National Certificate in Building, Construction and Allied Trades Skills (BCATS)

Apply elementary workshop procedures and processes for a BCATS project

Unit Standard – 24356

Level 1, Credit 8

Name: _____

Contents

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What you need to do

By the end of this module, you should be able to:

- establish job requirements for a specified project and prepare to apply processes;
- mark out materials for further processing;
- apply cutting and shaping processes;
- join materials and assemble product components;
- apply finishing processes; and
- complete work operations.

How you will be assessed

To achieve this unit standard, you need to complete and document a construction project (for example, a table, cabinet, seating, storage chest or complex shelving unit) where you can establish the job requirements; get the materials ready; mark out, cut, shape, join and assemble the materials; and finish the project. You need to use

- **timber** and **3** other materials (for example, manufactured board, metal, plastic, glass, concrete, mechanical fasteners, adhesives, finishing materials, upholstery fabric/leather).

You need to show your teacher/tutor that you can:

- read and listen to the instructions for a job and check anything you are not sure about;
- get the right materials for the job;
- mark out the materials using the correct tools and methods;
- cut and shape the materials using the correct tools and methods;
- join and assemble the materials using the correct tools and methods;
- finish the project correctly;
- complete all operations safely;
- clean the work area and dispose of waste; and
- clean and store tools, plant and equipment correctly.

Your teacher may provide you with an Assessment Record Sheet for Workshop Processes that will allow you to document the workshop processes used during your project.

Glossary of Terms

Term	Meaning
Brittle	Material with a tendency to break or fracture
Compressive strength	The ability of a material to resist a force that when applied will tend to decrease its volume.
Corrosion	The gradual deterioration of a material, e.g. ferrous metals will rust
Corrosion-resistant	The ability of a material to avoid decay in adverse conditions
Ductility	The capability of a material to be easily hammered, shaped, moulded or drawn into wire.
Electrical conductivity	The ease that electricity can travel through a material
Electrical insulation	The resistance of a material to electricity
Ferrous	Metals containing iron
Hardness	The ability to withstand scratching and indentation
Heat conductivity	The measure of how heat can travel through a material
Magnetism	The ability of a material to attract iron
Malleability	The ability of a material to be reshaped
Non - ferrous	Metals that do not contain iron
Non – metallic	Materials that contain no metals
Non-magnetic	Materials that do not attract iron
Oxidisation	The gradual deterioration of a material, e.g. non-ferrous metals such as aluminium will oxidise
Porous	The ability of a material to absorb air, water and other liquids
Tension	A force tending to produce elongation or extension
Thermoplastic	The ability of a material to be remoulded over and over again
Thermosetting plastic	A plastic that undergoes a chemical change when heated and cannot be reshaped
Toughness	Strength, resistance to fracturing

Introduction

The school workshop is a potentially dangerous environment. Most of the equipment that you will be using is designed to hit, cut or shape wood and other materials. Hand tools, such as chisels, can cut you and hammers can injure your hands. The heavy fixed machines, such as circular saws, have the power to permanently maim or even kill you.

It is important that you enter this environment with the maturity to work in a manner that is not going to harm either yourself or other people around you.

Your teacher will explain to you the correct way to use the tools and equipment. If you follow instructions and apply some common sense the environment will be quite safe to work in and you will have the satisfaction of using tools and equipment to develop useful skills and to construct some excellent projects.

Time spent in researching, evaluation and preparation will ensure that any project will be fit for the purpose for which it is intended.

Choosing the most appropriate materials for the construction of projects is important if expensive mistakes are to be avoided. Preliminary research will help to determine whether the task can be completed with the resources available. The quality of the research will determine how useful the finished product will be.

Job Specifications

A project specification is essential to ensure that there is a clear idea about the finished product.

Job specifications are instructions about:

- what the project is; and
- how the project is to be done:

  materials; and

  finishes, etc.

Job Specifications are made available before the project begins. They can be:

1. drawn;
2. written;
3. verbal; and
4. a combination of ALL of the above.

Drawn information includes:

- detailed plans, drawings and elevations; and
- quick sketches or diagrams.

Written information includes:

- handwritten instructions and explanations;
- typed instructions and explanations;
- faxed or mailed instructions; and
- cutting lists.

Verbal information includes:

- face-to-face conversations/instructions;
- phone conversations/instructions; and
- verbal messages.

Using the job specifications

To ensure that the project matches exactly the specifications it is important to:

1. read through the written specifications with the person providing the information and clarify what is required;
2. check that the working drawings and written specifications provide all the required information; and
3. listen to the oral instructions and check that:
    - they match the written specifications;
    - they are easily understood and clearly state what is required;
    - it is possible to visualise the finished product;
    - the materials to be used are clearly identified and appropriate;
    - health and safety requirements have been identified;
    - the required equipment has been identified;
    - any additional instructions or training requirements have been identified;
    - any additional help, information or supervision requirements have been identified; and
    - the expected duration of the project and the completion date has been determined; and
4. confirm the requirements of the job specifications with the person who provided the information to ensure that all the information needed to complete the task is available.

Materials

The job specifications will identify the materials that are to be used including:

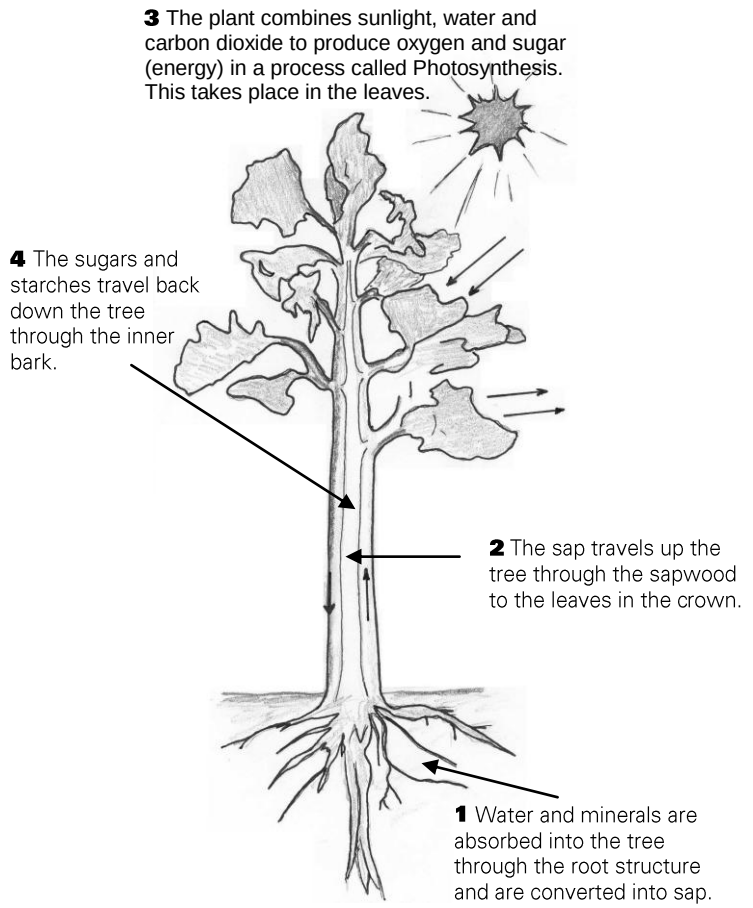
- material type – e.g. plaster board;
- material brand – Winstone Gibraltar board; and
- material size – 16mm.

Timber

Timber is wood which is milled and prepared for use for buildings, tools, utensils, furniture, fences, boat building etc.

Trees are a naturally renewable resource. They produce timber through a nourishment and growth process called photosynthesis. This takes place in the leaves and involves:

- light – usually from the sun;
- chlorophyll – the green pigment in a leaf, which acts as a catalyst for the reaction that converts:
    - carbon dioxide, which the plant absorbs through its leaves; and
    - water – the plant's sap, which contains nutrients from the soil into sugars, (which the plant can use), starch (which the plant stores) and oxygen (which the plant excretes).



Parts of a tree

Trees are made up of the following parts.

