular types of pliers having toothed jaws for gripping flat and round stock. Has blades on edges for cutting wire and small cable.

12 CLAMPS & VICES

12.1 Woodwork vice

The wood working vice is fixed to the underside of the bench with the jaws level with the bench top. It is used for

holding work of a range of activities such as planning, sawing, chiselling and can also help facilitate clamping of glued work. Cast iron versions have a large and strong holding capacity with two common types available – a plain screw and a quick release. The quick release version allows quick alteration of the position of the jaw by depressing a trigger near the handle. Once depress the vice can be slide open or closed quickly. The cast iron jaws are readily available in widths from 175 to 260mm with opening capacities from 200-380mm. the cast iron jaws are faced with hardwood, such as beech to prevent damaging the work piece.



12.2 G Clamp

G clamps are used for clamping work securely onto a bench or surface when sawing, chiseling or shaping. They are also often used for holding parts together whilst glue is drying. They come in a variety of capacities ranging from 50mm to 300mm. The body of the clamp is usually made from cast iron with a threaded bar screwed into it. The clamp is tightened by turning this threaded bar via the wingnut end. A swivel shoe is fitted to the threaded bar face to enable it to hold tapered work.

12.3 Sash Clamp

The metal sash clamp is used for holding and drawing together work such as window sashes, doors, frames and cabinet carcases etc while fixing or adhesive set. Sash clamps have a capacity of about 600mm to 2m. For larger work an extension bars can be added in increase the sash clamps capacity. In order to minimise any damage from the clamp faces while material is being clamped then scrap or packing wood should be used between the face and the object being clamped.

12.4 T bar Clamp

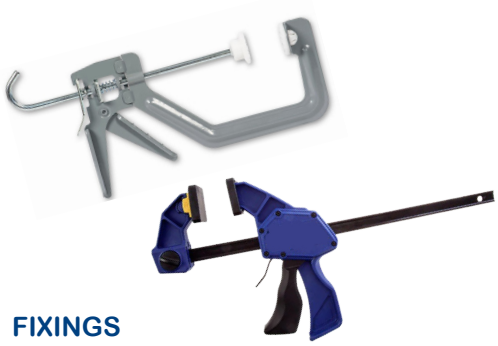
A T-bar clamp is a heavier version of a plain sash clamp. It is used where larger and heavier work is being clamped as the “T” section gives increased rigidity and the larger sides also provide a larger pressure area. Similar lengths to sash clamps are available.

12.5 Mitre Clamp

The design of a mitre clamp makes it possible to glue and nail mitre joints on items like picture frames, trinket boxes etc under pressure. Two screw adjusted feet are set at an exact angle of 90° to each other and s they are tightened the secure the joint at a perfect right angle. The clamp body is drilled to allow it to be secured down to a bench or board. Sizes range from 50mm to 100mm.

12.6 Quick Grip Clamp

A quick grip clamp, also known as a one-handed clamp, incorporates a ratchet mechanism which advances the mov able jaw forward when the trigger handle is squeezed. This allows the user to hold the work with one hand and tighten the clamp with the other. Clamping pressure is released by means of another trigger. Sizes range from 100mm – 900mm.



13 FIXINGS

13.1 Nails

Nailing is the process where two or more pieces of timber, manufactured board or sheet material are joined together by metal fasteners (or fixing devices) called nails.

A nailed joint is generally regarded as a permanent joint since it is difficult to dismantle without damage to the nail or the joint. Most nails are manufactured from bright mild steel. These can be zinc galvanised to prevent rusting in exposed conditions.

A few of the wide variety of nails available are described below.

13.1.1 Wire Nail (A)

Wire nails are used in general joinery work. This nail head is large and round with a serrated surface to prevent the hammer face from skidding when the nail is driven into the wood. The neck is roughened to increase the frictional grip on the wood. Commonly available lengths from 25mm to 200mm.

13.1.2 Oval Nail (B)

Because of its oval cross-section this nail (or brad) is particularly suitable for nailing close to the edges of timber where splitting is liable to occur. Easily punched beneath surface of timber. Lengths available from 20mm to 1S0mm.

13.1.3 Clout Nail (C)

Used for fixing sheet materials such as plasterboard, roofing felt, slates, tiles and canvas. Clout nails are galvanised to prevent corrosion.

13.1.4 Lost Head Nai (D)

This is a fine wire nail with a circular cross-section. Can be punched beneath the surface of the timber. Lengths from 20mm to 150mm.

13.1.5 Panel Pin (E)

This has a fine diameter shank and a small round head that is easily concealed by punching below the surface of the wood with a fine nail punch.

13.1.6 Escutcheon Pin (F)

Escutcheon pins are made from brass and used in exposed conditions for securing ornamental work such as keyhole plates and for small boatbuilding work.

13.1.7 Tack (G&H)

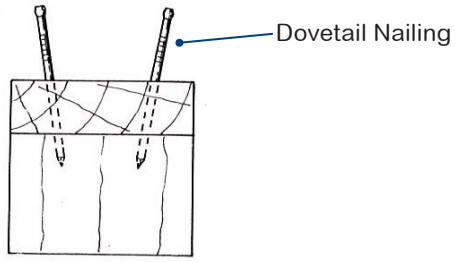
Two types of upholstery tack are available. The cut tack, made from bright mild steel, is blued or galvanised to prevent rusting. Upholstery tacks or nails, made from bright steel, plated with chromium or brass, have large dome shaped heads as shown.

A B C D E F G H

13.1.8 Some Points To Note When Nailing

1. When possible, for maximum holding power, thinner piece of timber should be nailed to thicker piece by dovetail nailing.

2. If material is liable to split then it is good practice to drill a clearance hole equal to the shank diameter of the nail in the thinner piece



13.2 Screws

Woodscrews are metal fasteners used to join two or more pieces of wood. They are also used to join other types of material, such as metal and plastics, to wood.

A screw joint is a temporary joint since the screw can be removed fairly easily without damage to the joint.

Screws are manufactured using variety of metals such as mild steel, stainless steel, brass, chromium plated brass, aluminium alloy, and bronze etc. Some steel screws are given a special coating to protect against rust. e.g. galvanised screws are coated with zinc, “black japanned” screws are coated with a black lacquer

Woodscrews are classified by the metal they are made from, their shape of head, shank diameter and length. N.B. The shank diameter, or gauge of the screw, is equal to half the diameter of the screwhead as shown below. The shank of the screw is threaded for two thirds of its length at the pointed end. On turning, the thread pulls the screw into the wood providing a stronger joint than nailing.

Some of the more common types of screws are described below.

13.2.1 Countersunk Head Screws (A)

Used when screwheads must be flush with the surface of the wood, metal or plastics material. The surface is counter sunk to accommodate the countersunk head of the screw.

13.2.2 Round Head Screws (B)

Used in situations where it is not necessary to countersink the screwhead.

13.2.3 Raised Countersunk Screws (C)

Used for securing decorative work like door and window furniture to wood.

13.2.4 Phillips Or Star Screws (D)

The recess in the head of this type of screw is designed to eliminate screw driver slip and give a more positive torque or turning effect on the screw.

13.2.5 Coach Screws (E)

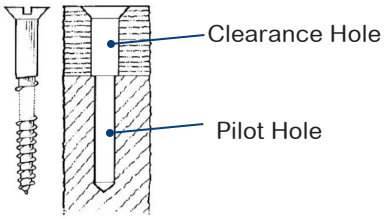
Much woodscrews, the screwed into the stronger and heavier than other coach screw is turned and wood using a spaner.

13.3 Joining Timber

When joining two pieces of wood together with screws a “clearance hole” of slightly larger diameter than the shank is drilled in the top piece. In hardwoods it is necessary to drill a “thread” or “pilot” hole in the bottom piece.

