

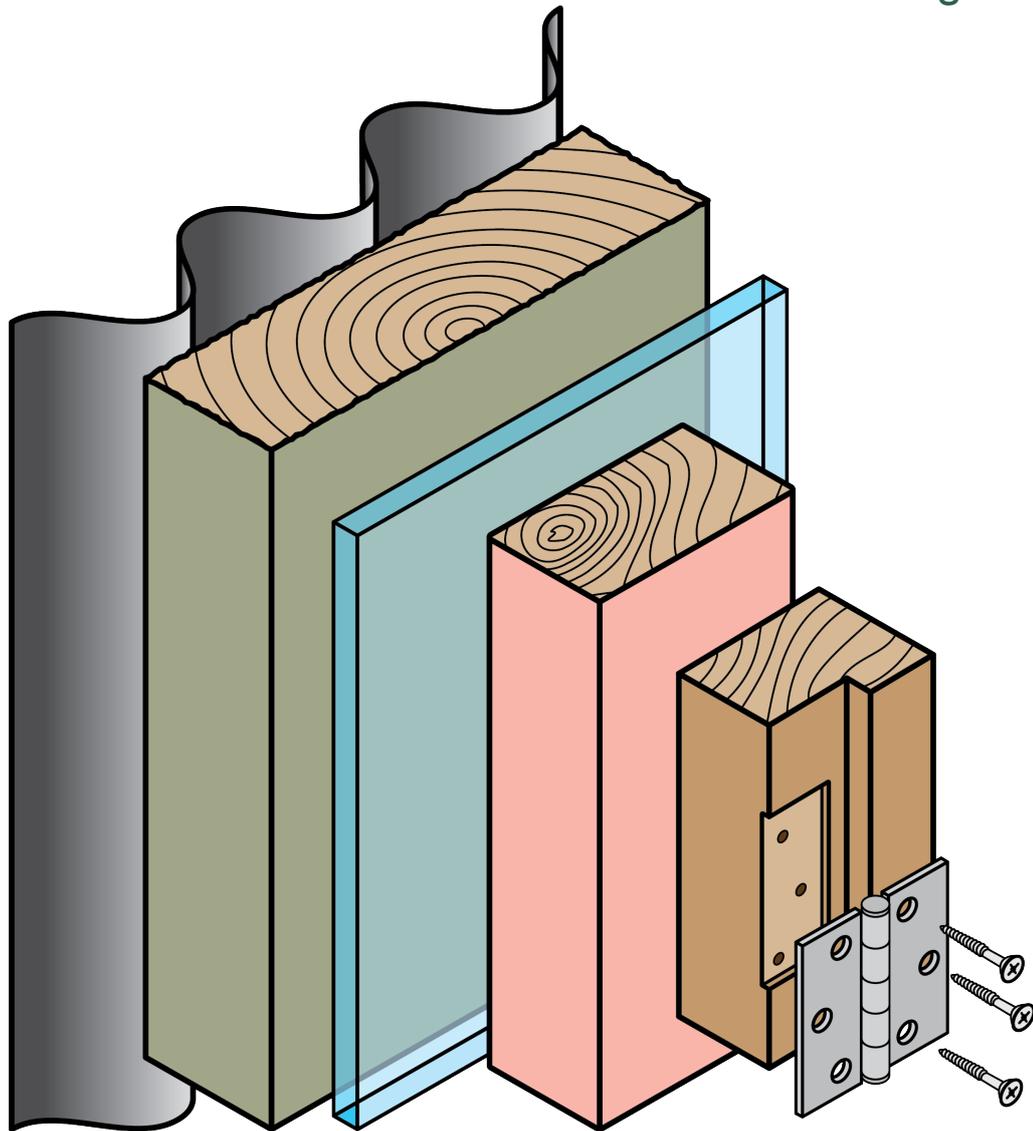


**BCATS**

BUILDING, CONSTRUCTION  
AND ALLIED TRADES SKILLS

# Materials and hardware

Learning resource



**This resource provides guidance  
for the following BCATS skill standards:**

**Level 1 - 40541**

Use materials for a basic BCATS project or related tasks

**Level 1 - 40545**

Use hardware and fastenings for a basic BCATS project or related tasks

**Level 2 - 40552**

Use materials for a BCATS project

**Level 3 - 40570**

Select and use materials for a BCATS project

**BCITO**  
He Hunga Hanga Mātou  
building people



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# Introduction

Understanding different types of materials helps you choose the best ones for your project. The materials you select affect how safe, strong, and good-looking your finished work will be. Using the wrong materials can lead to weakness, damage, or a project that doesn't meet the required standard.

This resource introduces the types of timber and other materials commonly used in Building, Construction, and Allied Trades Skills (BCATS) projects. Your teacher may also provide specific materials for you to work with, depending on your project and what is available.

You will learn about:

- the uses of timber and other common building materials
- the properties and correct storage of these materials
- how to use materials safely in a workshop.

# Planning tips



## ➤ **Suitable materials**

Think about how the material performs.

Is it strong enough for the job?

Will it handle the environment?



## ➤ **Client needs and sustainability**

Think about the impact of the material.

Is it sustainably sourced or recyclable?

Is it safe for people and the environment?



## ➤ **Working with materials**

Think about the practical aspects of working with the material.

Is it easy to handle and assemble?

Can it be cut, shaped, and joined using the tools available?

When selecting materials and hardware for your project, think about:

- Do the project instructions list what materials you need?
- Do the materials suit the product and look good?
- Have you got all of the tools needed to work with the material?



# Timber

Timber is wood that has been processed into beams and boards. It is commonly used in the construction of buildings, fences, and furniture.

Timber comes in quite a few different types for many different purposes. When you choose which timber to use you will need to pick something suitable for what you are going to do with it. For example:

- indoor vs. outdoor
- structural vs. decorative
- local vs. imported
- sustainably sourced.

## Timber classes

Timber is divided into two main classes: softwood and hardwood. The 'soft' and 'hard' relate to the 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, such as rimu, are quite hard.

### Softwood



Softwoods are usually evergreen trees with needle-like leaves.

*Evergreen* - Leaves stay on all year.



The timber is usually lighter, softer, and weaker than hardwood.



### Hardwood



Hardwoods are usually fruit-bearing, deciduous trees with big leaves.

*Deciduous* - Leaves fall off in autumn and grow back in spring.



The timber is usually harder and stronger than softwood.



## Timber varieties

Timber is also grouped by where the wood comes from.

### Native timber

These trees are native (indigenous) to Aotearoa New Zealand. This timber is less common because the trees grow slowly and the felling and milling of native trees is restricted.

Examples of native timber are rimu, totara, and kauri.