- **Pith** – This is the centre of the tree and is the dead tissue of the original sapling.
- **Growth Rings** – These rings are made up of cells representing one season's growth. They are divided into two distinct layers.
- **Spring (Early) Wood** – This layer is formed during the spring and early summer when the growth rate is at its greatest. It is lighter in colour, soft, and has large thin-walled cells.
- **Summer (Late) Wood** – This layer is formed during the summer and early autumn when growth is slower. It is darker in colour and has small hard-walled cells.

Growth rings vary in width, shape and colour depending on the seasonal conditions affecting growth. In normal conditions these rings are distinct enough to determine the age of the tree.

Sapwood

This is the newly formed wood which surrounds the heartwood. It is usually softer and lighter in colour. It is through the cells of the sapwood that water and minerals are conducted to the leaves. As the tree grows the sapwood ages, becomes inactive and turns into heartwood.

Heartwood

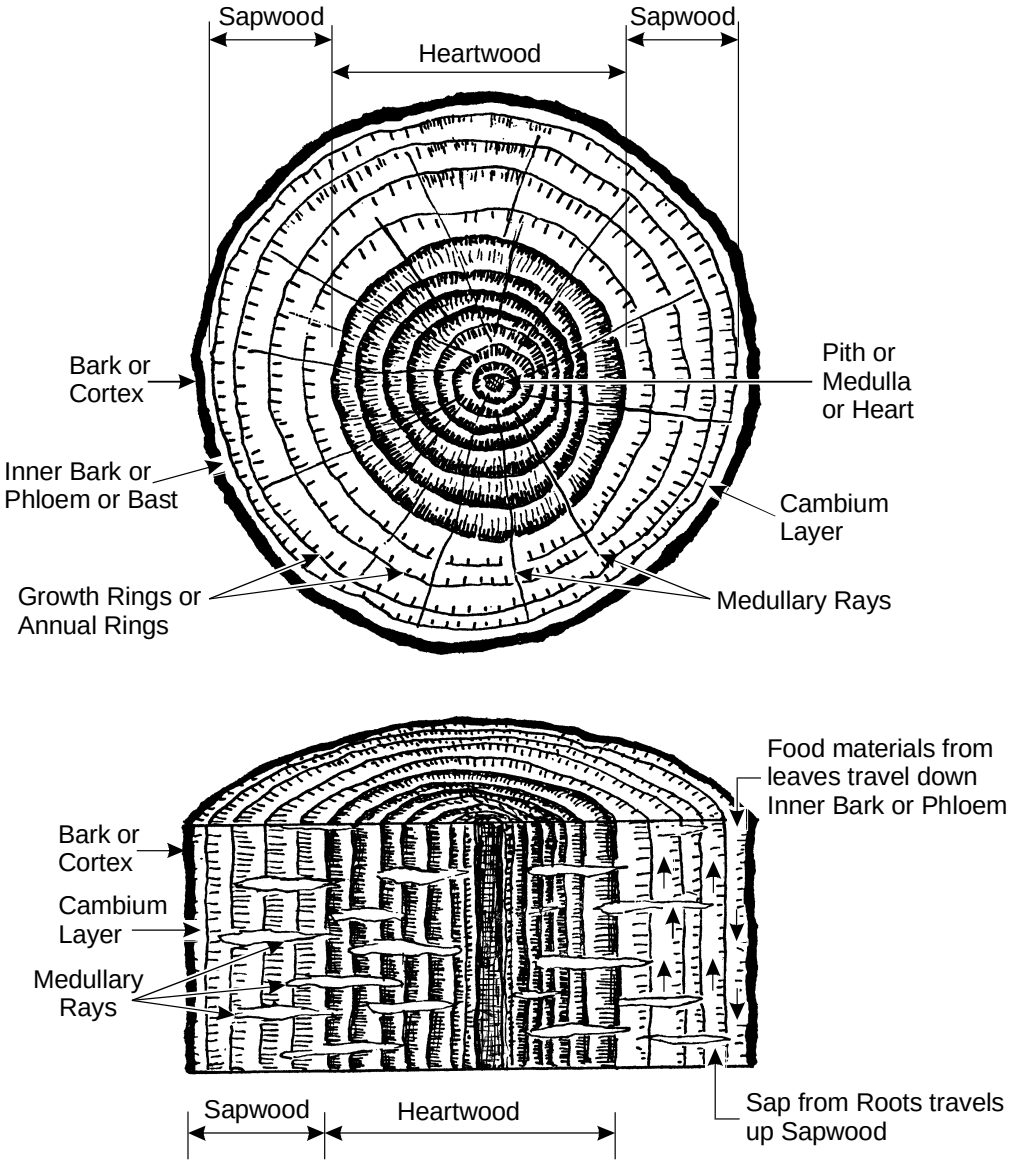
The heartwood lies between the sapwood and the pith and is made up of older inactive layers. Its main function is to help the tree to remain straight and upright. This section of the tree generally produces timber which is more durable and resistant to decay and insect attack.

Cambium layer

The cambium consists of a two-celled layer. The inner layer (called bast or phloem) produces new sapwood while the outer layer (cortex) produces new bark.

Bark

The outer bark serves as protection for the tree against insects and injury and also prevents the cambium layer from drying out.

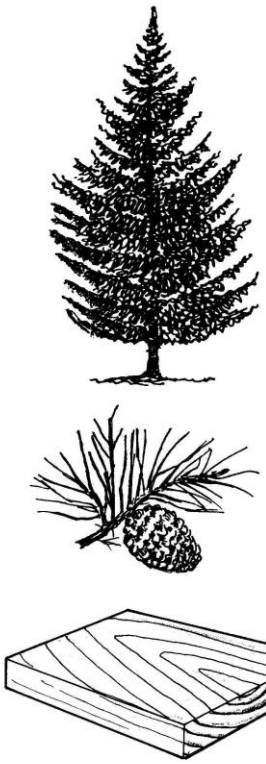

Sapwood
Heartwood
Sapwood
Bark or Cortex
Pith or Medulla or Heart
Inner Bark or Phloem or Bast
Cambium Layer
Growth Rings or Annual Rings
Medullary Rays
Food materials from leaves travel down Inner Bark or Phloem
Bark or Cortex
Cambium Layer
Medullary Rays
Sapwood
Heartwood
Sap from Roots travels up Sapwood

Classification of Timber

Timber is divided into two classes – softwoods and hardwoods.

Hardwood and softwood are botanical terms relating to the cell structure of the tree. They do not relate to the physical property of the timber.

Some hardwoods, such as balsa wood, are very soft in texture, while some softwoods are quite hard, e.g. matai.



Softwoods – are usually cone bearing, evergreen trees with needle-like leaves.
The timber is generally lighter, softer and weaker than hardwoods.

Hardwoods – are usually fruit bearing, deciduous trees with broad leaves.
For example an acorn is the seed from an oak tree.
The timber is generally harder, denser and stronger than softwoods.
The timber is often more difficult to season and treat with preservatives.

Trees are further classified as indigenous, exotic or imported.

Indigenous timber	Native to New Zealand.
Exotic timber	Grown in New Zealand but originating from a foreign country.
Imported timber	Grown in a foreign country and imported into New Zealand.

Indigenous timbers (native)

Trees that are native to New Zealand. This timber is becoming harder to obtain because the trees grow slowly and the felling and milling of native trees is increasingly restricted.

There is a thriving furniture industry based around recycled timbers, notably Rimu, Kauri and Matai.

Manufactured Boards

Plywood is a timber product made from thin sheets of wood veneer glued together under heat and pressure. It is a very strong and stable material that provides equal strength in all directions. It comes in a variety of grades and thicknesses for use in interior, exterior and marine applications.

Particle board is a low density fibreboard manufactured from wood particles, such as wood chips, shavings or sawdust, held together by a synthetic resin. It is susceptible to damp if unsealed, and is used for flooring, cabinet carcasses, vanities, cupboards and wall and ceiling linings.

Medium density fibreboard (MDF) is a manufactured board that goes through a similar process to all other particle boards. It is heavier than particle board and equally susceptible to damp if unsealed. It is used extensively on interior applications, such as cabinet carcass construction, furniture, wall linings, etc.