Screw Gauge Number	2	4	5	6	8	10	12
Metric Equivalent	2.4	2.7	3.1	3.5	4.2	4.9	5.6

The thinner piece should be screwed to the thicker piece. To prevent staining, brass screws should be used with acidic timbers such as oak. For easier turning of the screw the pointed end can be lubricated using wax. Before inserting a screw ensure that the tip of the screwdriver is in good condition.



14 ADHESIVES

14.1 PVA Glue

Polyvinyl acetate. or PVA, is probably the most common type of wood glue used in furniture manufacture and in school workshops. It is a white, water based iquid adhesive with a creamy consistency and is supplied in plastic containers, ready for immediate use. In use, PVA is applied. under pressure, to ONE surface only.

It is easy to apply and non-staining, although excess glue should be Wiped off work with a damp cloth. If joints are a good fit, PVA forms a strong bond and attains its full strength after about 12 hours. PVA is suitable mainly for interior work although a waterproof version is available for exterior work. Used mainly for glueing wood to wood it can also be used for glueing textiles and leather.

14.2 Cascamite

The trade name for one of the most commonly used synthetic resin wood glues is Cascamite". It comes with a resin and hardener ready mixed as a powder. The powder is mixed with water to a thick creamy paste that must be applied to both surfaces of the wood. This "ONE SHOT" synthetic resin glue fills small gaps in joints and sets after about 3 hours although work should be left in cramps overnight. Tends to stain some timbers.

14.3 Polyurethane Wood glue

Polyurethane glue is a non-water based glue that provides very strong adhesion to surfaces. It does not have a high moisture content and therefore doesn't make joints swell like some water-based glues. It actually cures from a chemical reaction to moisture. This makes gluing wood with a high moisture content or an oily wood easier to glue over a glue such as PVA, which would have difficulty bonding these types of surfaces at all.

14.4 Contact Adhesive

Contact (or impact) adhesives such as Evostick, Bostik, etc; are supplied in tins or tubes as a thick (thixotropic) highly flammable liquid mixture of synthetic rubbers and resins in a solvent. Both contact surfaces should be covered in a thin, even coating of glue and left, to be come touch dry, for about 15 minutes before assembly. Used mainly for glueing laminated plastic sheets, such as formica, to chipboard. Not waterproof. Also used for glueing leather and textiles.

14.5 Cyanoacrylates

These are a special type of acrylic based adhesive which cure through the reaction with moisture held on the surfaces to be bonded. Close fitting joints are essential and, on application, under contact pressure only, they usually solidify in seconds. Most of the "super glues" on the market today are of this variety. They have a wide range of applications e.g. plastics to glass, metal to metal, wood to metal, glass to glass etc.

14.6 Epoxy Resin

Epoxy resin (e.g. Araldite) is a very tough and durable synthetic resin "TWO SHOT" adhesive. It consists of an epoxy resin

and a hardener that are mixed together in equal quantities to form a thick paste of creamy consistency. On mixing, the adhesive begins to cure and must be immediately applied to both contact surfaces. Araldite sets to form a very strong, waterproof, non-shrinking bond to almost any known material; ego wood to wood, metal to metal, china to china, glass to glass, etc; or combinations of. Joints should be left, preferably under pressure, for at least 24 hours.

15 ABRASIVES

Before applying a finish to timber, it is important to ensure that all the surfaces are perfectly smooth by using abrasives.
Confusion is often caused because this is frequently called 'sanding' and the abrasive referred to as 'sandpaper', the reason being that the early abrasives were made from sand glued to paper.

Today the most common abrasives are not made of 'sand' but either glass, garnet, aluminum oxide, silicon carbide or tungsten carbide.

15.1 Glasspaper

Crushed bottle glass is sieved to produce various grits to make papers in a range of coarseness. it can quickly blunt and clog.

15.2 Garnet

Red in appearance and harder than glasspaper. However, it still tends to clog fairly easily.

15.3 Aluminum Oxide

This is an artificial abrasive commonly used on machine sanders. it is especially good on hardwoods, keeping sharp and not burning by friction.

15.4 Silicon Carbide

This is an artificial abrasive which is hard and brittle. The backing paper is water proof and tends to come in finer grades (220 upwards). This abrasive is ideal for flatting and use on painted finishes such as cellulose.

15.5 Tungsten Carbide

This is an exceptionally long life abrasive that cuts quickly. it has a metal backing sheet, which allows it to be cleaned using a wire brush.

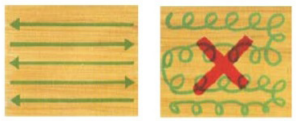
Most abrasives are available in disc and sheet form in a range of sizes to suit both hand sanding and machine sanding.

The grade of abrasive is printed on the back of each sheet either in the English system (00, 0, 1, 1 ½, F2, etc.) or the European system (220, 150, 120, 100, 80, etc.), or both.

The table below shows comparative grades.

	Aluminium Oxide Silicon Carbide	Garnet	Glass
Extra Fine	1200		
	800		
	600		
	500		
	400		
	360		
	320		
	280	8/0	
	240	7/0	
	220	6/0	00 (flour)
Fine	180	5/0	
	150	4/0	0
	120	3/0	1
Medium	100	2/0	1 1/2
	80	1/0	F2
	60	1/2	M2
Coarse	50	1	S2
	40	1 1/2	2 1/2
	36	2	3
Very Coarse	30		
	24		
	20		
	16		
	12		

When working on large flat surfaces, the glass-paper is wrapped tightly around a cork block. This increases the rubbed area and ensures flatness. Sanding should always be done along the grain. Never use a scrubbing action as this covers the surface with unsightly scratches.



15.6 Steel Wool

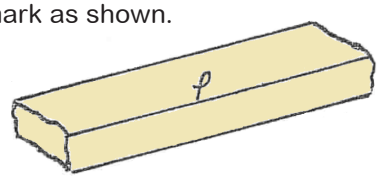
Steel wool or wire wool is made up of very fine and flexible sharp edged steel strands. It is used as an abrasive, for polishing or cleaning items. It is made from low carbon steel in a process like broaching where heavy gauge steel wired it extruded through toothed dies that remove thin, sharp shavings. Caution sound be noted when using on some materials, for example when used on oak, remaining traces of iron may react with tannins in the wood to produce blue or black iron stain. It comes in a variety of grades from 5 at the course end for stripping to 0000 at the fine end.

16 PREPARING TIMBER

Unless timber is properly prepared, i.e. perfectly square surfaces and edges and appropriate reference marks then it will be impossible to make frames and projects that are accurate and true. Irrespective of the size of the product to be made, the stages or steps in the preparation, should always be carried out in the order shown. For example, converting a rough (off saw) piece of timber the following procedure should be carried out.

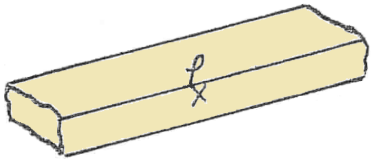
16.1 Face Side

Choose and plane face side perfectly smooth and flat. Mark on the face side mark as shown.



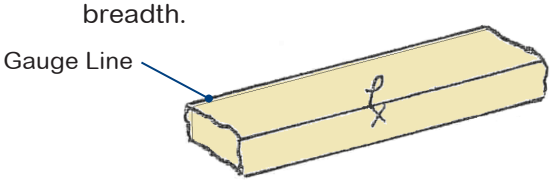
16.2 Face Edge

Plane face edge and test for squareness with the face side. Mark on face edge mark as shown.