### Exotic timber

These trees are grown in Aotearoa New Zealand but originally come from another country. Plantations of exotic trees cover large areas of the North and South Islands. They are typically chosen because of their fast growth and usefulness in commercial work.

Examples of exotic timber are pine, Douglas fir (NZ oregon), and cedar.

### Imported timber

This is timber grown and/or milled in other countries and brought into Aotearoa New Zealand. These trees are not easy to grow in local conditions but the timber is still in demand because of the specific grain patterns, colours, or durability.

Examples of imported timber are oak, maple, and kwila.



Forestry in tropical rainforests raises serious ethical, environmental, and social problems. Tropical rainforests are some of the most important ecosystems on Earth, and when they are logged irresponsibly, the impacts can be long-lasting.

The FSC (Forest Stewardship Council) and the PEFC (Programme for the Endorsement of Forest Certification) are international organisations that set standards for responsible, sustainable forestry. Wood and paper products with PEFC and FSC labels come from forests that are managed in a way that protects the environment. Choosing certified timber helps make sure the products come from responsibly managed forests.



# Timber production

## Milling

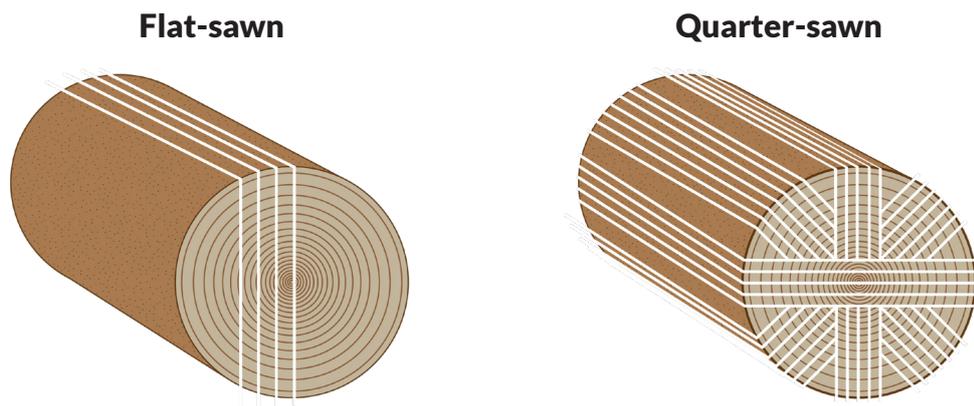
Timber milling is the process of making logs into timber.

Here is the basic milling process.

- **Harvesting and transport.** Trees are usually felled when they are 25 – 30 years old. The logs are then transported to a sawmill.
- **Debarking and sawing.** Bark is removed from the logs, and they are cut into smaller pieces.
- **Trimming and drying.** The timber is cut into lengths and then dried.
- **Planing.** Creates smooth surfaces and exact sizes of timber.

In the milling process, both flat and quarter-sawn boards are produced.

- **Flat-sawn boards** are strong and suitable for uses like flooring, doors, shelving, and tabletops. They are the most common boards produced through milling.
- **Quarter-sawn boards** are more expensive because they are very stable and less likely to warp. Common uses for quarter-sawn boards are fine furniture, cabinetry, and flooring



## Timber seasoning

Trees contain a lot of moisture or sap. When they are felled, this moisture starts to leave the timber.

Seasoning is the process of drying timber until the moisture content is equal to the surrounding environment.

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### Reasons for seasoning

Timber that has been seasoned is:

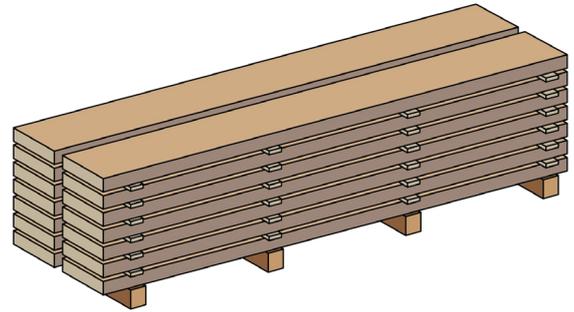
- lighter to handle
- easier to transport
- stronger and harder
- easier to work with when machining and sanding
- able to take paint and other finishes.

## Timber seasoning methods

### Air (natural) seasoning

Boards are stacked with fillets to create spaces between them. This allows air in to dry the boards.

The boards can be stacked indoors or outdoors if there is good airflow through the stack. They need to be covered to protect them outdoors.



Boards should be stacked off the ground. This is to stop them from absorbing moisture and allow for airflow.

Fillets should all be the same size and stacked one above the other. This helps keep them straight as they dry.

### Kiln (artificial) seasoning

Boards are stacked in the same way as air seasoning. They are then placed in a hot kiln that dries the timber.

### Combined seasoning

A combination of air and kiln seasoning can also be used. This can save time and money.

## Comparing seasoning methods

Air seasoning	Kiln seasoning
Advantages	
No artificial heat is needed. Cheaper method.	Quicker and more controlled. Dried to an exact moisture content. Timber can be supplied all year round.
Disadvantages	
Slow and weather dependent. Large area of land is needed. Impossible to dry to an exact moisture content. Any exposure to weather will darken the timber.	Expensive. Can lead to damage if timber is dried too quickly.

## Planing and surfacing

This is often the first time timber takes on a commercial appearance that is smooth, straight, and ready to use.

### Rough sawn timber

Rough sawn timber has a rough surface.

Common sizes of rough sawn boards are: 125 x 125, 100 x 50, and 75 x 50mm

It is abbreviated to RS.

### Planer gauged timber

Planer gauged timber has been through planers and surfacers that smooth and size each board to exact industry standards.