Hard board is a high density fibre board similar to MDF but much harder, denser and, depending on the oil content, water resistant. It is used as a base for Formica and vinyl, and in construction, furniture, appliances and automobiles, for skateboard ramps and half-pipes.

Tempered hardboard is made by adding oil when the board is formed under high temperature and pressure. This gives it more water resistance, hardness, rigidity and tensile strength.

Fibre cement sheet is available in a wide range of shapes and sizes. It is extensively used in the building industry for weatherboards, wall, shower and soffit linings, bracing panels and for fire and acoustic-rated walls.

Plaster board – also known as GIB board, is produced as a flat sheet with a plaster inner core covered with heavy paper. It is available in sheets and is used to cover the framing and provide a finish to the inside walls and ceilings. Plaster board is used on almost all building sites.

Plaster board is fixed to the wall frame or structure with adhesive and nails, or specially designed screws.

Metals

Mild steel

- Strong and versatile general purpose material.
- Low cost.
- Poor corrosion resistance – moisture will cause the metal to rust.
- Becomes malleable when heated, so it can be forged.
- It is easily worked and welded.
- Available in a wide range of forms including:
  - sheet metal;
  - bright and black bar including flat, round, square, hexagonal forms; and
  - angle, channel and tee sections.
- Used for general construction work and furniture making.
- Often used where large amounts of steel are required for construction work, such as structural steel, columns, rolled steel joists (RSJ) and roof trusses.

Stainless steel

- A hard, tough and corrosion resistant material.
- Does not stain or rust.
- Is difficult to cut or file.
- Available in a wide range of forms including:
  - sheet;
  - plate;
  - bar;
  - wire;
  - tubing.
- Is widely used where a strong hard-wearing material is required, such as in kitchens and bathrooms, furniture, hardware, industrial equipment, marine and aerospace assembly.

Copper

A reddish coloured metal with excellent heat and electrical conductivity.

- Is corrosion resistant, easy to work and shape.
- Can be easily joined using solder or by brazing.
- Is available in wire, sheet, tubing and pre-formed fittings.
- Widely used in construction for electrical and plumbing applications, e.g. water pipes and electrical wiring. High quality spouting and flashings are often made out of copper.

Brass

An alloy made up of 65% copper and 35% zinc.

- Is corrosion-resistant, harder than copper, casts well, is easily joined and is a good conductor of heat and electricity.
- Is used for castings and forgings, such as common tap fittings.

Aluminium

A light-weight, soft metal with a high strength to weight ratio.

- Is corrosion resistant and a good conductor of heat and electricity.
- Is difficult to join and should not be used in contact with other metals.
- Is available in a wide range of forms including:
  - sheet;
  - plate;
  - bar; and
  - extruded sections.
- It is commonly used in boat building, joinery and construction and for hardware, such as ladders.

Plastics

There are many different types of plastic available. Most have been developed for specific purposes.

Thermoplastics

Polythene

Polythene is low density, tough plastic with good chemical resistance and electrical insulation.

Available in:

- sheet;
- film;
- bar; and
- pipes.

Commonly used as a waterproofing membrane under concrete.

Polystyrene

Polystyrene is expanded plastic foam, making it a lightweight buoyant material that provides good sound/heat insulation. It is available in pre-formed sheets. It is commonly used for packaging material, for bouyancy in boats and as an insulation material for construction.

Nylon

Nylon is a hard, tough material that is resistant to wear and machines well.

Available in:

- bar;
- mouldings; and
- wire/thread.

Commonly used for brushes, bearings and machined items, such as gear wheels.

Thermosetting plastics

Formica

Formica is available in sheet form in a wide range of colours and surface finishes, rigid and smooth

Commonly used for hardwearing surfaces, such as bench tops.

Epoxy resins

The applications for epoxy based materials are extensive and include:

- coatings;
- adhesives; and
- composite materials, such as those using **carbon fibre and fibreglass** reinforcements. (Polyester, vinyl ester, and other thermosetting resins are also used for glass-reinforced plastic.)

Surf board fin repaired with epoxy resin

Epoxy resins are a two-pack system available in liquid or powder form. (The resins require mixing with a hardener.)

Other Materials

Glass

Glass is a hard and transparent material that is used extensively in a wide range of situations. For example, basic sheet glass, which is commonly used in windows, can be upgraded to meet more stringent or decorative requirements including:

- safety glass;
- rolled plate;
- polished plate;
- float, laminated;
- self cleaning;
- sound proof;
- tinted or stained glasses;
- textured surfaces; and
- lead lighting.

Glass is very brittle and can easily be broken, so specialist equipment must be used when drilling holes in it or polishing or bevelling its edges. Safety glass must always be used in situations where people could be injured if the glass is broken.

Ongoing developments in glass formulations and processing technologies are continually increasing the range of uses for this versatile material.

Fibre-glass

Fibre-glass is a composite material made up of a glass matt reinforced by a polyester or epoxy resin. Fibreglass is used extensively in the manufacturing and construction industries, particularly boat-building.

Concrete

Concrete is one of the most frequently used building materials. It is used extensively for a wide range of construction work, such as foot paths, driveways and roads, residential and commercial construction – floors and walls; foundations and footings, for posts, fences and block walls; and even boat hulls.

Concrete

Concrete is made up of aggregate (generally gravel and sand), cement and water, which are mixed together into a plastic mass. The water reacts with the cement setting off a chemical reaction that hardens the cement, which in turn bonds the other components together to eventually create a hard rock-like material.

The initial plasticity of concrete allows it to be moulded easily into different shapes.

Reinforcing steel

Concrete is an extremely versatile construction material. However, while it has a high compressive strength it is very weak in tension.

Steel has very high compressive and tensile strength.

The combination of steel and concrete as a composite construction material combines the high tensile strength of the reinforcing steel and the compressive strength of concrete.

Steel rods, bars and heavy wire sheets are the most commonly used methods of reinforcing. The correct placement of reinforcing is critical to the performance of the reinforced concrete.

Joining Materials

Fastenings

Nails

Nails are the most commonly used method for connecting members in wood frame construction and where appearance is not a factor. Where nails are required to enhance the appearance of the finished product, e.g. cladding, decking and finish work, care in selecting the appropriate nail type is important.

Types of nails:

- **Diamond head** and **jolt head** nails are recommended for general construction work.
- **Flat head** nails are recommended for softer timbers, such as radiata pine.
- **Panel pins** are a small, slender nail recommended for joinery or furniture finishing work. The small head means it is easily disguised.

Nails are quick to install and rely mainly on friction to resist withdrawal.

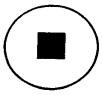
Screws

Screws are available in a wide range of types and sizes. Each type is designed specifically for a particular purpose or for use with a particular material.

The screw head is specially shaped to allow a screwdriver, or bit, to grip the screw when it is being driven in. It also stops the screw from passing right through the material and provides compression.

Screws rely on their threads to provide resistance to withdrawal and can normally be removed and reinserted without reducing their effectiveness. They have greater holding power than nails and permit disassembly and reuse of materials.

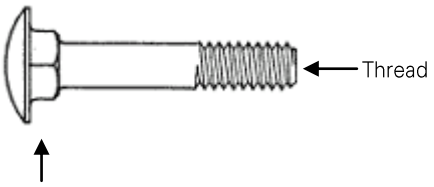
There are many different types of screw heads available and it is important that the screwdriver fits the head of the screw correctly.

	**Slotted**	Standard or flat for driving single slotted screws. Tip width range from 4.2mm to 12.5mm.
	**Phillips**	Designed specifically for use with a Phillips head screw, which has two recessed slots at right angles to each other. Sizes range from 0 point (small) to 4 point (large).
	**Pozidriv**	Similar to the Phillips style, the screw can be identified by additional lines on the face. Sizes range from 1 point (small) to 4 point (large).
	**Square drive**	Square tip, commonly used in industrial applications. Sizes range from 1 point (small) to 3 point (large).

Bolts

Bolts are used to hold materials together (usually steel). They provide a strong joint using a clamping action to hold the two surfaces together.