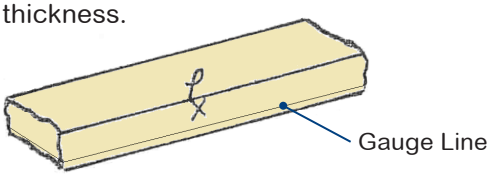
16.3 Breadth

Gauge and plane timber to required breadth.



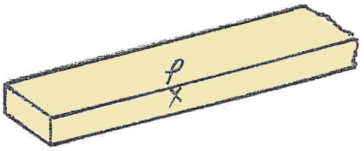
16.4 Thickness

Gauge and plane timber to required thickness.



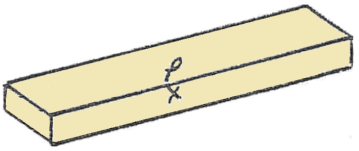
16.5 Square End

Square and sand one end perfectly square with the face side and face edge.



16.6 Cut to Length

Measure the required length from square end, square right round section and saw off waste. Sand end square.



16.7 Use of Face Marks

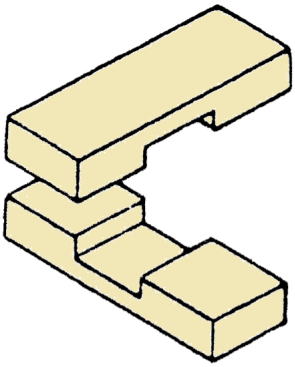
The purpose of face side/face edge marks are to indicate clearly the prepared and

tested sides and edges of the timber. When squaring, holding the face of the stock of the try square against the face side or face edge only, ensure that the lines will be accurately squared right round the timber.

When gauging, keeping the face of the stock of the marking gauge against the face side/face edge only, ensures that the gauge lines will be perfectly parallel with the face side/face edge.

Also, the use of face side and face edge marks assist greatly in the setting out and assembly of projects.

Note, the majority of timber used in schools will now be supplied “dressed”. This means it has been previously machined smooth, flat and square. However, due to the nature of timber you cannot rely on it still being square since machined. Therefore similar procedures to the one shown will need be carried out.

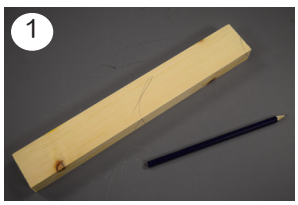


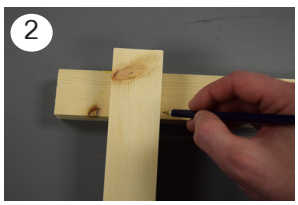
17 WOODWORK JOINTS

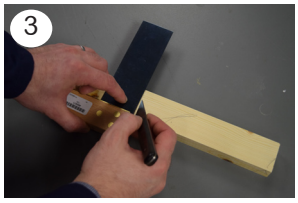
17.1 Cross Halving

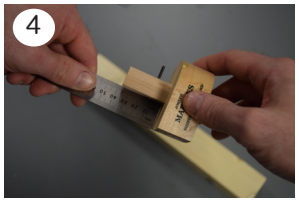
There are a number of variations of the halving joint. The cross halving, is commonly used in underframes of tables or internal divisions within drawers etc. Half the timber is removed from each piece being joined to allow them to fit into each other providing a flush cross over.

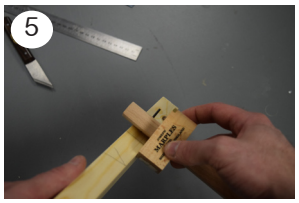
1. Mark out face side and face edge (1)
2. Mark width of wood on the end (2)
3. Using try square, marking knife square lines across face side and down edges (3)
4. Using same procedure, mark width of wood on the other end.
5. Set marking gauge to half the thickness and scribe a line (4) (5)
6. Mark out waste wood
7. Using a tenon saw and sawing board, saw down to gauge line (saw inside the line) (6)
8. Make some extra sawcuts to aid chiseling.
9. Place in vice and use chisel and mallet (if necessary) to remove waste wood. Work towards middle and at a slight upwards angle (7)
10. Turn wood around and repeat from other side. Once most waste has been removed pare away middle section (8) (9) (10)
11. Use a hand router (if necessary) to level out base.
12. Repeat on the other half of wood.



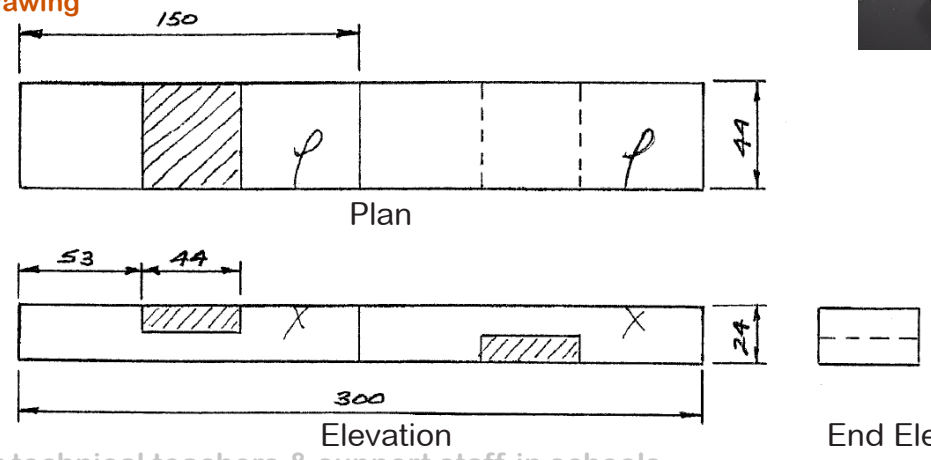






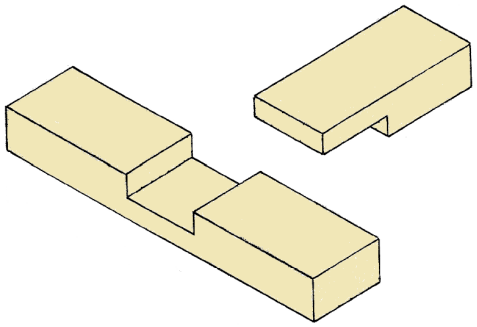


Working Drawing

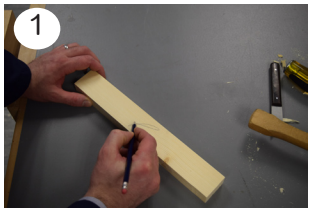


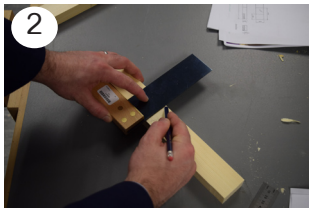
17.2 Tee Halving

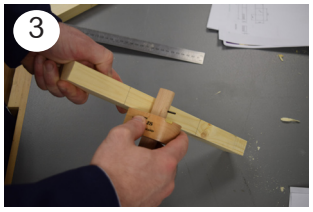
The tee halving as other halving joints is created by removing half the timber from each piece in order for them to lock in flush with each other. The Tee halving are often used to make light frames for doors etc.