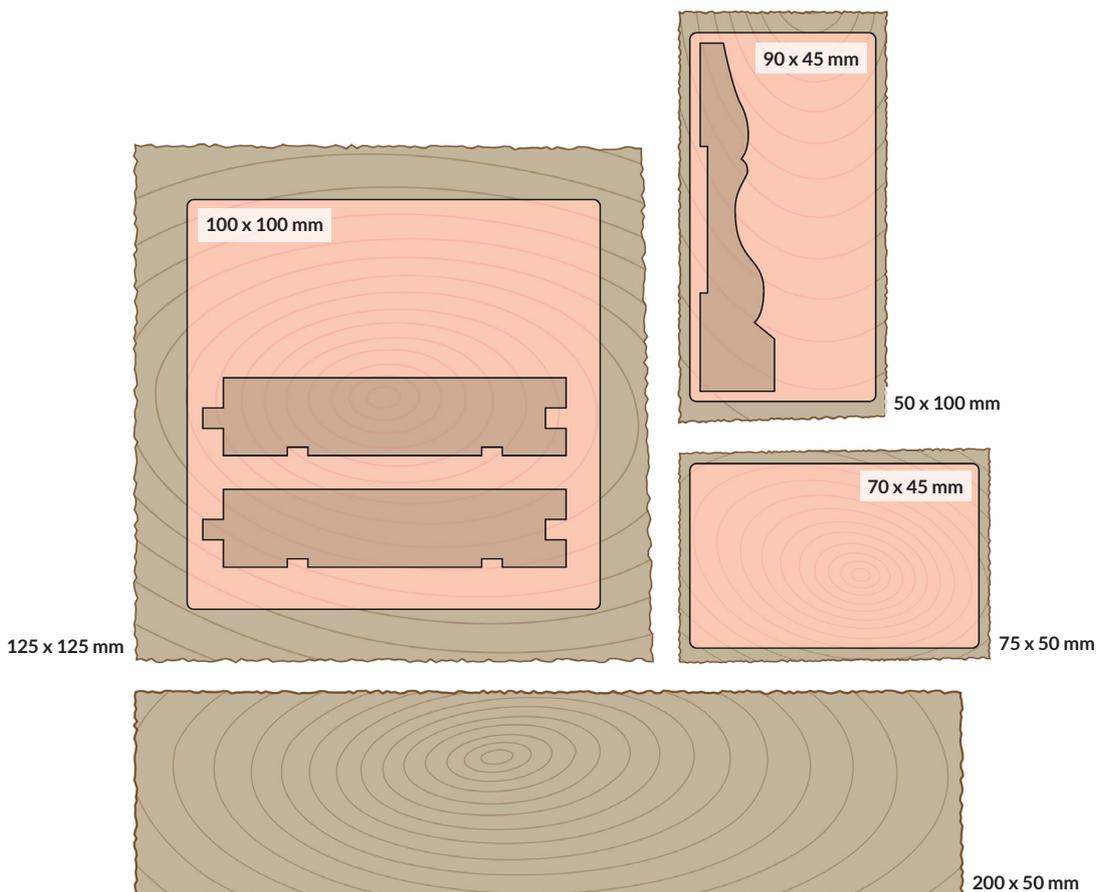
### Dressed timber

Dressed timber is machined so it has a smooth surface finish and appearance.

It is usually dressed on four sides (abbreviated to D4S).

### Mouldings

Some boards also pass through moulders to give them specific profiles (e.g. tongue-and-groove). These finishing machines prepare the timber for flooring, panelling, or decorative applications.



## Timber treatment

While most native timber is naturally strong, native and exotic softwood timbers are easily damaged by decay and insects. If they are going to be exposed to damp or wet conditions, these timbers need to be chemically treated.

Timber treatment makes timber poisonous to wood-destroying organisms.

There are a lot of different treatment grades and types available. This chart lists them and when to use them.

Hazard class	What it protects timber against	Uses in construction
<b>H1.1</b>	Borer or insect infestation	<b>Non-structural interior:</b> Interior joinery (e.g. door frames, stairs, architraves, skirtings, cornices).  Built-in or free-standing joinery (excluding window reveals and frames).
<b>H1.2</b>		<b>Structural interior:</b> Wall, floor, and roof framing and trusses, plywood sheet bracing, framing for enclosed decks and balconies.
<b>H3.1</b>	Basic weather protection when not in contact with the ground.	<b>Non-structural exterior:</b> Cavity battens, fascias, weatherboards, facings, exterior joinery, and painted trim.
<b>H3.2</b>		<b>Structural exterior:</b> Decking, fencing, pergolas, stairs, rafters exposed to the weather, uncoated or stained radiata pine weatherboards and trim.
<b>H4</b>	Continuous contact with the ground and exposure to weather.	Posts, landscaping, retaining walls, garden edging, and planter boxes.
<b>H5</b>		<b>Critical major structural:</b> House piles, retaining wall posts.
<b>H6</b>	Continuous contact with seawater.	<b>Marine:</b> Wharf piles, sea walls.

### Timber tags and stamps

In most cases, it is easy to identify the treatment on new timber. It has either a tag or a stamp on the end that indicates where it came from, the chemicals used, and the hazard class.



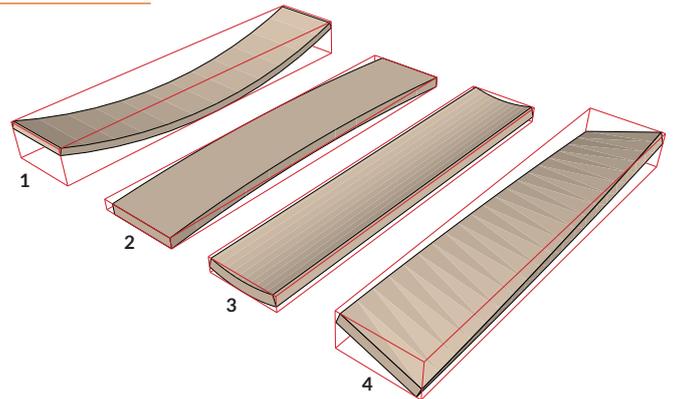
# Timber defects

A defect is any feature of timber that could lower its commercial use. This is because defects can affect how strong, useful, or visually appealing the wood is.

## Warp

This is any variation from a true flat surface. The four types of warps are:

- 1 - **Bow** - curving flatwise along the length.
- 2 - **Crook** - curving lengthwise along the length.
- 3 - **Cup** - curving across the width.
- 4 - **Twist** - spiral curving along the length.



## Knots

Knots are formed from a section of a branch that grew from the tree trunk. It shows up when the log is milled. Some knots (black) fall out as the timber dries, while other knots (tight) remain firm in the piece of timber.

Timber around a knot is weak and this causes:

- reduced ability to cope with load
- difficulty with smooth finishing.

Knots are a greater risk when the timber is in tension. For example, a knot that is in the middle or lower half of a beam will cause the structure to be very weak



Knot

## Checks / splits

These occur where timber fibres shrink during the drying process and create small cracks lengthwise in the grain. These are generally in the surface only but can extend right through the finished timber.



Checks

## Grading

The final boards are inspected and graded. Grading involves checking the timber for warping, bowing, knots, other defects, and moisture content.

Grading must be accurate to make sure timber meets quality standards. Timber is typically put into three main grades: appearance, structural, and industrial.

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### Appearance grade

Appearance grade timber is used in places where the look of the surface is important.

**Clear** means free from knots or defects and boards are straight. Clear is the finest grade of timber and has a premium price. It's suited to fine joinery and furniture.

**Dressing** is close to clear but has small tight knots. You might choose dressing as it's more affordable or because you prefer the look of it. It can be used for all the same things as clear.

**Panelling** is a mid-grade product. It has small loose knots and/or larger tight knots (up to a third of the width of the board). Typically used for wall and ceiling panelling, and for decking.