Coach bolts are used to bolt metal to wood. The head of the bolt is usually rounded with a square portion on the shank directly under the head. The square portion of the shank pulls into the timber as the bolt is tightened.



Rivets

Rivets are used to fasten sheet metals or similar materials with a pop rivet gun. They produce a very strong and permanent fastening.

Welding

Welding is the process of joining materials, usually metals or thermoplastics, by melting and fusing the parts together.

Brazing and soldering

Brazing and soldering involves joining materials by melting a lower-melting-point material onto the workpieces.

This is done without the melting of the workpieces. Gas welding sets are often used to provide the heat for this process.

Adhesives

Adhesives can be used to provide a quick and efficient jointing method between a wide range of materials. The most common adhesives used include:

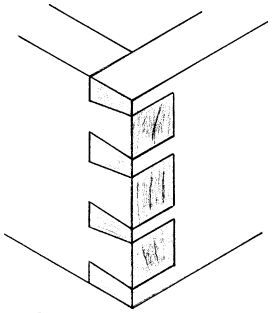
- **Polyvinyl Acetate (PVA):** A creamy white thermoplastic wood adhesive that is ready for use straight from the container. It is a clean, non staining glue, easy to use and will provide a strong joint. It is not waterproof and will break down if exposed to moisture and also when exposed to excessive heat. PVA will join most materials that have a porous surface.
- **Ados F2:** This is a contact adhesive. This means that the adhesive bonds to itself. To use it you must spread a thin layer of adhesive on each surface and allow it to dry, usually about 10 to 15 minutes. When the two surfaces are touch-dry they can be pressed together. It is important that the surfaces are correctly positioned because contact adhesives adhere, or stick, immediately on contact.

  Ados F2 can be used to join a wide range of materials to either timber or steel. These materials include Formica, plastic laminates, wood veneers and rubber.
- **Araldite®** is the brand name for a range of high performance epoxy adhesives. Araldite is a two pack adhesive that is made up by mixing equal portions of hardener and resin. It can be used on a wide variety of repairs and bonds most materials including glass, ceramic, leather, wood, metal, masonry, most hard plastics and rubber. Araldite adhesive creates a super-strong, water-resistant bond that can be painted or sanded. It is extensively used in domestic and industrial applications.
- **Hot glue** (or hot melt glue) is a form of thermoplastic adhesive. The glue comes in solid sticks that are fed into an electric hot glue gun, which melts the glue so that it can be applied to the work. It cools and hardens in less than a minute.

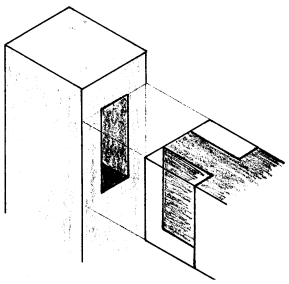
Wood joints

Wood joints are used to join pieces of timber together. Their use either increases the strength of the joint or improves its appearance. Quality wood joints will add value to the quality of the finished product. Modern machinery has largely superseded hand tools for the production of wood joints.

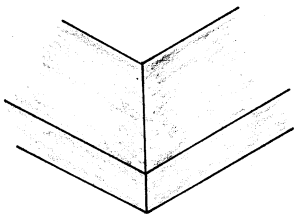
There are many different types of wood joints including:



Common dovetail joint



Mortise and tenon joint



Mitre joint

Surface Finishes

Surface finishes are a design element that must be appropriate to the specific project and how it is going to be used. There is a wide range of surface finish materials available that can be applied with a brush or roller, or sprayed on.

Paint

Paints cover and add colour to an object or surface by covering it in a pigmented coating. Paints are available in gloss, satin and matt finishes.

There are three main coats of paint that are normally required to complete a quality job:

- **Primer** is a preparatory coating put on materials before painting. Priming ensures better adhesion of paint to the surface. It increases paint durability and provides additional protection for the material being painted.
- **Undercoat** – has opacity to cover any blemishes. It provides a base for the finish coat.
- **Finish Coat** – provides the final hard wearing surface with gloss and colour pigments. A finish coat will not cover blemishes and will not stick to a surface for long without an undercoat.

The two main types of paint that you will use will be enamel (oil based) and acrylic (water based):

- **Acrylic paint** is a fast-drying paint that can be diluted with water. It becomes water-resistant when dry. Acrylic based paints are increasing in popularity and are regularly used for tasks such as house painting and interior decorating. Brushes are washed in water.
- **Oil based paints** are slower drying but produce a hard wearing paint finish. Brushes are washed in mineral turpentine.

Varnish

Varnishes provide a protective coating without changing the colour. They are paints without pigment. Like paints they are available in gloss, satin and matt finishes.

- **Acrylic varnish**: Quick drying and non-toxic. Brushes can be rinsed out in water.
- **Polyurethane**: Commonly used for a wide range of applications. Coats can be applied by brush, roller or spray painted depending on the job and the availability of equipment. Once fully hardened, the surface should provide a hard wearing, resilient surface. Clean brushes in mineral turpentine.
- **Sanding sealer**: A clear-finish primer formulated for application over bare wood. It is designed to 'raise the grain', which is then sanded to provide a smooth surface under oil-based polyurethane topcoats. Its quick-dry feature allows you to seal and top coat your project in one day. Clean brushes in mineral turpentine.
- **Lacquer**: A fast-drying solvent-based paint or varnish that produces an especially hard, durable finish. Clean brushes in mineral turpentine.

Oil

Oils provide a quick and easy finish to most timber surfaces. There is a wide range of oil types available depending on the finish that you require. The main problem with oils is that they fade over time. Examples of oils are:

- **Danish oil**: Excellent on pine, it gives a natural low-lustre finish.
- **Lemon oil**: This provides a suitable finish for teak and matt finished woods where a wax finish is not desired. It has the aroma of fresh lemons.
- **Linseed oil**: A natural product available in natural and boiled form. A traditional wood finish, although it does tend to go gummy if applied too heavily.
- **Teak oil**: A quick-drying penetrating seal for teak and similar woods. It leaves a slight sheen when dry.
- **Tung oil**: This oil gives a superior finish to that of linseed oil, and is water-resistant. It can be easily applied using a rag.
- **Vegetable oil:** Commonly used on surfaces that are in contact with food, e.g. salad bowls. The oil is non-toxic and will not taint the food

Clean brushes in mineral turpentine.

Polish

Polishes help to seal the timber and provide a harder wearing surface than a stand alone oil finish. As with the oil finishes, there is a wide variety of polishes available:

- **French polish**: A traditional polishing method that is made from pure shellac and alcohol. It provides a high quality finish for furniture.
- **Wax polish**: A good quality wax polish, with added beeswax, will provide a hard, protective coating with a natural sheen. Wax polishes are available in a number of forms including liquid, paste, a special brushing wax, coloured waxes and staining waxes.

Marking out tools

Accurate marking out requires the use of appropriate tools and careful measurement.

A work bench, saw horse or other stable surface is required to support the material that is to be marked out. In some cases the material may need to be held in a vice or other adjustable work holder.

The marking out surface needs to be at an appropriate height and inclination to suit the work and the worker.

Marking-out tools include:

- steel rule;
- folding rule;
- carpenter's pencil;
- measuring tape;
- tri square;
- combination square;
- sliding bevel;
- marking gauge;
- cutting gauge; and
- mortise gauge.

Steel rule

Stainless steel rule – common size 300mm long.

Use

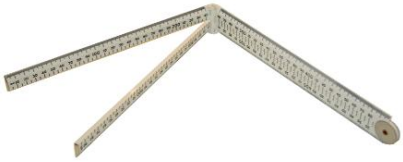
- For accurate measuring and marking out, particularly for bench work and setting up machines.
- Maximum accuracy is achieved when used with a sharp marking knife or sharp pencil.

Care and maintenance

- Protect the edges and ends from damage.
- Keep clean.

Folding Rule

A folding, 1-metre rule graduated in millimetres.



Use

- For accurate measuring and marking out.
- Use flat for an approximate reading, use on its edge to accurately mark measurements with a sharp pencil.