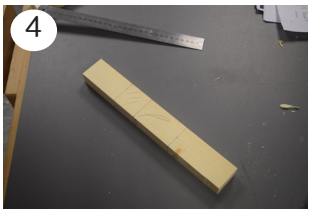


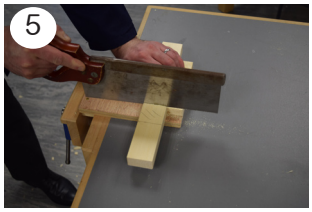
1. Mark out face side and face edge (1)
2. Mark width of wood on the cross member at the required positon
3. Using try square, marking knife square lines across face side and down edges (2)
4. Using same procedure, mark width of wood on upright member.
5. Set marking gauge to half the thickness and scribe a line (3)
6. Mark out waste wood (4)
7. Using a tenon saw and sawing board, saw down to gauge line (saw inside the line) (5)
8. Make some extra sawcuts to aid chiseling
9. Place in vice and use chisel and mallet (if necessary) to remove waste wood. Work towards middle and at a slight upwards angle (6)
10. Turn wood around and repeat from othe side. Once most waste has been removed pare away middle section (7)
11. Use a hand router (if necessary) to level out the base.
12. Repeat on the other half of wood.

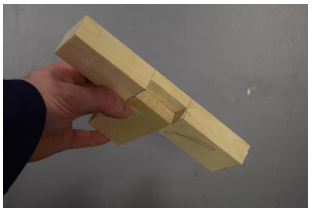


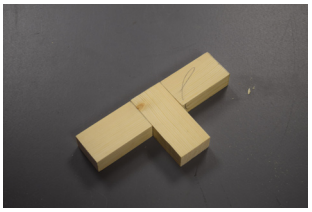




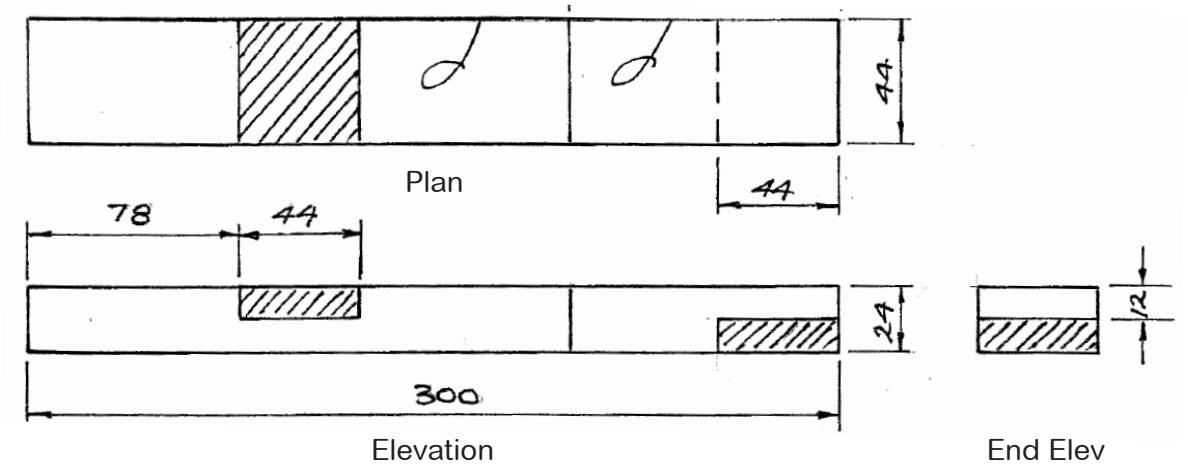






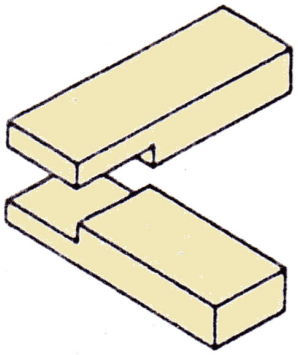


Working Drawing

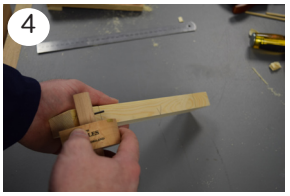


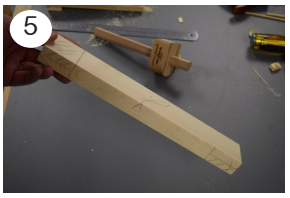
17.3 Corner Halving

The corner halving (sometimes known as a corner half lap) consists of removing half of the wood thickness from each of the two members of wood and bringing the remaining halves together to form a flush surface. This is used in light frame works where a strong joint is not required.

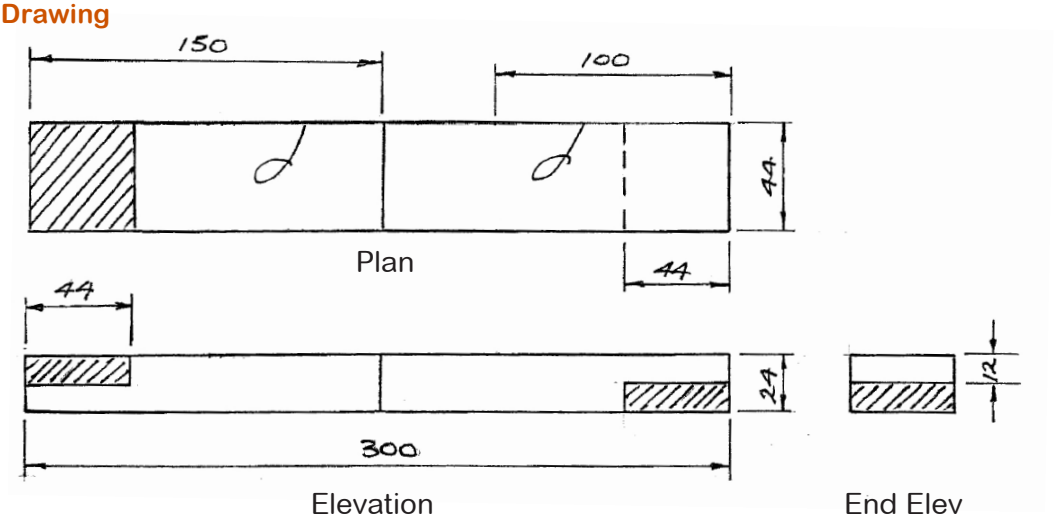


1. Mark out face side and face edge (1)
2. Mark width of divider on the rail. (2)
3. Using try square and marking knife square lines across face side and down edges (3)
4. Using same procedure, mark width of rail on the divider.
5. Set marking gauge to half the thickness and scribe a line (4)
6. Mark out waste wood (5)
7. Using a tenon saw and sawing board, saw down to gauge line (saw inside the line) (6)
8. Make some extra sawcuts to aid chiseling
9. Set in vice at angle and use chisel and mallet (if necessary) to remove waste wood. Work towards middle and at a slight upwards angle. (7)
10. Turn wood around and repeat from other side. Once most waste has been removed pare away middle section (8) (9)
11. Use a hand router (if necessary) to level out the base.
12. Repeat on the other half of wood.



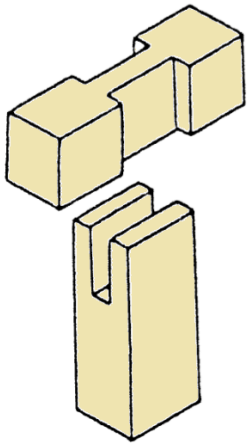


Working Drawing

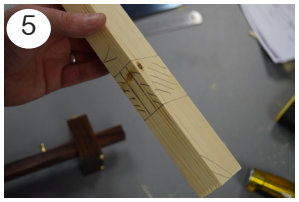


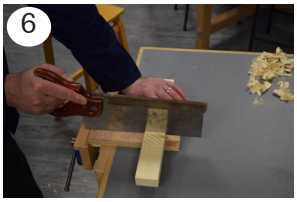
17.4 Tee Bridle

The tee bridle consists of an open socket, or slot, at the end of one piece that fits over a pin on the other piece. This is often used in place of mortise and tenon joints although it is not as strong.