**Merch** is a knotty grade with large defects generally used for jobs where fine quality isn't needed. People line sheds with it and make rough, chunky furniture. In the softwoods, it can be less than half the price of clear.

**Boxing** is the lowest grade but if you want oversize dimensions for garden beds or concrete boxing, this is what you'd use. Expect large loose knots, surface splits, or other defects.

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### Structural grade

Structural grade timber is essential for construction projects. These grades are strictly managed to make sure the timber is reliable and can withstand significant loads and stresses.

**SG8** - general load-bearing framing for buildings.

**SG6** - for non load-bearing purposes.

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### Industrial grade

Industrial grade timber is used when function is more important than appearance. Commonly used in packaging products such as pallets or cable drums.

# Handling and storage

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## Timber handling

Handling of timber can be dangerous. Here are some simple steps you can take to protect yourself from injury and long-term health problems.

- Wear gloves and overalls to prevent your skin absorbing chemicals and getting splinters.
- Use a dust mask to avoid inhaling the wood dust.
- Dispose of treated offcuts properly. Your school might have special bins for different kinds of waste.

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## Timber storage

Timber is quite a soft material, and it needs to be protected from moisture to stop it from warping.

There are two main methods used to stack timber:

**1 - Fillet stacking** – thin pieces of wood (fillets) are placed between layers of timber to stop them from touching.

**2 - Block stacking** – boards of the same width and thickness are stacked together, without fillets, and covered. This method is easier to set up and takes up less space.

In the workshop there will also be a place to store offcuts. Your teacher will show you where to put them so the area stays tidy and safe.



# Other materials

In this section, we look at other materials you could use for BCATS projects.

Engineered wood, metals, and plastics are commonly used in construction. These materials are chosen for their extra strength, visual appeal, and the wide range of shapes and forms they can be made into.

Each material has different advantages, so the one you choose can change how your project looks, feels, and performs. Your teacher will work with you to decide which materials are most suitable for your design.



# Engineered wood

Engineered wood products are made by bonding wood fibres, particles, veneers, or strands into beams and large sheets using heat, pressure, and adhesives.

There are many different types of engineered wood products such as plywood, MDF, or laminated, finger jointed, and cross-laminated timber.

These materials are widely used in construction, cabinetry, furniture, interior linings, flooring, and manufacturing. They offer:

- good strength
- less warping
- large sheet sizes
- lower cost.

Below are some of the more useful engineered wood products you might use for BCATS projects.

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## Plywood

Plywood is made from thin veneers of wood that are glued together. It is a very strong material that is less likely to crack, shrink, twist, and warp.

Because plywood is made from layers of veneer, the wood grain is visible. The final surface layer of plywood can be made from a range of wood species to suit different needs.

Plywood comes in a range of types and thicknesses. Some common types include:

- **Interior plywood:** used for furniture, such as tables, chairs, bookshelves, and wardrobes. Usually has a clear surface with no defects.
- **Construction plywood:** manufactured in New Zealand from radiata pine and used for cladding, flooring, and general building. The surface will have knots and other defects.
- **Exterior (marine bonded):** generally waterproof and used for fencing, decks, or other projects that will be outside.




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## Particle board

Particle board, or low density fibreboard, is made from wood chips, shavings, and sawdust, held together with resin. Particle board is cheaper than solid wood; however, it can swell, crumble, and fall apart if it gets very wet.




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## Medium density fibreboard

Medium density fibreboard (MDF) is made by breaking wood down into fibres, and combining the fibres with wax and resin.





## Hardboard

Hardboard is a high density fibreboard. It is similar to MDF but is much harder and denser. It is used when a thin, hard wearing surface is required, such as in furniture, appliances, and cars.

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



## Engineered bamboo

Bamboo grows extremely fast and regenerates after harvesting, making it a highly renewable resource.

Engineered bamboo is made into sheets and boards in much the same way as other engineered wood products. Bamboo can also be made into very strong, thin, and flexible veneers and sheets less than 1mm thick.



## Comparison table

Material	Strength	Moisture resistance	Cost	Appearance	Typical uses
<b>Plywood</b>	High	Mostly good Varies by type.	Medium	Visible wood grain, surface quality depends on grade.	Structural flooring, wall/roof bracing, furniture, cabinetry, formwork.
<b>Particle board</b>	Low	Very poor It swells and loses strength if wet.	Low	Flat and smooth but plain, usually laminated or veneered.	Flat-pack furniture, shelving, benchtops (with laminate), cabinetry.
<b>MDF</b>	Moderate	Poor It swells if wet.	Low to medium	Very smooth, ideal for paint and detailed profiles.	Cabinet doors, furniture, skirting, interior wall panels, mouldings.
<b>Hardboard</b>	Moderate to high	Poor Can warp with moisture.	Low	Smooth, dark surface on one side.	Drawer bottoms, backing boards, door skins, pegboard.
<b>Engineered bamboo</b>	High	Moderate Needs sealing/finishes for moisture resistance.	Medium to high	Natural, modern look with grain.	Flooring, wall panels, furniture, benchtops, interior finishes.

## Working with engineered wood products

Engineered wood products, such as MDF, particle board, and plywood, are made from toxic resins and adhesives. When they are cut, drilled, or sanded, dust will be given off. This dust can irritate the nose, throat, and eyes. .

Always use appropriate PPE when working with engineered wood, and use tools with exhaust extraction or work in well-ventilated areas.

Here are a few tips.

### Cutting

- Choose the right saw blade. Use a carbide-tipped blade with fine teeth to reduce the chance of chipping.
- Apply masking tape along the cutting line to minimise splintering.

### Drilling and fastening

- Drill pilot holes to avoid splitting when using screws or nails.
- Avoid over-tightening screws as engineered wood will crumble under too much pressure.

### Sealing and finishing

- Sand edges to smooth out roughness before applying a sealant.
- Apply a primer before painting MDF and particle board to get a smooth finish.
- Use clamps to hold components together while adhesives cure.

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## Storage

To reduce warping, engineered wood should lie flat in dry, well-ventilated areas away from sources of heat.

Offcuts must not be burnt because of the risk of formaldehyde gas being released. Dispose of offcuts and general waste in approved landfill sites.

### IMPORTANT

Newly manufactured and freshly cut boards can release small amounts of formaldehyde gas. This has been known to cause cancer. The amount of gas increases if boards are stored in small spaces that aren't well ventilated.

There is a much lower chance of formaldehyde gas being released when the boards are sealed with paint, varnish or other surface finishes.

Always use appropriate PPE when machining engineered wood products. This includes safety goggles, class P1 or P2 full-face respirator, long-sleeved overalls and gloves.



