

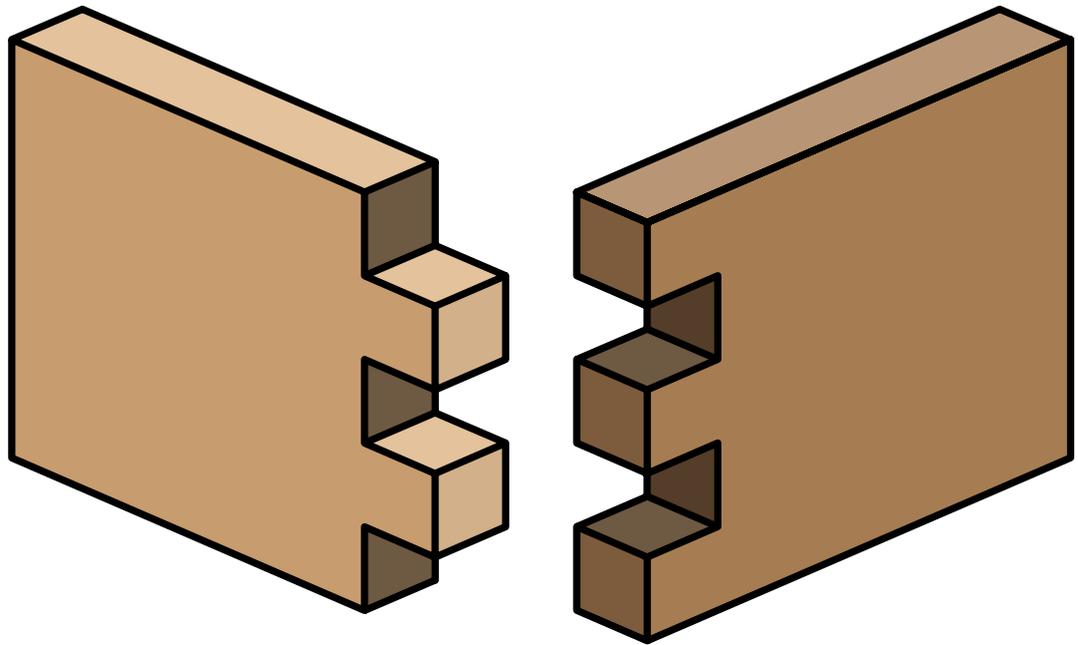


BCATS

BUILDING, CONSTRUCTION
AND ALLIED TRADES SKILLS

Joins

Learning resource



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

Level 1 - 40546

Create joints for a BCATS project or related tasks

BCITO
He Hunga Hanga Mātou
building people

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Introduction

This resource is about different types of wood and metal joints used in Building, Construction, and Allied Trades Skills (BCATS) projects. These joints include:

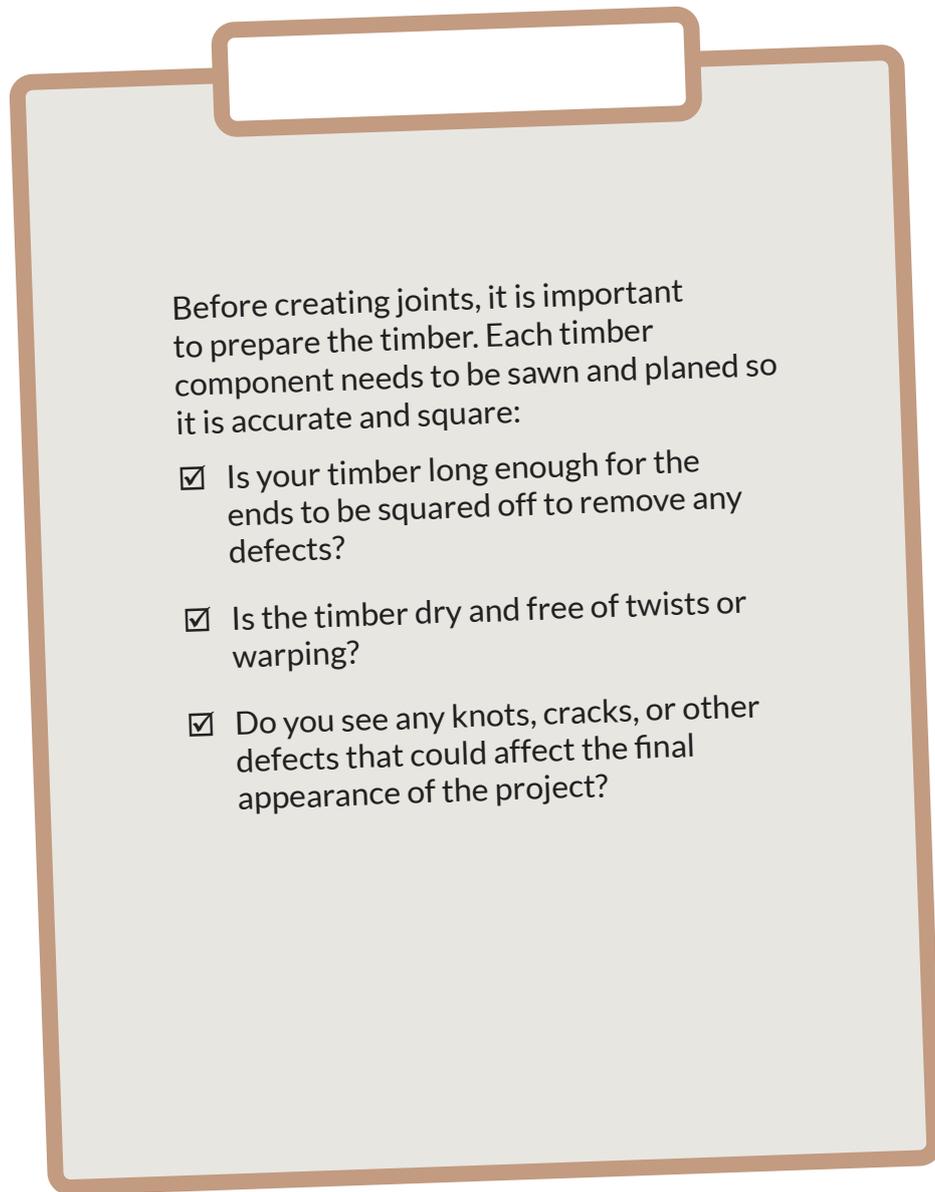
- Mitre
- Housing
- Welded
- Riveted
- Box
- Rebated
- Halving
- Dowelled
- Soldered
- Edge to edge (butt).

Your teacher may have specific joints they recommend you use for your project.

You will need to look at the project instructions to understand the joint types required and think carefully about the process you need to follow using the materials you have to create the joint.

Glossary of terms

Term	Meaning
Acetylene	Colourless, odourless gas when combined with oxygen and ignited, used for metal welding and cutting.
Adhesive	Substance that can hold materials together.
Alloy	Combination of two or more metals that can be used for special purposes.
Architrave	Decorative moulding surrounding a door or window.
Chamfer	To grind the end to make it smooth and round.
Dowel	Timber pin or rod used to strengthen a timber joint.
Oxyacetylene	Mixture of oxygen and acetylene that can produce a flame temperature of 3300°C on ignition.
Solder	Metal alloy of tin and lead used to join metals.
Timber component	Length of timber. Also known as a 'board'.



Wood Joints

For thousands of years woodworkers around the world have used wood joints to join pieces of timber together.

Traditionally, wood joints were made entirely from timber to create sturdy structures or furniture without the use of modern fastenings like nails or screws.

These days metal fastenings or adhesives are commonly available and are almost always used to make strong joints.