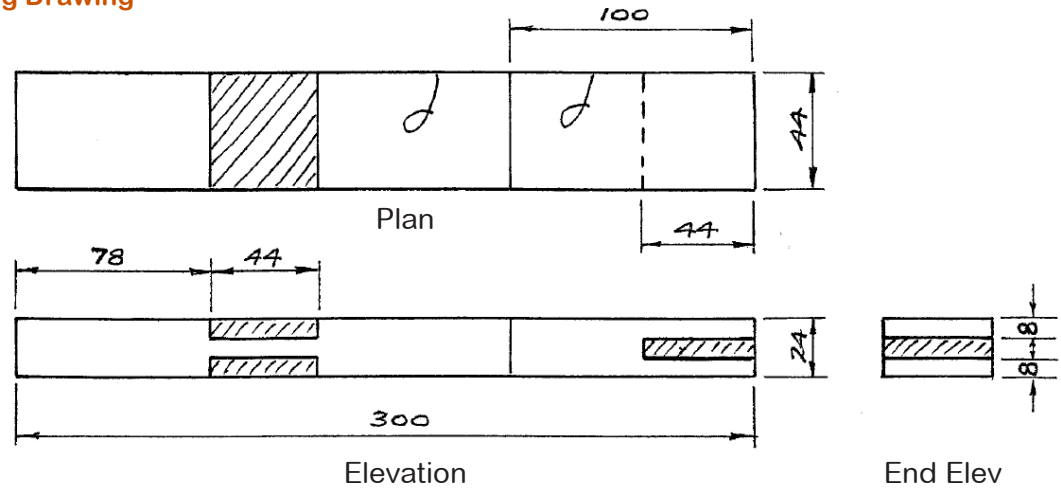


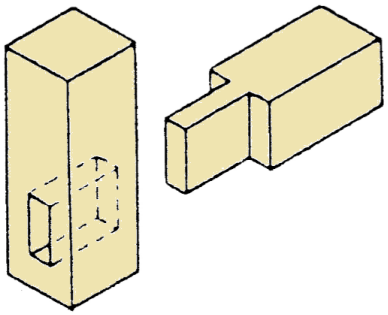
1. Mark out face side and face edge (1)
2. Mark out the positon of the tenon member.
3. Square lines all round using try square. Scribe lines with marking knife (2)
4. Set mortise gauge to 1/3 of the thickness of the tenon member and adjust stock to centre spurs. Scribe mark between squared lines (3) (4)
5. Repeat for the mortise member.
6. Mark out waste (5)
7. Using tenon saw, saw down to gauge line on the tenon member (inside the lines) on both sides (6)
8. Remove waste using chisel, working into the middle from both sides at slight angle before levelling off (7)
9. Using a tenon saw, saw down the gauged line on the mortise member (8)
10. Using a chisel, chisel out waste from mortise member (9)
11. Square end of shoulder with a chisel.
12. Test fit and it necessary remove excess material using a chisel.
13. Apply glue and clamp together (10)





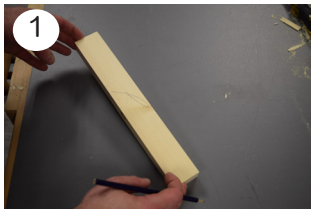
Working Drawing

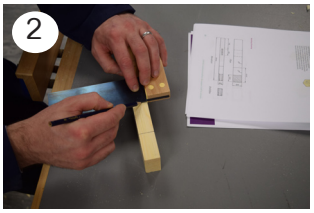


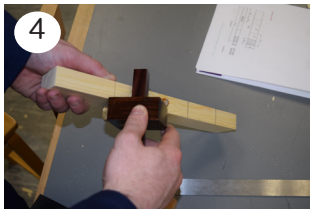


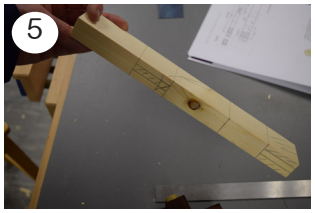
17.5 Mortise & Tenon

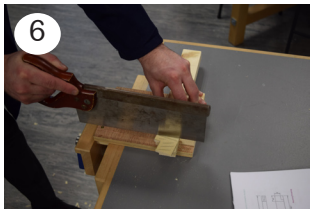
Mortise and tenon joints can be used to make strong angle joints. Rectangular holes (mortises) are cut in one piece and tenons, to fit the mortises, are cut on the end of the other piece.
The tenons can be stopped or they can go right through and can be wedged for greater strength. The tenon is approximately 1/3 the thickness of the timber. This type of joint is stronger than the dowel joint due to the larger gluing area but are more time consuming to make. It is commonly found in door and furniture manufacture.

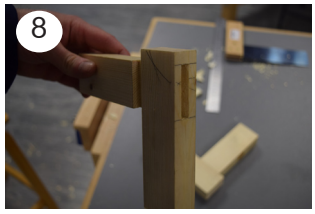






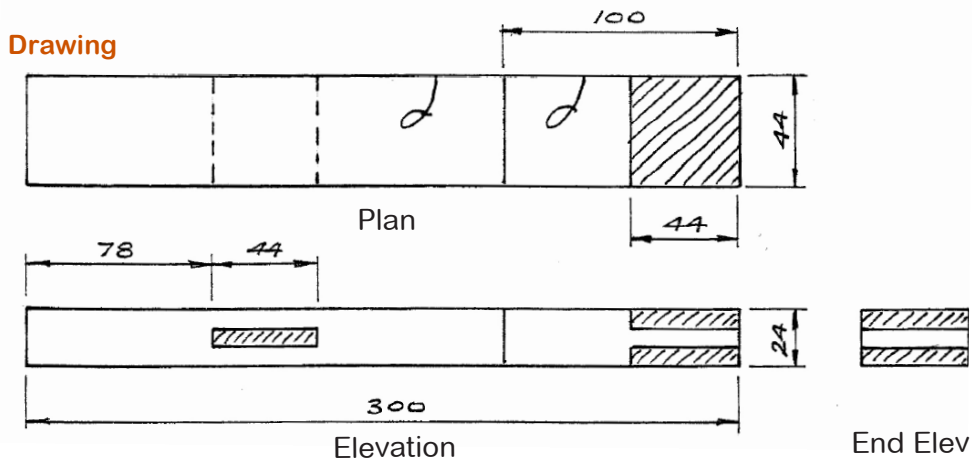






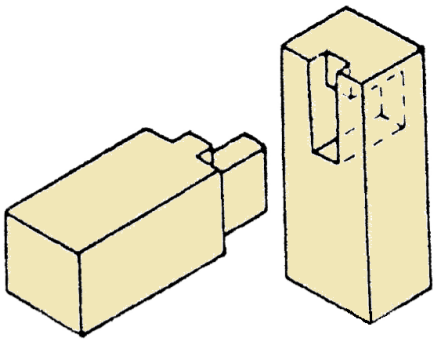
1. Mark out face side and face edge (1)
2. Measure width of wood to work out depth of mortice/length of tenon (approx. ¾ of width)
3. Using try square and marking knife, scribe line all round tenon (2)
4. Set mortice gauge to width of chisel and ad just stock to centre spurs on the edge of the wood (3) Mark position and width on the edge and end (4)
5. Mark position and width of tenon member on the inside edge of mortice member.
6. Square lines across using try square
7. Use mortise gauge to scribe lines between square lines.
8. Mark out waste (5)
9. Using tenon saw, saw down shoulder and down its length. If necessary use a chisel or hand router to flatten level (6) (7)
10. Using a mortice chisel and mallet, chop out the mortice (use tape around chisel to mark depth)
11. Make sure that the bottom is flat.
12. Check fit, it necessary use chisel to pare excess wood away
13. Apply glue and clamp together (8)