Care and maintenance

- Easily broken.
- Lubricate hinges and keep the ruler clean.

Carpenter's pencil

The carpenter's pencil has a rectangular shaped lead and comes in hard, medium or soft grades.

Use

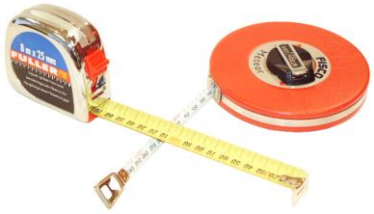
- For marking and recording measurements.
- Use as a finger gauge for drawing lines parallel to an edge.

Care and maintenance

- Keep the point sharp and chisel shaped.

Measuring tape

A flexible strip of steel divided into millimetres, centimetres and metres. Common lengths used by carpenters are 5m and 8m.



Use

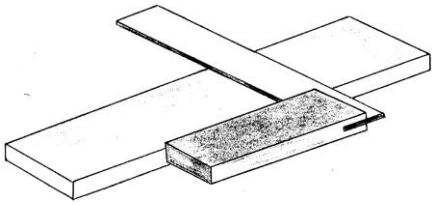
- To accurately measure lengths.
- When measuring, hold the tape tight and support it to prevent sagging.
- Rewind after use.

Care and maintenance

- Avoid loops in the tape as they may cause it to snap when it is pulled tight.
- It's important to keep the tape dry, lightly oiled, and free from grit that may scratch the enamel surface and make reading and rewinding difficult.
- Avoid retracting the tape hard onto the stop end.

Tri square

A blade fixed at 90 degrees to the stock.



Use

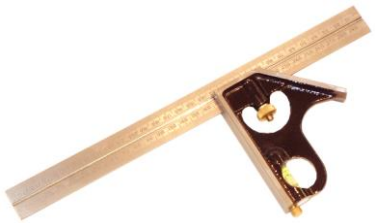
- For marking angles of 90°.
- Test if edges and corners are square.

Care and maintenance

- Keep clean and free of rust.
- Ensure that squares are not knocked or damaged.

Combination Square

The stock is adjustable and can be fixed by a thumb screw in any position along the blade.



Use

- For marking angles of 45° and 90°.
- Use as a gauge in awkward places and for measuring the depths of rebates.

Care and maintenance

- Keep clean and free of rust.
- Lightly oil the thread screw so the stock moves easily on the blade.

Sliding bevel

The blade is held in position on the stock by a thumb screw. The blade of the bevel can be adjusted to any desired angle.

Use

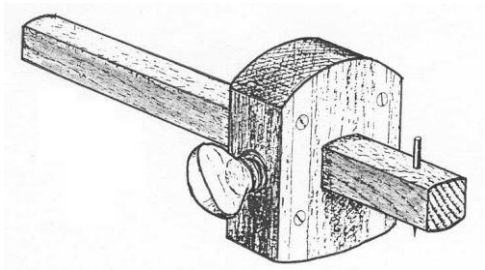
- For marking odd angles and testing bevel cuts and mitres.

Care and maintenance

- Keep clean.
- Lightly oil thread at thumb screw to keep moving parts in operating order.
- Retract blade when storing.

Marking gauge

The spur scribes the line and is mounted in the stem. Move the position of the stock on the stem to adjust. The thumb screw locks the gauge in a set position.



Use

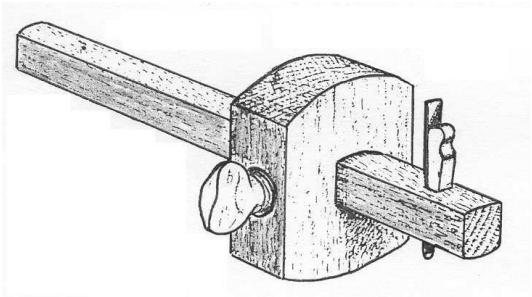
- For scribing lines parallel to an edge.

Care and maintenance

- Keep the spur sharp.
- Release the tension on the thumb screw when not in use.
- Store in a clean and dry environment.

Cutting gauge

Similar to the marking gauge but with a cutter or blade instead of a spur.



Use

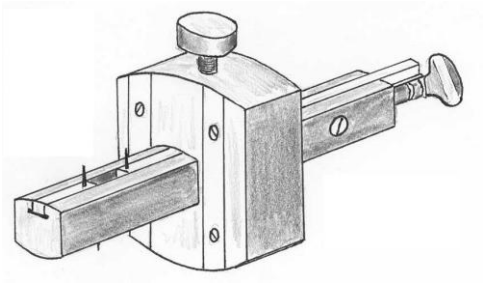
- For cutting or marking out across the grain.
- Used for cutting veneer or thin timber into strips.

Care and maintenance

- Keep the cutter sharp.
- Release the tension on the thumb screw when not in use.
- Store in a clean and dry environment.

Mortise gauge

The mortise gauge has two spurs, one of which is adjustable and used to mark two lines parallel to a face or an edge. This gauge is particularly useful for marking out mortise and tenon joints as well as positioning for dowel joints.



Cutting and Shaping Processes and Tools

Tools for cutting and shaping:

- Tenon saw
- Panel saw
- Rip saw
- Hack saw
- Planes
- Scraper
- Rasps and files
- Dovetail saw
- Cross cut saw
- Coping saw
- Chisels
- Spokeshaves
- Oilstone
- Sanding block

Saws – general comments

A well-balanced handsaw is an essential item for any woodworker. While portable circular saws have, in many cases, superseded hand saws, a properly sharpened and set saw can produce a smooth, straight cut with greater accuracy than a power saw.
Handsaws vary in size and shape to suit particular jobs. The three main groups are:

- backed saws, such as tenon saws and dovetail saws;
- rip, crosscut and panel saws; and
- curve cutting saws, such as coping saws.

The number of teeth per 25mm gives the size of the saw.

Tenon saw

The tenon saw has a brass or steel ridge on the top edge to strengthen and stiffen the blade. Blade lengths vary from 300 to 400mm, with 13 points per 25mm.

Use

- For general bench work, e.g. when a fine cut is required on small items, such as mouldings.
- Can also be used in a mitre box for consistency and improved accuracy.

Care and maintenance

- Store in a rack or hang by the handle or blade,
- Keep clean and free of rust.
- Maintain the saw in a sharp condition.

Dovetail saws *are smaller versions of the tenon saw, with 18 to 22 teeth per 25mm. The dovetail saw is used for cutting dovetails and other fine work.*

Panel saw

Panel saws are normally 600mm long or shorter, with 10 to 12 points per 25mm.

Use

- For fine crosscutting on finishing timber and panels.

Care and maintenance

- Store in a rack or hang by the handle or blade.
- Keep clean and free of rust.

Crosscut saw

Crosscut saws are normally 700mm long, with 5 to 10 points per 25mm.

Use

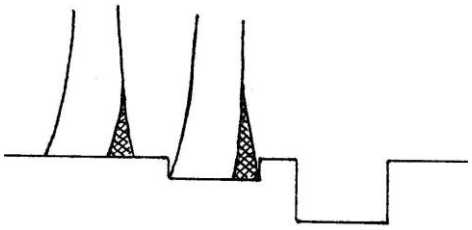
- For general-purpose cutting across the grain of timber.

Care and maintenance

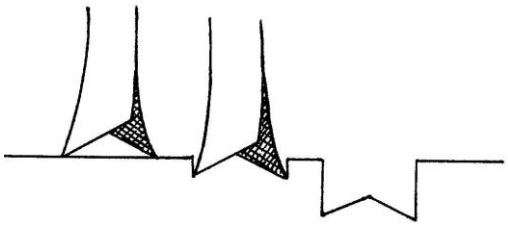
- Hang by the handle or blade.
- Keep clean and free of rust.
- Send to saw doctor for sharpening and setting when required.

Rip saw

Normally 700 to 800mm long, with 3 to 6 points per 25mm.