Quality measures for wood joints

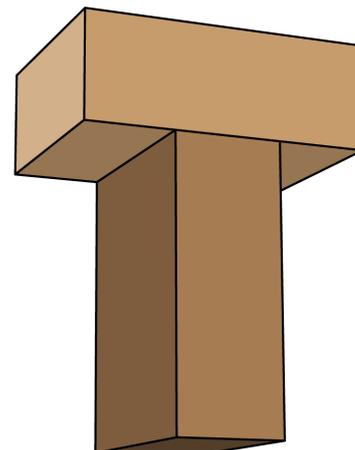
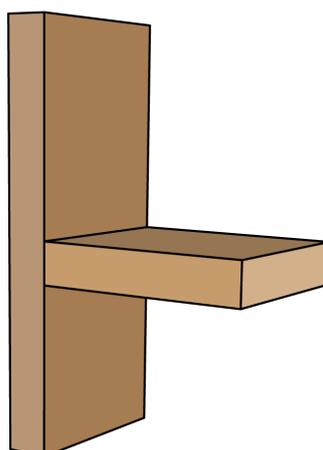
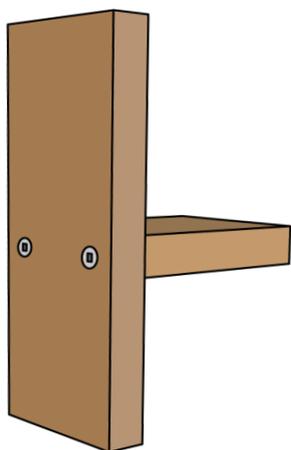
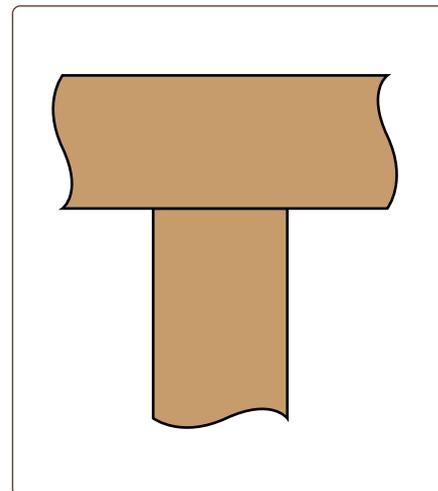
- **Fitting and alignment** – the timber components should fit together snugly without gaps. If properly aligned, the joint will be strong and tidy.
- **Smooth cuts** – rough or uneven cuts can weaken the joint.
- **Strong adhesives** – using high-quality glue is very important. It should bond well and dry without leaving visible marks.
- **Proper clamping** – after gluing, use clamps to hold the components together tightly until the glue dries. This will form a strong bond.

Butt joints

A butt joint is a simple wood joint where the end of a timber component is placed (or 'butted') against another component.

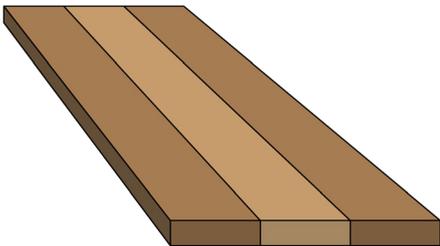
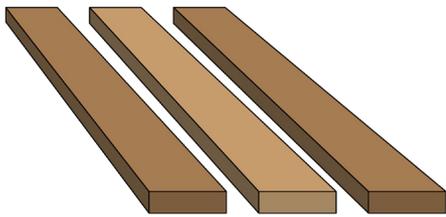
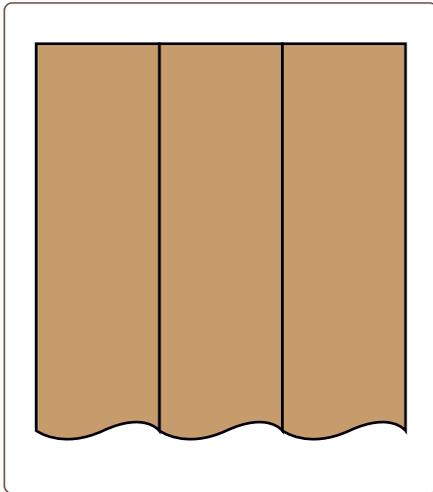
The butt joint is used a lot in carpentry and construction.

Because these joints can be weak they are usually reinforced with fastenings as well as glue.



Method of construction

1. Cut the two timber components to the lengths you need.
2. Butt the timber components against each other and check they align properly to make a 90° angle or other desired angle.
3. Apply wood glue to the joining faces of each component. Spread it evenly for a strong bond.
4. Press the components together firmly and use clamps to hold them in place while the glue dries.