## Plasterboard

Plasterboard, also called gypsum board, is a common building material used to line internal walls and ceilings. It is made from a core of gypsum plaster that is sandwiched between two layers of heavy paper lining. This makes it lightweight, easy to cut, and quick to install.

Plasterboard sheets come in a range of types for different uses like moisture, fire, or sound resistance.

### Working with plasterboard

Plasterboard can be easily cut with a utility knife. It will create a lot of fine dust so you need to wear a suitable mask and it's a good idea to vacuum up the mess.

Plasterboard will usually be finished with plaster and painted or papered.

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### Storage

Plasterboard sheets should be kept indoors, lying flat in a dry area. Avoid putting heavy things on top of stored plasterboard as it is easily scratched or dented.

## Fibre-cement board

Fibre-cement board is a strong, durable sheet material made from cement, sand, and cellulose fibres. It is commonly used for both interior and exterior construction. It is highly resistant to moisture, fire, and pests, making it suitable for cladding, tile backing, and soffits.

Fibre-cement is heavier and tougher than plasterboard, and it offers better durability and weather resistance.

### Working with fibre-cement boards

It must be cut carefully with special blades. Because cutting it produces fine dust you will need a suitable dust mask and use dust extraction or be outside.

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### Storage

Fibre-cement board sheets should lie flat on a level surface. Keep it covered from the weather and off the ground.



Plasterboard



Fibre-cement board



Carbide tipped board cutter

# Metals

Metals are chosen over timber in many situations because they offer greater strength, durability, and performance. This makes them ideal for a wide range of engineering, construction, and design applications.

## Mild steel

Mild steel is a strong and versatile general-purpose material that is quite low cost. It comes in many forms, such as sheets, tubes, and bars.

Mild steel will rust if it gets wet, but it can be quite resistant if it is galvanised (i.e. a protective zinc coating).

Mild steel gets used for:

- reinforcing rods for concrete
- brackets, fastenings, and other hardware
- fabricated sheets for roofing and cladding.

It can be joined by welding, riveting, screwing, and bolting components together. Mild steel can also be recycled.



## Stainless steel

This is an alloy of steel, zinc, and chromium. It is a tough material that does not stain or rust as easily as ordinary steel.

It comes in many forms, such as sheets, plates, bars, wire, and tubing.

Stainless steel gets used for:

- benchtops
- tube steel furniture
- hardware in coastal areas.

It can be very hard to weld, drill, or cut so you need special tools to work with it.



## Aluminium

Aluminium is a lightweight and soft metal. It is non-corrosive and fully recyclable. It comes in many forms, such as sheets and extruded sections.

Aluminium gets used for:

- window and door frames
- equipment like ladders and scaffolding
- packaging and foil.



It is important to stop aluminium from being in permanent contact with other surfaces or fastenings made from another kind of metal. This can cause a chemical reaction that will cause it to break down.

**Make sure to use suitable stainless steel fastenings to fix or join aluminium.**

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## Copper

Copper is a red metal that doesn't rust easily. It is an excellent conductor of heat and electricity.

Copper is available in wire, sheet, tubing, and pre-formed fittings.

Copper gets used for:

- > electrical wiring
- > plumbing, especially hot-water
- > decorative features such as wall panels, splashbacks, and countertops.

Sheet copper can be easy to work and shape with a ball peen hammer. It is usually joined by solder or gas welding (brazing).

## Brass and bronze

Brass and bronze are copper alloys. They are still corrosion resistant, but harder than copper. They are commonly used for decorative fittings and hardware due to their durability and attractive appearance.



Copper



Brass



Bronze

## Working with metal

Like any other material, there are risks when handling and working with metals.

Your teacher will show you how to handle, use, and store metals in your workplace. However, you always need to use appropriate PPE, including:

- overalls and leather apron
- leather gloves
- steel-capped boots.

Depending on what you're doing with the metal, you might need to use extra PPE such as:

- earmuffs
- face shield/safety goggles
- welding helmet
- respirator.

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## Storage

Store metals in a dry area that is well ventilated.

Metals should be stored in a vertical rack or flat on a shelf to stop them from bending. Use a barrier to stop them from falling.

To make it easier to find the right piece for your project, keep metals grouped by material (e.g. steel, aluminium, copper), and then by shape or size (flat bar, tube, sheet, rod).

# Plastics

Plastics are widely used in construction because they are lightweight, durable, and resist moisture and corrosion.

Materials like PVC and polyethylene are commonly used for pipes, cladding, and electrical conduit. This is because they don't rust and are easy to cut and install.

Other plastics, such as polystyrene, are used for insulation; acrylic and polycarbonate are used for clear panels and glazing, while composite materials like fibreglass and carbon fibre offer high strength with low weight.

## Common properties

- Easy to cut, join, and shape
- Lightweight
- Resistant to moisture, chemicals, and corrosion
- Good electrical insulation
- Good for moulded shapes
- Low cost.

Plastics get used for:

- > plumbing pipes and fittings
- > guttering and downpipes
- > plastic sheeting and liners (DPM)
- > window frames and cladding
- > insulation
- > vinyl flooring
- > outdoor furniture
- > roofing sheets.

## Working with plastics

When working with plastics, it's important to use the right tools and take care not to overheat or crack the material. Most plastics are easy to cut, drill, and shape, but they can melt, warp, or produce fumes if too much heat is applied. Always follow safe work practices, such as using sharp tools, drilling slowly, and supporting the material properly.

Working with plastics can also create dust or shavings, so clean up the work area and use standard PPE.

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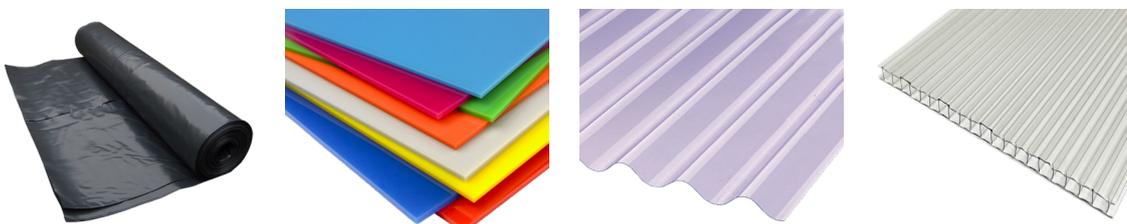
## Storage

Make sure products are kept away from heat sources, sharp objects, or heavy loads that could cause dents or damage.

Always keep the storage area clean and free of chemicals or solvents, as some plastics can react with them.

Keep them in a cool, dry, and shaded area, because long-term exposure to direct sunlight can weaken or fade some plastics.

Store flat sheets (like acrylic or polycarbonate) on a flat, level surface or upright in a rack so they don't bow or scratch.



# Glass

Glass is a hard, translucent material that has many different uses. It can be easy to break so special tools and techniques are needed for cutting, drilling holes, or polishing edges.