*Rip saws cut along the grain with a **chiselling** action.*

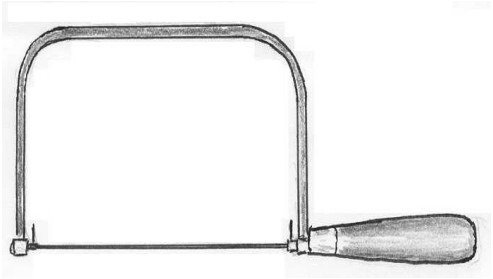


*Crosscut cuts the wood fibres with a **slicing** cut.*

***Note:** Ripping timber along the grain is now usually done either with a portable power saw or on a saw bench.*

Coping saw

Coping saws have a fine blade held in tension in an adjustable steel frame. Two adjustable levers alter the blade position.



Uses

- For cutting sharp curves in thin timber.
- Scribing the ends of mouldings at internal angles.

Care and maintenance

- Replace the blade when necessary.
- Keep clean and free of rust.
- Align the adjustable pins to ensure that the blade is straight within the frame. A twisted blade will produce a rough inaccurate cut and is more likely to break.

Hack saw

Blade lengths vary from 225 to 305mm, with 18, 24 or 32 teeth per 25mm. Hack saws have a detachable blade held in a heavy duty metal frame. The blade is held under tension to help prevent it twisting and bending.

Uses

- For cutting metal or plastic.
- For softer material, generally use a coarser blade.

Care and maintenance

- Release blade tension when storing.
- Keep clean and free of rust.

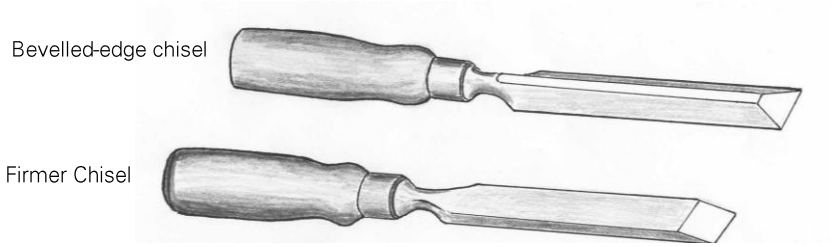
Chisels

A metal tool with a sharp bevelled edge, used to cut and shape stone, wood or metal. Traditionally the tool was struck with a wooden mallet. Modern versions, with shatter resistant handles, can withstand the blows of a steel hammer. High quality forged steel blades also help to ensure a fine cutting edge. Chisels are predominantly used for:

- fine, delicate cutting, such as removing waste from dovetail joints;
- heavier chopping work such as checking in hinges, or halving joints; and
- shaping and trimming timber.

Chisel widths vary from 6 to 50mm. The beveled-edge and firmer chisels are most commonly used.

Other chisels available include butt, registered firmer, paring and carving chisels.



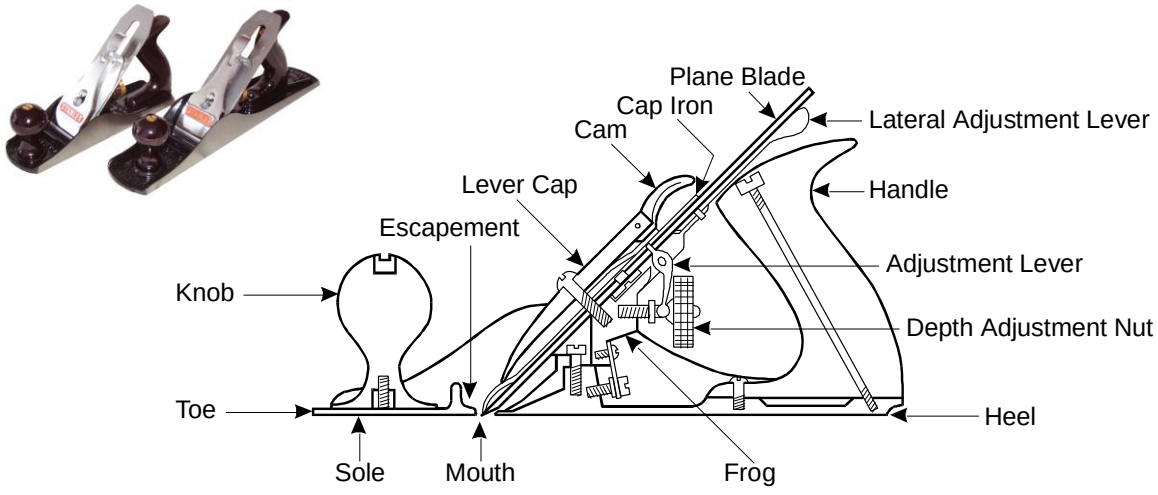
Planes

Planes are a tool used to take shavings off timber to produce smooth timber surfaces, straighten timber and reduce timber to a required width.

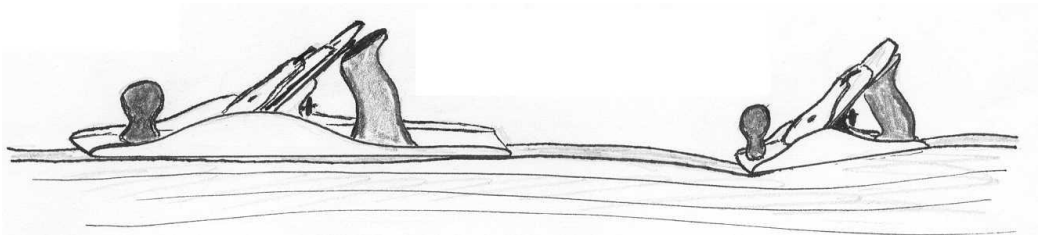
Planes and chisels require a very sharp blade if the cut is to be effective.

Metal planes have a cast steel body and a steel blade (of back or cap iron) that can be adjusted in two directions using a lever and a wheel adjustment.

Metal planes vary in size, with the most common size being 245 x 50mm (No 4).



A **jackplane** has a longer sole and is more suited to straightening long lengths of timber.

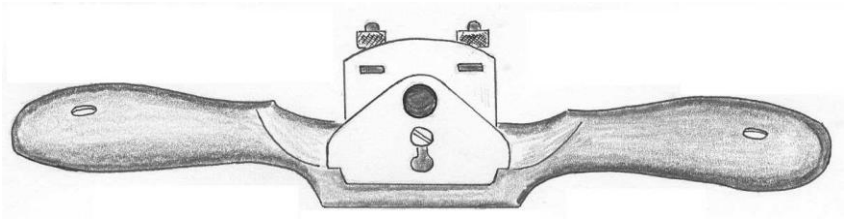


Jointer or try planes have a very long sole and were used for planing long straight edges or surfaces. Mechanised portable electric planers have largely superseded them.

Block planes are used for fine chamfers and end grain.

Spokeshaves

A spoke-shave is used for smoothing surfaces on internal or external curves. The cutting action is similar to that of a plane, but the sole is short so that it will follow the curve of the component. The sole face can either be flat or curved, with the curved sole being more suitable for concave curves. The care and maintenance is the same as for planes, although spokeshaves are likely to break when dropped.



Scraper

The hand scraper is usually a flat piece of steel, with the cutting edge being formed by burring over the long edges of the scraper. It is used to remove marks and defects on the planed surfaces and is particularly effective on irregular or opposing grains. Scrapers can also be shaped up for use on curved surfaces.

Joining Materials and Assemble Products

Construction of wood joints

Wood joints can be constructed either by hand or by machine, depending on the project and the equipment available.

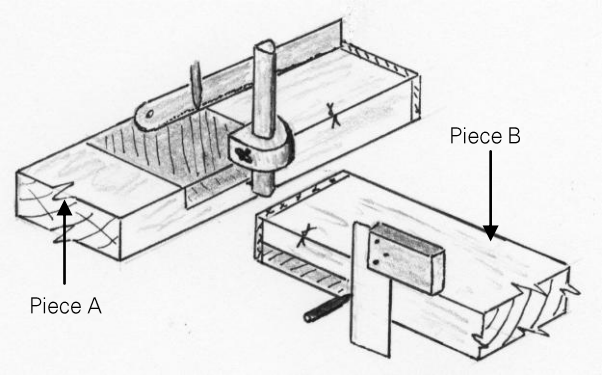
Similar construction principles apply to most hand crafted wood joints with accurate marking out, cutting and shaping skills forming the basis of quality workmanship.