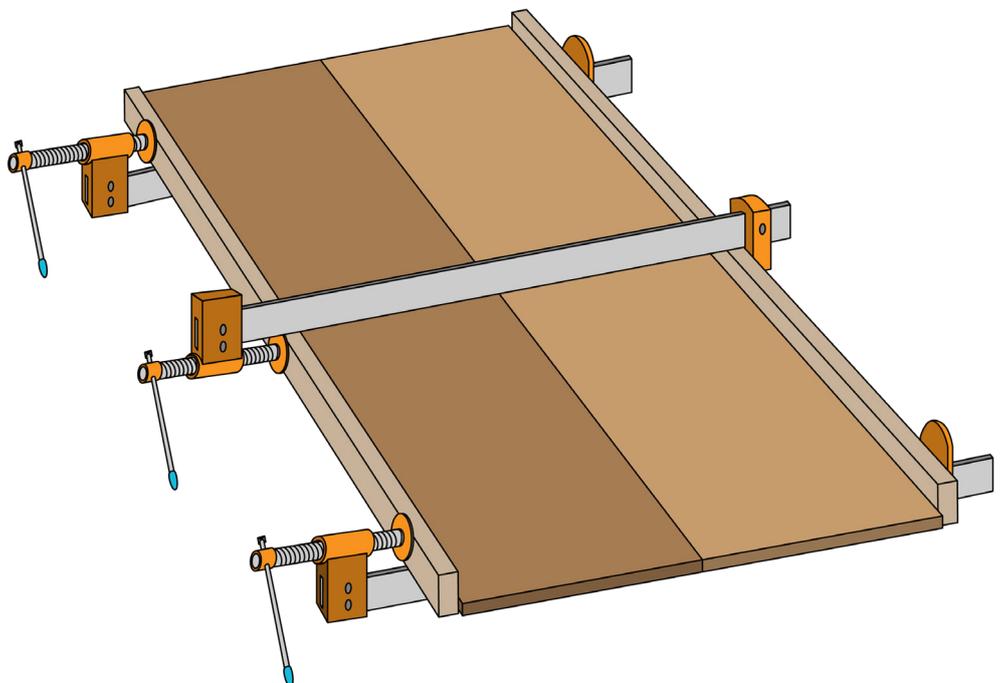
Edge to edge joints

This type of joint is used to assemble timber components to create a larger surface area (e.g. a tabletop).

Components can be held together just with glue or reinforced with dowels, biscuits, or tongues set into grooves. Metal brackets can also be used to give the joint extra strength.

Method of construction

1. Prepare each timber component by planing the edges straight, making sure the thickness is even.
2. Lay the components out on support battens with the best sides facing up.
3. Before applying the glue, check for any gaps along the length of the joint by squeezing the components lightly together with a long clamp (e.g. a sash/bar clamp or large F-clamp). Place a batten between the clamp heads and timber to stop the heads marking the edges.
4. Undo the clamps and stand the components on their edge. Apply the glue evenly with a brush.
5. Check the clamp beds are level before placing the components back into position.
6. Place a clamp **under** each end of the project and depending on the length of it, alternate clamps **over** and **under** to keep the surface of the joint straight.
7. Apply pressure gradually to each clamp. Be careful not to overtighten.

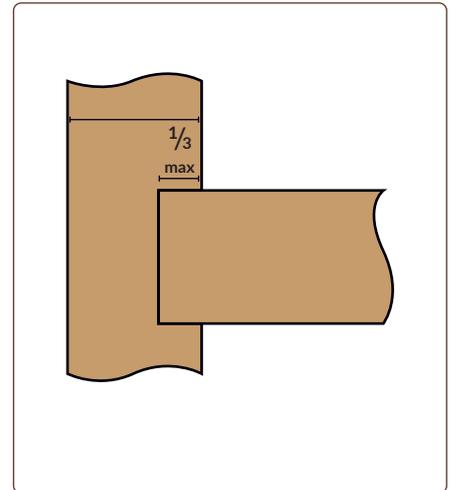


Housing joints

This joint (also called a 'dado' joint) is often used for cabinets and shelving units.