There are four main types of glass available for construction projects.

## Basic sheet glass

- Used in standard windows
- Breaks into sharp pieces

**Toughened (tempered) glass** – heat-treated to make it stronger

- Breaks into small, blunt pieces (safer)

**Laminated** – two sheets glued together with a plastic layer

- Used for skylights and balustrades
- Stays in one piece when broken

**Stained, frosted, or textured**

- Used in decorative windows and doors
- Also used for lighting or sculptures.

## Working with glass

Always check for cracks or scratches before working with glass. Damaged glass can break suddenly.

Make sure to use suitable cutting blades and drill bits for cutting and drilling glass.

Keep the work area clean. Sweep up any glass waste straight away and dispose of it properly (in a marked container or wrapped).

Safety glass should always be used in situations where it could be broken and injure people.

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## Glass storage

Store large glass sheets standing up in racks at a 3 – 5° angle. Smaller pieces could be safely stored flat in a drawer.

Use mesh fencing or a similar barrier to stop the glass from falling sideways.



# Upholstery

Upholstery is the process of covering furniture such as sofas and seats with layers of soft materials and a fabric or leather covering. The purpose of upholstery is to make furniture comfortable, attractive, and durable.

Support layers of springs, padding, and foam can be used to cushion the item. The type of upholstery you use depends on how and where the furniture will be used.

- Items that will be heavily used (e.g. couches) will need a more durable covering.
- Items that will be used less often (e.g. armchairs, ottomans) can have a less durable covering.

Upholstery fabric can be natural or synthetic. Synthetic upholstery tends to be more durable and less expensive than natural upholstery.

Some common plant-based natural fabrics can be made from cotton, flax (linen), hemp, or bamboo.

Natural animal-based materials are leather or hide, wool or hair, and silk.

Synthetic materials include nylon, acrylic wool, polyester, PVC (faux leather), microfibre, and acetate.

## Working with upholstery

The main issues when working with upholstery include sharp tools, dust, and chemical fumes. Good PPE, ventilation, and safe handling techniques reduce these risks.

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### Storage

Keep fabrics dry and out of direct sunlight. Fold or roll up the material carefully to avoid leaving permanent marks or creases. It is also a good idea to have any fabric wrapped up to keep it clean.



# Masonry

Masonry is a form of construction that involves laying or bonding materials together. Common examples include bricks, concrete blocks, and natural stone (such as granite, marble, or limestone).

Masonry is valued for its strength and durability, and it can also add visual interest to a structure.

Masonry gets used for:

- structural items like walls, fireplaces, and chimneys
- patios, walkways
- decorative features like fire pits.

## Working with masonry

Working with masonry involves risks such as dust inhalation, manual handling injuries, eye injuries, noise exposure, and chemical burns. These risks can be reduced by using PPE, proper tools, and ventilation.

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### Storage

Bricks, blocks, and porous stone like limestone need to be stored on a flat area and are generally covered by a tarpaulin to keep dry.



# Coatings

A project will often be finished with a decorative or protective coating. They help make materials last longer by resisting moisture, dirt, wear, and UV light.

Common coatings include paint, stain, varnish, oil, and polish. The right coating depends on the material, how the item will be used, and the finish you want.

There are two main forms of coating.

**Acrylic** - is fast-drying and can be diluted with water. When it is dry, it becomes water-resistant. Acrylic-based products are used for house painting and interior decorating because of the low odour.

**Oil-based** - is slower drying and can be diluted with turpentine or white spirit. When it dries it produces a hard-wearing finish, best used on outdoor furniture or on metal. Oil based solvents give off toxic fumes that have a strong smell.

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## Paint

Paint adds colour to an object or surface and covers imperfections. Paints are available in gloss, satin and matt finishes.

There are three main coats of paint that are usually needed to complete a project.

1. **Primer:** goes on before painting to help get a better surface cover. It also provides extra protection for the material being painted.
2. **Undercoat:** covers any blemishes and provides a base for the finish coat.
3. **Finish coat:** provides the final hard-wearing surface with gloss and colour. This coat will not cover blemishes or stick to a surface for long without an undercoat.

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## Stain

Wood stain is a type of paint used to colour wood while still showing the grain. It is not a protective coating on its own and will generally be varnished or oiled.

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## Varnish

Varnish provides a protective coating, showing the natural grain without changing the colour, although it will darken slightly. Varnish is made with resins which dry to a hard-wearing surface.

Some different types of varnish are acrylic, polyurethane, and lacquer.



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## Oil

Oil provides a quick finish for timber surfaces. Oil can take longer to dry than varnish and can fade over time. Oil, by itself, doesn't produce toxic fumes but it is often thinned with turpentine to get the oil to soak into the wood.

Apply a series of very thin layers with a soft, lint-free cloth.

There are a lot of different types depending on the finish you want. Here are some examples of oils.

- **Linseed:** gives a traditional wood finish, although it tends to go 'gummy' if the coat is too thick.
- **Tung:** provides a very hard water-resistant finish.
- **Danish:** cures to a hard satin finish that resists liquid well.
- **Lemon or orange:** often used on surfaces that are in contact with food (e.g. salad bowls). It is non-toxic and will not taint food.

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## Wax

Wax is a soft finishing product used mainly on wood to give it a smooth feel and a natural, low-shine appearance. It sits on the surface of the material rather than soaking in deeply. Wax is easy to apply with a cloth or brush and is often used as a final topcoat to enhance the look of oil finishes.

Wax is not as durable as varnish or polyurethane and may need re-applying over time. It is best for projects that won't get heavy wear.

## Working with coatings

Craftspeople will often use blends of varnish, oil, and wax to finish materials.

Working with coatings involves risks such as spills, fumes inhalation, and eye or skin irritation. These risks can be reduced by working in a ventilated area and always wearing appropriate PPE.

Always clean up your brush or roller when you're finished.

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## Storage

Different coatings will have different storage needs. Most should be stored in a cool space, out of direct sunlight, and away from heat sources.

Coatings will generally have storage directions on the container.



## Recovered materials

Salvaged and recovered timber and other materials are becoming common for use in BCATS projects. They help to reduce waste and are sometimes a lot cheaper than new materials.

There are some important tips for working with recovered materials.

### ➤ **Inspect them for quality**

Make sure materials are free from defects, pests, rot, mould, and harmful chemicals. Old timber will sometimes be coated in paint with lead in it.

### ➤ **Make sure they are clean**

Clean up your materials by removing any old nails and dirt before you plane or sand any rough edges.

### ➤ **Plan your cuts**

Make sure the material is the right size, strength, and type for what you're making. Recovered timber can be odd sizes, so planning your cuts is important to make the most of it.