Working Drawing

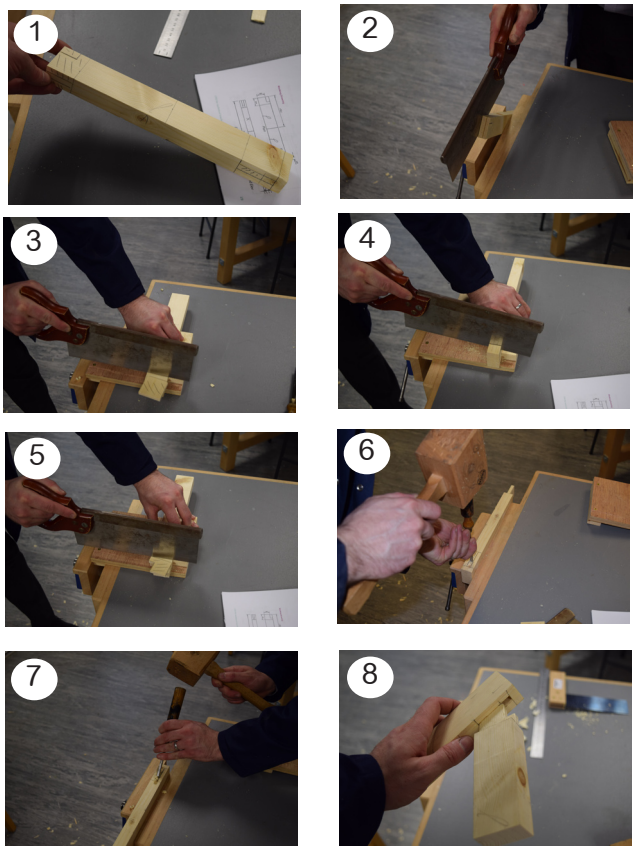


17.6 Haunched Mortise & Tenon

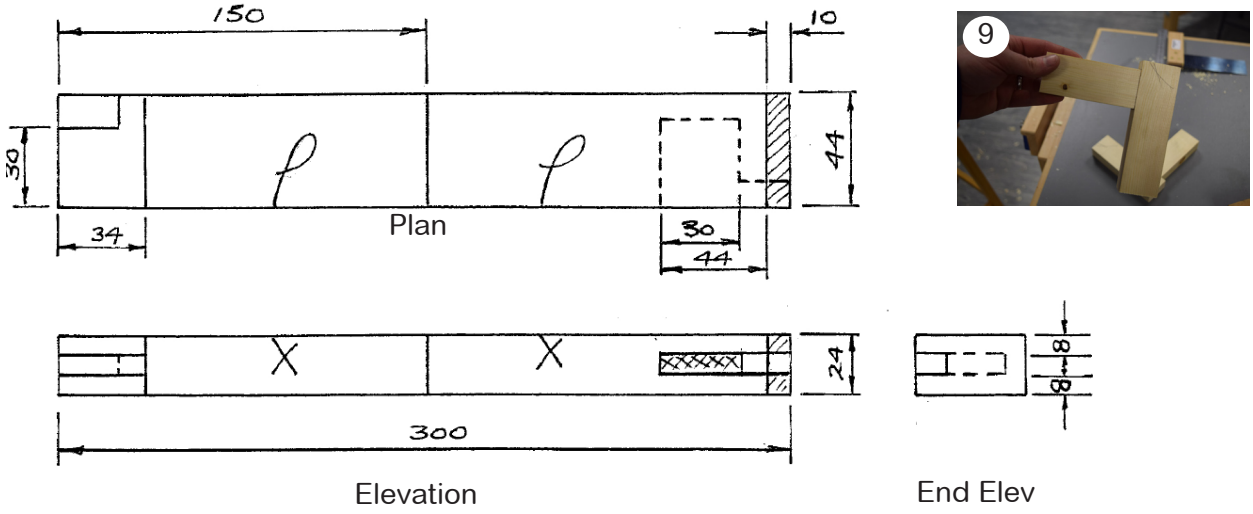
This joint is used where a rail meets the stile at its end e.g. where the top and bottom rails meet the stiles of a framed door. The tenon is cut narrower than the width of the rail so that it can be wedged in the mortise. The width of the rail and the tenon is usually 2/3 the width of the rail and the haunch, which helps to prevent the frame from twisting and gives added gluing area, can be either square or sloped. The sloped haunch is used when the end of the stile is visible.
When the tenon does not go right through the stile the joint is called a stopped haunch mortise and tenon.



1. Mark out face side and face edge
2. Mark out wood using the same procedure as a normal mortise and tenon joint.
3. Mark out waste (1)
4. Using tenon saw, saw down shoulder and down its length. If necessary use a chisel or hand router to flatten level (2) (3)
5. Using tenon saw, saw out haunch (4) (5)
6. Using a mortice chisel and mallet, chop out the mortice (use tape around chisel to mark depth) (6) (7)
7. Make sure that the bottom is flat.
8. Check fit, it necessary use chisel to pare excess wood away (8)
9. Apply glue and clamp together (9)

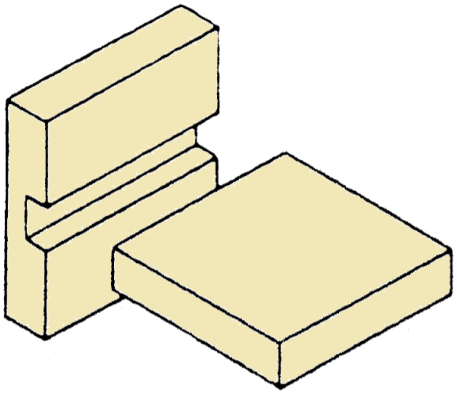


Working Drawing

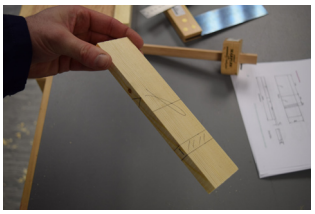


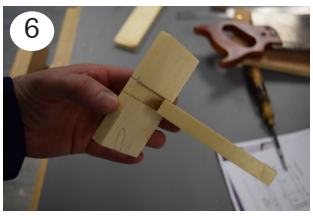
17.7 Through Housing

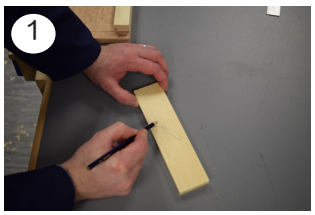
The through housing joint consists of sinking the whole end of one piece of timber into a housing in the other piece with the joint being visible from both sides.

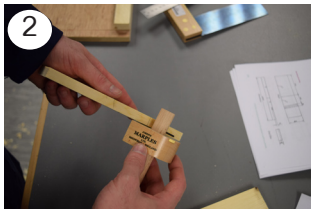


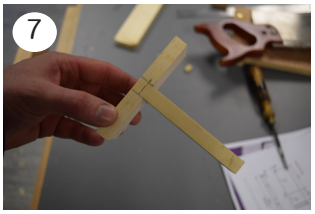
1. Mark out face side and face edge (1)
2. Mark out the thickness of the wood in the required position
3. Square lines round using try square and marking knife.
4. Set marking gauge to the required depth, (no more than 1/3 the thickness of the wood) and scribe line (2)
5. Mark our waste (3)
6. Using a beveled edged chisel remove waste, working on toward the middle on both sides at a slight angle (4)
7. Level out the base of the housing using chisel and then hand router (5)
8. Fit other wood into housing, if necessary re move any excess wood with chisel (6)
9. Apply glue and clamp joint together.