Traditionally there has been a wide range of strong and decorative methods for joining timber, each suited to a specialist application. Many of these wood joints are still used in areas, such as joinery, boat building and furniture making:

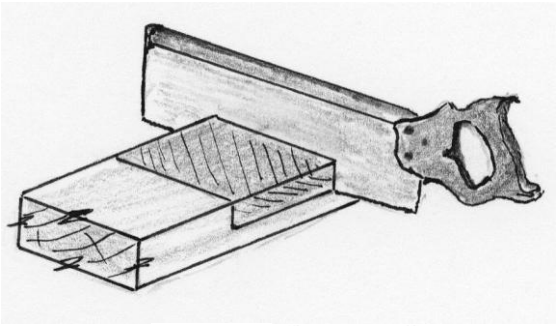
- angle halving joint;
- mitre joint;
- bridal joint;
- dovetail joint;
- rebate/ shouldered butt;
- cross halving;
- rail to stile; and
- stub mortise and tenon joint.

Preparing a halving joint

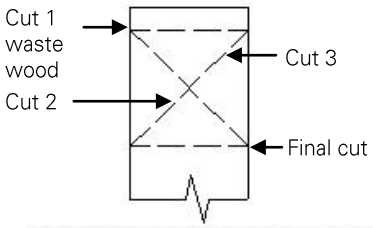
1. Prepare the timber, identifying face side and face edge. Mark out the timber joint. Ensure that an allowance is made for final dressing of the timber.



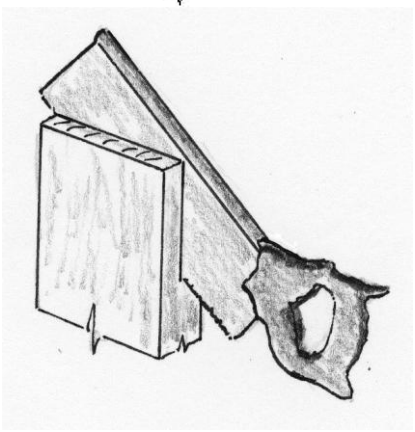
2. Saw across the grain down to the gauge line on Pieces A and B. Make sure that you are cutting on the waste wood side of the line.



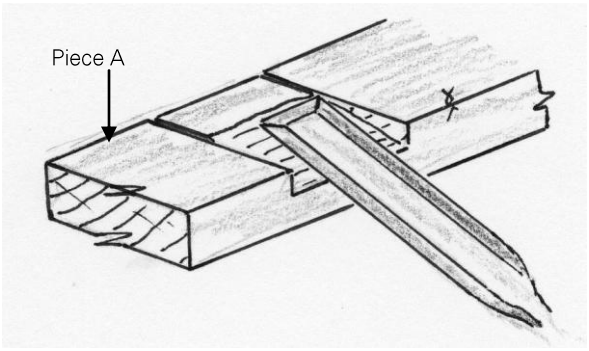
3. Remove waste wood on Piece B using tenon saw. Follow cutting plan to provide the straightest cut. Clean up cut surface using a wide chisel.



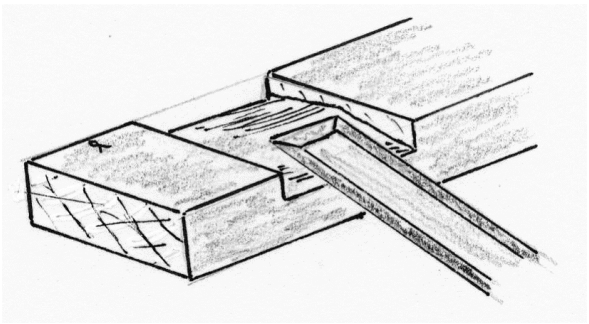
Piece B demonstrating cut 2



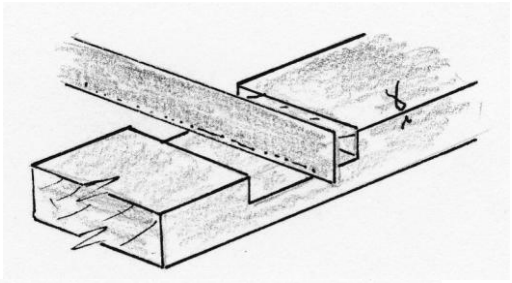
4. Remove waste wood from Piece A. Chisel up on a slope, towards the centre of the work. Ensure that work is held securely and never place your hand or any part of your body in front of the chisel.



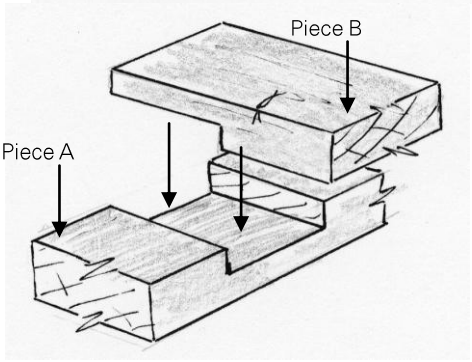
5. Repeat the chiselling process from the other side.



6. Chisel bottom flat (test for flatness with rule).



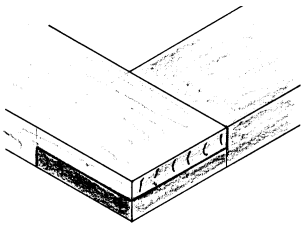
7. Fit the parts together and clean up work.



Halving and corner joints

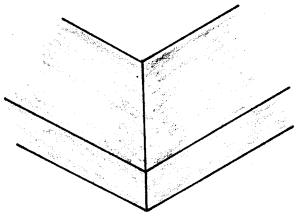
Angle halving joints

Used for corner joints in framing construction. It is a quick and easy joint to construct and is relatively strong.



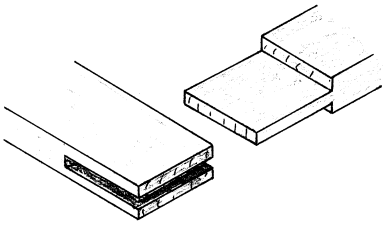
Mitre Joint

In its most basic form it is a butt joint that has had a 45 degree angle cut on the ends of each piece. It is often used for decorative work because no end grain is exposed. The joint is not very strong but can be strengthened by inserting wooden tongues.



Bridle joint

This is a strong and attractive wood joint. The joint is usually glued together and is often pinned with a dowel through the side of the joint.

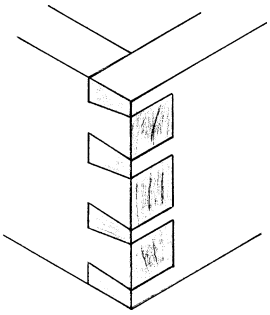


Dovetail joint

Dovetails are one of the strongest forms of angle joints. The strength in this joint is obtained through:

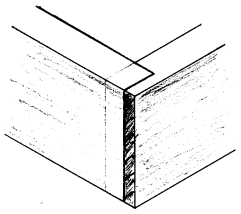
- extra gluing surfaces of the dovetails
- the angle of the dovetails.

The dovetail joint is used in the construction of strong boxes, chests and drawers, where strength and an attractive appearance are required.



Rebate/shouldered butt

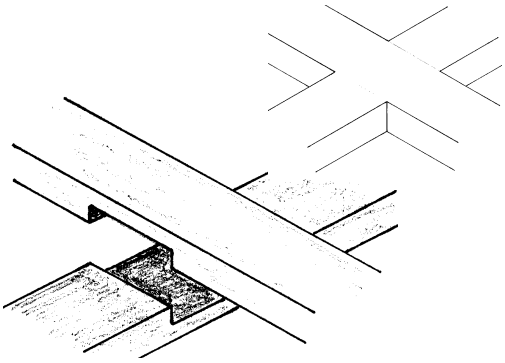
This joint is a simple form of construction that provides greater strength than a basic butt joint. The shoulder helps support the joint as well as offering additional gluing surface.
It is used for boxes, plinths and cheap drawers.