## Working with recovered materials

Using recovered materials can be rewarding but it often takes more time because of the extra preparation. Even though timber can look free of nails, there will sometimes be pieces of metal stuck inside. Be careful with any tools you use and wear suitable PPE, including eye protection.

If you are stripping paint or other coatings wear a suitable mask to protect against toxic fumes.



# Hardware and fastenings

Hardware and fastenings are items used to join or secure materials in your BCATS project. This includes items like:

- nails
- bolts
- handles
- screws
- hinges
- brackets.

Hardware and fastenings come in many shapes, sizes, and finishes, because different materials and joints require different strengths and functions. Choosing the right one helps make sure your project is strong, safe, and built to last. As you work, you'll learn which fastenings suit tasks like securing timber, attaching hardware, or creating moving parts—skills that are essential in building and construction projects.

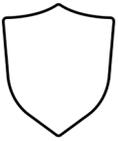
# Selecting hardware and fastenings

When choosing hardware or fastenings, think about the conditions the project will face. Does the fastening or hardware you use need to be:



## **Durable**

Will it last a long time without breaking?



## **Rust resistant**

Is it able to withstand exposure to water?



## **Compatible**

Could it react with other materials in the project?

The best type of fastening to use for any project depends on:

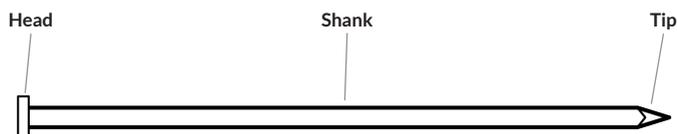
- the type of material to be fixed
- durability requirements
- compatibility between the fastening and the materials
- the type of finish you want.

Some other things to consider include the load the fastenings will need to support, and whether the connection needs to be permanent or will require occasional disassembly.

These considerations will help you make the best choice for successfully completing your project.

# Nails

Nails are used to fix timber together or attach hardware like brackets. They come in a range of lengths, thicknesses, and finishes to suit different kinds of work.



## Nail types

### Jolt head

Jolt heads are popular because their round heads can be punched below the timber surface. This leaves a small hole that can be filled to match the wood. They are used for framing and cabinet assembly.

### Flat head

Flat head nails have a large head for a stronger hold. They are easy to drive in but harder to hide. They are used to fix brackets and plates, interior and exterior cladding, and softwood framing.

### Panel pins/finishing brads

These are small, thin nails with a cone-shaped head. When punched below the timber surface, they leave a tiny hole that's easy to fill. They are used for light cabinet assembly and interior finishing like architraves and skirting.

### Textured nails

Some nails are textured or twisted to improve the holding power. By having grooves the nails will be harder to pull out.

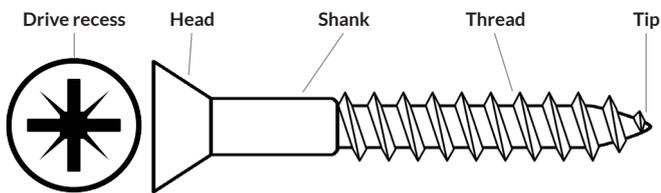


# Screws

These fasteners have a helical (spiral-shaped) thread for fixing timber and metal components together.

Timber screws are designed for fastening timber or timber materials together. They have a sharp, pointed tip that helps them easily dig into the wood, and threads that grip the wood to hold secure.

Screws come in a range of lengths, thicknesses, and finishes to suit different kinds of work. There are different head profiles for different finishes, such as flat, domed, or countersunk. Screws also come in a range of drive types as follows.



## Drive types

Screw drive types have changed as tools and technology have improved. Slotted screws slip easily when using power drivers, while modern types like Torx give much better grip.

Your teacher will help you choose the right drive type, or it may be specified in your project instructions.

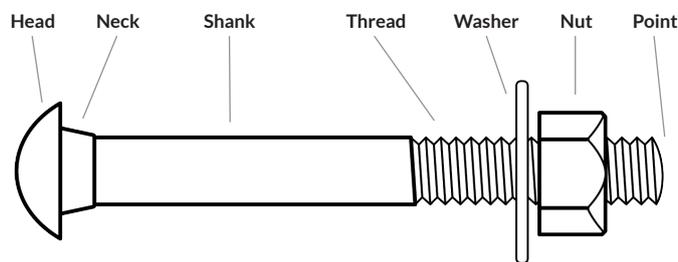


## Bolts

Bolts, along with nuts and washers, are used to bind materials. They are fitted into pre-drilled holes and create a strong joint by clamping the surfaces together.

Bolts are often used in outdoor furniture and construction equipment where strong joints are needed.

- Washers are flat discs placed under the bolt head or nut to distribute pressure and protect the surface of the material.
- Nuts are internally threaded metal pieces that secure bolts in place by tightening onto their threads.



### Bolt types

#### Coach (carriage) bolts

These have a smooth, round head and a square neck.

Coach bolts are used to secure timber to metal or other timber components in outdoor furniture and other projects.

#### Engineer's (machine) bolts

These have a hexagonal head, round shank, and threads for attaching a nut.

Engineer's bolts are used for outdoor furniture like barbecue tables.



## Adhesives

Adhesives bond and hold different materials together. Almost any material can be bonded using the right adhesive or glue. Make sure to prepare any surfaces before using adhesives. Materials must be clean, and free of dust.

### Safety when using adhesives

Many adhesives can irritate the skin and affect breathing. Fumes from solvent-based adhesives can be flammable and toxic. It is important to protect yourself.

- Always make sure there is good ventilation.
- Wear protective clothing.
- Wash off any spills.
- Read the manufacturer's instructions for further safety advice.

### Adhesive types

In the past, natural adhesives made from plant-based gums or animal by-products were common. Today, synthetic adhesives are more widely used.

#### Polyvinyl acetate (PVA)

PVA is a yellow/white, water-based wood adhesive that sets as the water evaporates.

Advantages	Disadvantages
Easy to use.	Will stretch or creep under stress.
Does not stain timber.	Can soften with heat.
Has a long shelf life.	Cannot be used where the temperature is less than 10°C.
Setting time is not too long.	Not waterproof.



#### Construction adhesives

These are strong glues used inside buildings in areas like flooring, wall linings, and skirtings.

Advantages	Disadvantages
Supplied ready to use.	Some construction adhesives are very hazardous.
Flexible and water-resistant.	Can break down if exposed to direct sunlight.
Can also be used outside.	





## Contact adhesives

A contact adhesive is a liquid that bonds instantly.