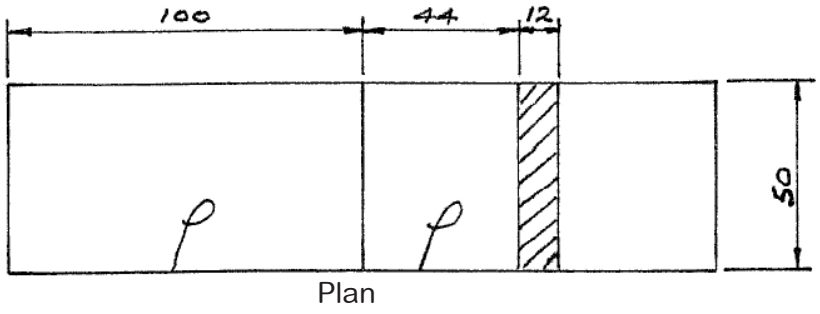




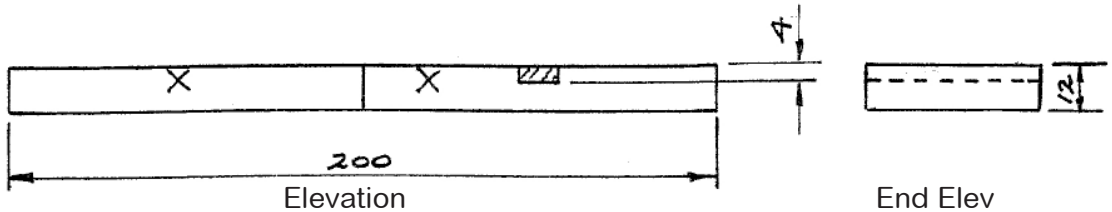




Working Drawing



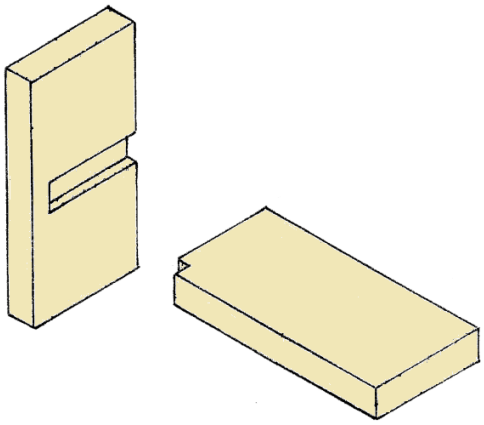
Plan



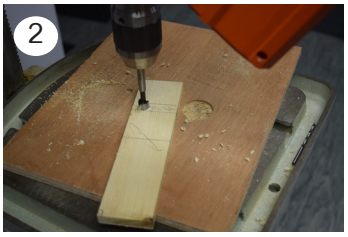
Elevation End Elev

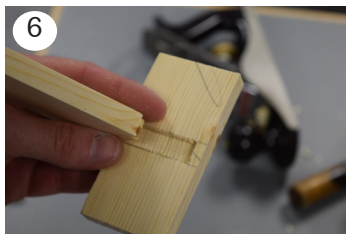
17.8 Stopped Housing

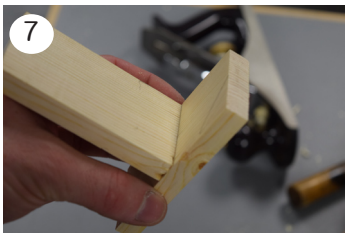
The stopped housing joint is used in preference to the through housing when an improved appearance is required. The end of the housing is stopped back from the front edge and the end of the other piece of timber is notched to suit. This is often used in shelving units, bookcases and cabinets.



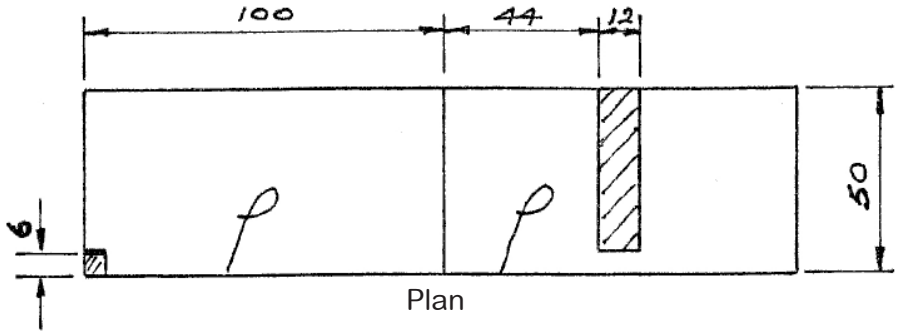
1. Mark out face side and face edge
2. Mark out the thickness of the wood in the required position.
3. Square lines round using try square and marking knife.
4. Set marking gauge to the required depth, (no more than 1/3 the thickness of the wood) and scribe line. Also scribe a line back from the edge to produce the stopped section.
5. Scribe the end of the fitted piece of wood to mark out the notch.
6. Mark our waste (1)
7. Using a forster bit in the pillar drill, drill out waste material at the 'stop' position (2)
8. Use tenon saw to saw down to gauged line (3)
9. Using a chisel remove waste, working towards the drilled out stop position. Square the ends of using the chisel (4) (5)
10. Level out the base of the housing using chisel and then hand router.
11. Using a tenon saw, saw out the notch.
12. Fit other piece into housing, if necessary remove any excess wood with chisel (6) (7)
13. Apply glue and clamp joint together.



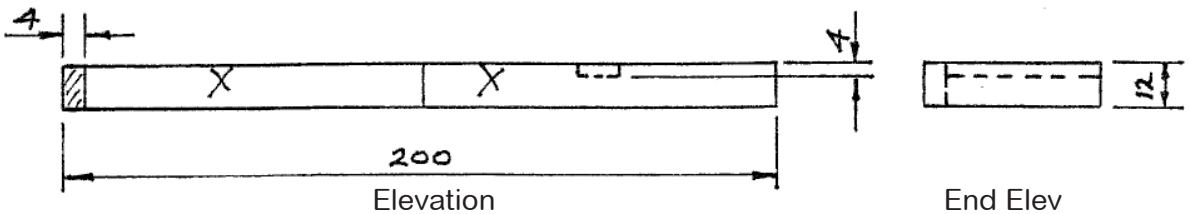




Working Drawing



Plan

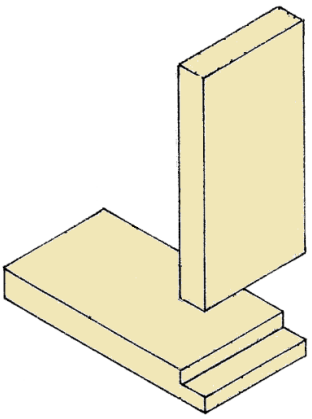


Elevation

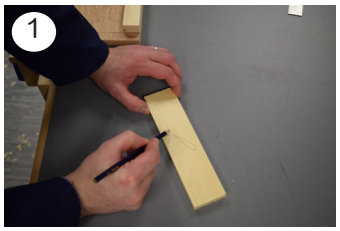
End Elev

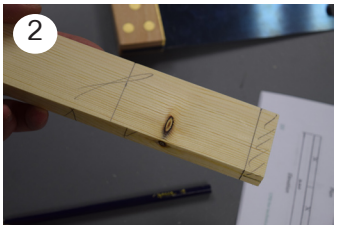
17.9 Corner Rebate

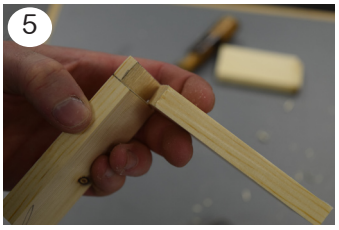
The end of one piece of timber fits into a rebate cut on the second piece of timber. This type of joint is stronger than a butt joint because it increases the area being glued. It also produces a neater joint because less end gain is visible. This type of joint is mainly used for making boxes, cheap cabinets and drawer constructions.