Halving joints

Cross halving

This joint is similar to the angle halving joint and is used where two pieces cross one another. It is a strong joint with the advantage of maintaining a flush surface finish.

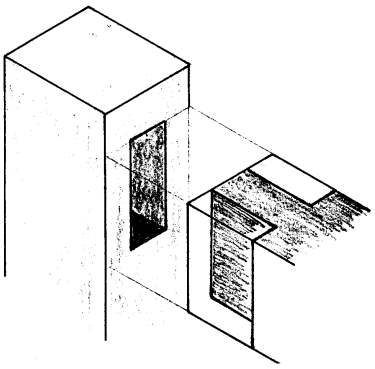


Rail to stile joints

Through mortise and tenon joint

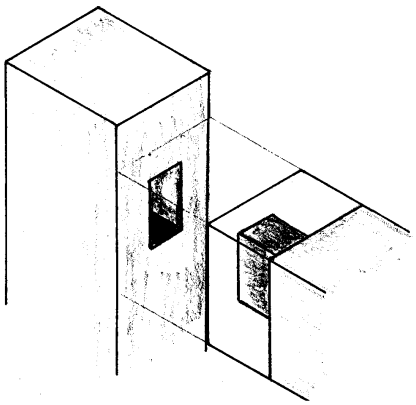
This is the simplest form of the mortise and tenon joint. It is used where a rail meets a stile. The mortise is cut right through the stile; the tenon runs through and is finished flush with the outside edge.

The joint can be strengthened with the use of wedges. This is a strong joint and is far superior to a dowel joint.



Stub mortise and tenon joint

This is a very similar type of joint to the through mortise and tenon with the exception that the tenon is stopped, i.e. does not pass through the stile. It is used on high quality work to prevent the end grain from being seen on the outside edge.



Safety

Safety is everyone's responsibility– not just the responsibility of the organisation, company, teacher/tutor, employer, supervisor or trainee. Through the combined efforts of everyone, accidents can be prevented.

Experience has shown that the best safety measure is a careful worker. Form safe working habits, wear the correct safety equipment and consider the safety and wellbeing of other workers.

Before I use any equipment or machine in the workshop I must be instructed in and know:

- how to correctly set up and operate the equipment or machine;
- how to identify hazards that I will be exposed to – for example, how the machine could injure or harm me;
- how to minimise the risk of these hazards to others and myself; and
- what to do in the event of an accident or emergency

I also know that:

- I do not have to use any machine that I do not feel safe around or confident in its correct use.
- I will notify the teacher/tutor/supervisor if I do not understand any of the operating procedures or if I have missed any part of the lesson or instruction.
- if in doubt, I must ask!

When using the machine I will:

- wear the appropriate safety equipment correctly personal protective equipment (PPE);
- ensure that the area I am about to work in is safe and secure;
- set the machine up correctly, ensuring that all guards are in place and all safety procedures are followed;
- operate the machine in the correct manner;
- notify the teacher/tutor/supervisor of any problems or if the machine appears to be faulty; and
- notify the teacher/tutor/supervisor of any accidents or near misses.

Safety when using tools

Most work in workshops involves the use of hand and power tools. The following sections cover some basic points that should be considered when any hand tool, or portable power tool is to be used.

All BCATS National Certificates require students to use tools competently. A critical part of using these tools is the ability to use them safely.

Hand tools

Most hand tool accidents arise from one or more of the following:

- the tool not being properly used;
- using the wrong tool for the job; or
- using blunt or defective tools.

To avoid having an accident when using hand tools, always:

- use the right tool for the job;
- adopt the correct work method; and
- repair or replace defective or faulty tools.

Hand tools that are used for cutting must be kept sharp. It is much easier to be injured with a blunt tool than a sharp one.

Safe conduct and behaviour

While regulations set out official processes and procedures, and employers have their responsibilities, **you** must play **your** part in maintaining **your** personal safety and contributing to a safe site. **You** can achieve this through **your** personal conduct and by working safely with tools, equipment and taking due care in all work practices.

Safe conduct is applied common sense.

Safe conduct means working with due consideration for your own safety and the safety of others at all times.

A responsible and safe attitude can be summarised as:

- carrying out instructions properly;
- asking for advice when in doubt;
- reporting any unsafe conditions;
- using the correct tools and equipment;
- keeping the workplace clean and tidy;
- reporting any injury (however small) and having it attended to promptly;

- not distracting others or fooling around;
- wearing or using the personal protective equipment and clothing provided;
- using only tools, machinery and equipment that you have been trained to use;
- not starting machinery without all the guards in place;
- not leaving tools in places where others can trip over them. (similarly, not leaving tools where they might fall on someone); and
- reading the organisation's safety policy.

Personal protective equipment and clothing

Personal protective equipment (PPE) and clothing will vary greatly from job to job. It is often dependent upon the types of hazards that will be encountered while working on the site.

.Whatever the type of PPE and clothing required:

- keep it readily available;
- wear it whenever necessary; and
- keep it in good order and condition.

Today's standards for PPE and clothing are high. Responsible manufacturers usually meet specifications issued by the Standards New Zealand. Where the Standards New Zealand has approved the product, it will be identified with the standards certification mark.

Employers/teachers should provide (or ensure the student has) the right PPE and clothing necessary for each job. You must wear the PPE and clothing provided.

Ear plugs or muffs

High noise levels for even a short period can damage hearing, as can long exposure to moderate noise levels.

There are different grades of hearing protection available. Each grade is suitable for a different noise level. Use the grade suitable for the work and wear it whenever the noise level requires it. Where construction work is concerned use Class 5 protection, as this is the highest level and will cover all the noise levels likely to be encountered while working on site.

Protective glasses, goggles or face masks

Welding flash, flying sparks, wood dust and splinters, chemical splashes, dust, concrete chips and steel splinters, are some of the common causes of eye injury. The need to wear eye protection may not always seem as obvious. An example of this would be working near someone grinding steel. Logically, the person grinding the steel will need to wear eye protection, but any person working near the grinding should wear eye protection also. An eye injury needs to happen only once to blind a person for life!

Dust mask, respirator or self-contained breathing apparatus

Fumes, vapours and dust need to be guarded against by using an appropriate respirator or dust mask. The type of protection chosen depends mainly upon the type of work being undertaken. For simple tasks of short duration, a dust mask would be suitable. However, for more toxic vapours or long exposures to high dust levels, an air supplied breathing apparatus would prove to be more suitable.

It is important to remember that damage may be done to the lungs and respiratory system through either long exposure to seemingly harmless dusts or by short exposure to a chemical. People should know the risk and wear the correct breathing protection required to overcome the risk at all times while working in that area. Working outside does not lower the risk. Wearing the right equipment for the purpose is very important. A simple dust mask will not provide protection against toxic fumes from solvents and glues – especially in spaces where these fumes may build up.

Safety footwear boots or shoes

Suitable footwear for the work being undertaken is necessary on any construction site. In nearly all situations, this means safety boots or shoes (steel caps). Good robust footwear will provide a good footing and save possible slipping injuries. It will also protect feet from falling objects and objects penetrating through the sole of a shoe into the foot.

Hard hats

When a helmet is required, it is important to ensure that it is a good comfortable fit. It may also be necessary to wear eye or hearing protection at the same time as wearing a helmet. This is often best fitted to the helmet for comfort and convenience.

Wearing head protection on sites is often compulsory, especially where the site is designated as a "Hard Hat area". The type of head protection worn must meet the requirements of the recognised New Zealand or international standard.

Gloves and overalls

Wearing suitable gloves, overalls, high visibility (hi viz) jackets and other protective clothing can protect against exposure to dangerous materials and ensure that a person is "visible" on a construction site.

If wearing gloves or overalls, make sure they are a good fit, comfortable and appropriate for the environment and the task being performed.

Loose-fitting overalls and aprons can be extremely dangerous – particularly around machinery.

Sun protection

Even short periods of unprotected exposure to the sun can cause burning and skin diseases.

Protect yourself by using sun block, a sun hat and long-sleeved shirts. In other words,

Slip, Slop, Slap!