Apply it evenly on both surfaces, let it dry for 10-15 minutes, and then press the surfaces together.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>Supplied ready to use.</li> <li>No clamping or pressing is necessary.</li> <li>Bond is immediate.</li> <li>Does not stain timber.</li> <li>Quite waterproof.</li> </ul>	<ul style="list-style-type: none"> <li>No adjustments can be made after contact.</li> <li>Not recommended for exterior use.</li> <li>Not suitable where joints must slide together or where two pieces must tighten against each other.</li> </ul>

## Polyurethane (PU) glue

PU glue is a strong, water-resistant adhesive that can be used for interior and exterior jobs. It bonds to many materials, including wood, paper, metal, glass, and plastic. It expands to fill gaps as it cures, helping to keep water out.



Advantages	Disadvantages
<ul style="list-style-type: none"> <li>Supplied ready to use.</li> <li>Expands as it cures.</li> <li>Works best when applied to damp surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>Messy and hard to clean.</li> <li>Stains are hard to remove from wood and hands (so it is important to use gloves).</li> <li>Hazardous and needs more safety precautions than glues like PVA.</li> </ul>

## Two-part adhesives

These adhesives come in two containers.

- **Resin:** liquid or powder mixed with water to form a thick syrup.
- **Hardener:** usually a liquid.

The resin and hardener need to be mixed at the right ratio to work.

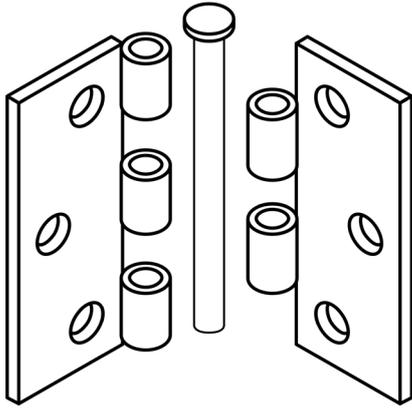


Advantages	Disadvantages
<ul style="list-style-type: none"> <li>Create stronger bonds than single-part adhesives.</li> <li>Often very durable.</li> <li>Heat resistant.</li> </ul>	<ul style="list-style-type: none"> <li>Requires careful mixing.</li> <li>Long curing time.</li> <li>Some two-part adhesives are very hazardous.</li> </ul>

# Hinges

Hinges connect two objects, allowing one to swing away from the other. They are used on doors, lids, and gates for opening and closing.

Hinges have two plates joined by a pin or rod.



## Butt hinge

A butt hinge is the most common type of hinge used on doors and windows.

Butt hinges can have either a fixed pin or a loose (removable) pin. Loose-pin hinges should not be used on windows or external outward-opening doors because someone could remove the pin from outside.

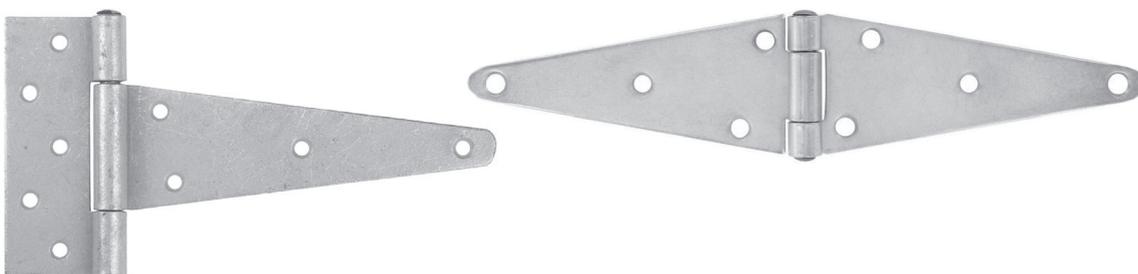
Butt hinges are usually recessed into the edge of the door and the door frame so the door can close flush. They are generally made from steel or brass, and come in many sizes and finishes.



## Gate hinge

Gate hinges are extra wide to support gate framing. They come in a range of sizes and are designed to suit different situations or decorative styles.

The right type of hinge to support the gate's weight and size is important. Tee or strap hinges are the most common type used for light to medium gates. These hinges do not have to be recessed and are normally fixed directly to a gate or post. Because gate hinges will be used outside they are generally made from galvanised steel.



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## Furniture hinges

### Piano hinge

These hinges are installed along the width of a lid or panel. Their length gives much better weight distribution.

They are used for piano lids, cabinets, and boxes.

### Counter flap hinge

This type of hinge is designed to let a panel lift up and fold back down again to make a flat surface.

They are often found on counters, bars, benches, and desks.

### Flush hinge

These hinges fit together so the plates close flush without needing a recess. They are lightweight and easy to install but not as strong as a butt hinge.

They can be used for small cupboards, lightweight doors, and hobby projects.

### Concealed hinge

These are installed on the doors of cabinets for a clean, seamless look. They often have a soft-close movement. Concealed hinges need a cup hole drilled into the door.



## Handles, locks, and latches

Handles, locks, and latches are mounted on projects to open, close, and secure doors and lids. There are many types and styles made from a variety of materials. Hardware should work smoothly and match the style and weight of the furniture. They must also be able to cope with years of use, so choose the right one carefully.

### Handles

Handles are used to allow doors and cupboards to open and close. They are also used to hold onto when pushing, pulling, or lifting.



### Locks

These are security devices used on doors, windows, or containers to prevent unauthorised access. A lock is used with a key.



#### Barrel lock

Barrel locks are a simple key-operated lock fitted into furniture through a hole drilled in the door or drawer.

#### Rim lock

These are installed on the inside of exterior doors and can usually be locked from both sides.

They offer extra protection against intruders.

#### Lockset

These locks are installed inside a door or piece of furniture. They have a locking mechanism that uses a key or sometimes is manually locked inside with a button or switch.

## Latches

A latch is used to keep doors and gates closed. It differs from a lock although they are often combined together as the same product.



### Snap latch

This is a simple latch system attached to a gate post that holds and secures a bolt on the gate.



### Tower bolt

A tower bolt is a surface mounted sliding bolt used to secure doors, gates, cabinets, and windows.



### Toggle latch

Toggle latches are used to securely attach two surfaces like panels, lids, or doors, while still allowing quick and easy reopening.

## Catches

Catches keep a door or lid closed through resistance. A spring or magnet holds the catch in place but can be opened by pulling or pushing against it.



## Castors

A castor is a small wheel attached to furniture or heavy objects to make them easier to move. They can be fixed or swivel 360 degrees and work best on smooth, flat surfaces. The type of castor you use depends on the object's weight and how often it will be used.



Fixed castor



Swivel castor



Swivel castor with brake

## Timber connectors

Timber connectors are used to strengthen joints between timber components and make construction easier. Connectors will be fixed with nails or screws

For small projects and inside furniture, light gauge steel connectors will be suitable. For anything that goes outside, connectors will need to be galvanised or stainless steel.

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### Brackets



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### Post anchors



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### Joist hangers



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### Nail plates