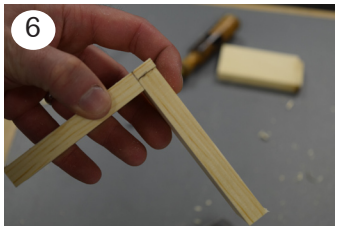


1. Mark out face side and face edge (1)
2. Set marking gauge to ¼ or 1/3 of the timber thickness.
3. Scribe a line on the end and over the top and bottom edge
4. Set marking gauge the thickness of timber.
5. Run the marking gauge against the butting end and scribe line.
6. Mark off waste wood (2)
7. Using tenon saw and sawing board saw down gauged line (3)
8. Using tenon saw with wood in vice and saw down gauge line to shoulder line.
9. Trim rebate with a chisel and/or hand router to produce flat level base (4)
10. Apply glue and clamp parts together, secure with pins if necessary

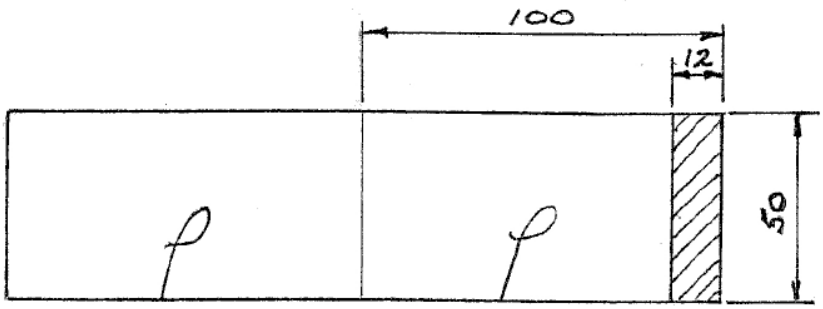




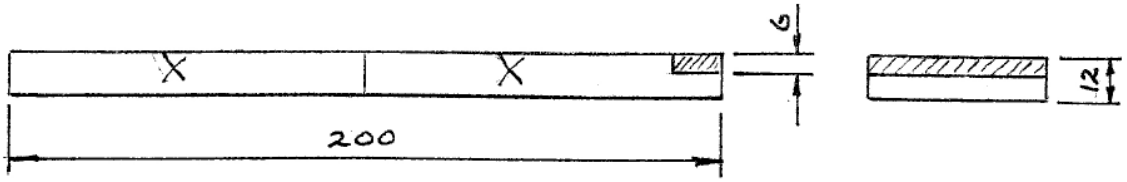




Working Drawing



Plan



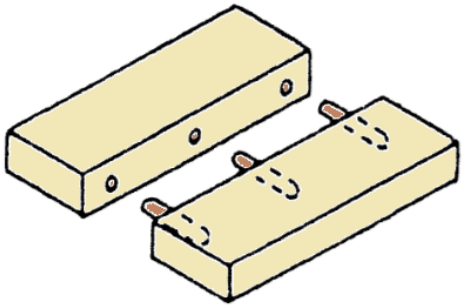
Elevation

End Elev

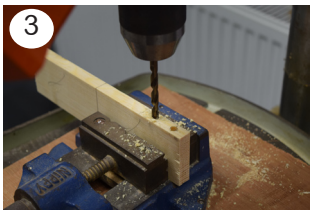
17.10 Dowel

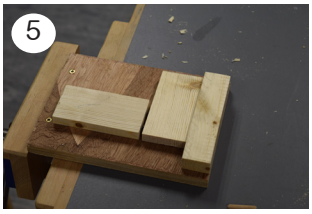
One end of a piece of wood containing wooden cylindrical wooden pins (dowels) locates into holes in the second piece to form a very strong joint when glued. Most dowels are made from hardwood such as beech or ramin.

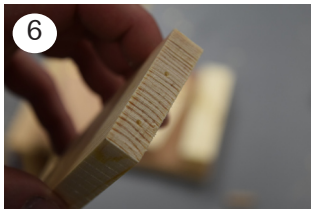
A doweling jig can be used to ensure that the holes locate exactly. The dowels are grooved lengthways to allow the glue to escape and chamfered at the end to make them easier to drive into the holes. This type of joint is commonly found on chairs and tables for fixing rungs and rails to legs.

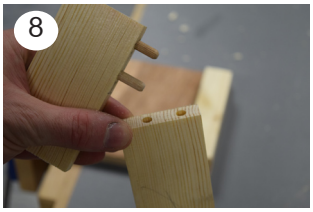


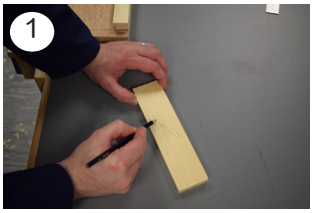
1. Mark out face side and face edge (1)
2. Using marking gauge, mark the centre of the wood.
3. Using try square complete the centre lines across the edge
4. Drill out wood at centre marks to required dowel size (e.g. 6mm) (3)
5. On the 2nd piece of wood mark the location of the centre marks using dowel markers. (4) (5) (6)
6. Drill to the required depth (7)
7. Cut dowels using fine toothed saw – also make saw cut along length to allow excess glue to escape.
8. Apply glue and clamps to finish (9)

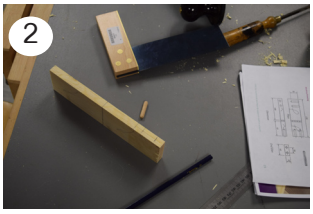


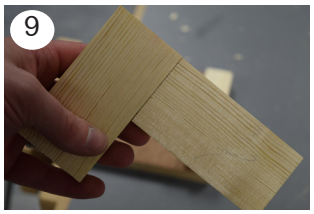




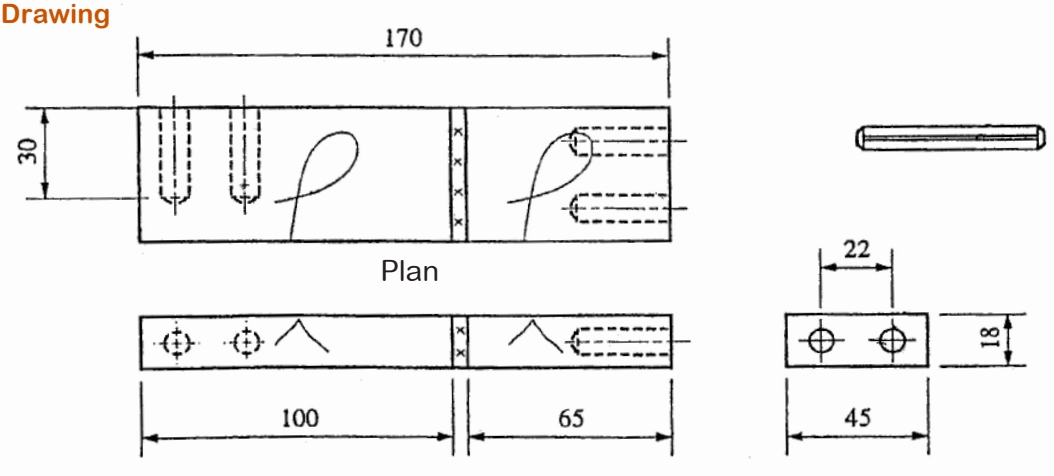








Working Drawing



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