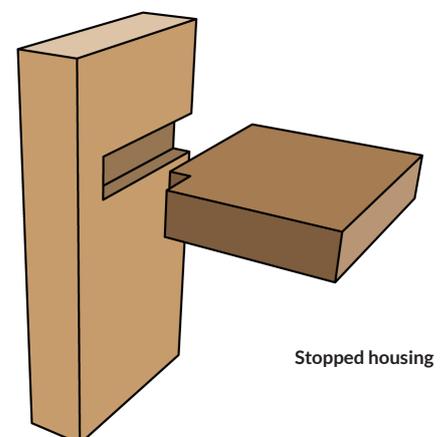
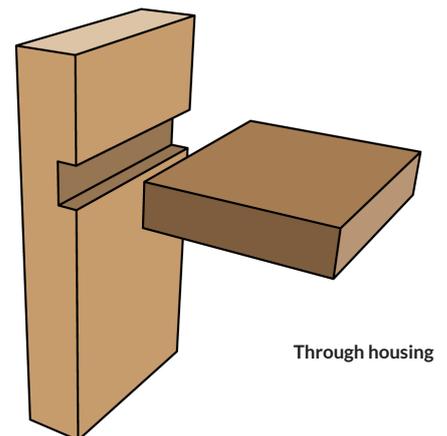
There are two main types of housing joints:

- > **Through housing** – where a trench is cut across the full face of the component.
- > **Stopped housing** – where the trench is stopped before the front of the board and a matching step is cut in to the component to be inserted in the trench. This method produces a better finish for display and cabinet work.



Method of construction

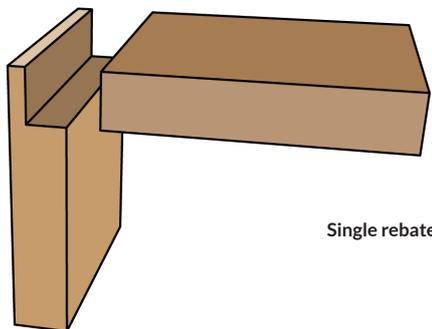
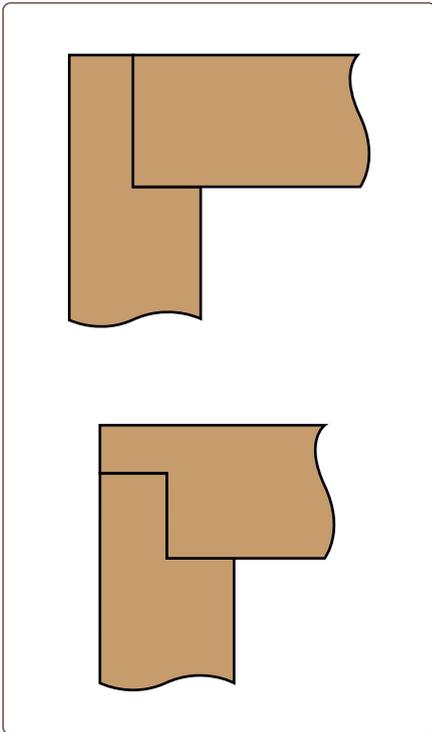
1. Use a pencil and ruler to mark the area where the trench will be cut into one timber component. The trench should be the same size as the matching component.
2. With a tenon saw or chisel, cut along the marked line and create the trench. It should be no deeper than one third the thickness of the timber.
3. Smooth the inside of the trench with a chisel and sandpaper so the matching component fits snugly.
4. Apply wood glue to both the trench and end of the matching component.
5. Fit both components together, making sure they are aligned.
6. Use clamps to hold the joint in place while the glue dries.



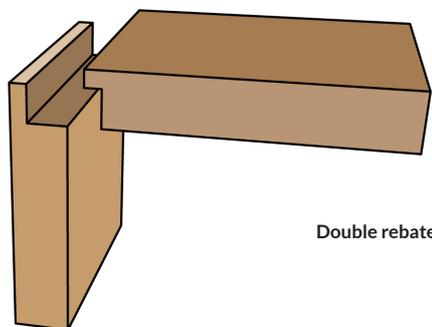
Rebate joints

Also called a 'lap' joint, this joint is one of the quickest and easiest methods of joining two timber components at a 90° angle.

A rebate (trench) is cut in one or both timber components to be joined. Make sure all surfaces are smooth and flush when the joint is assembled.



Single rebate



Double rebate

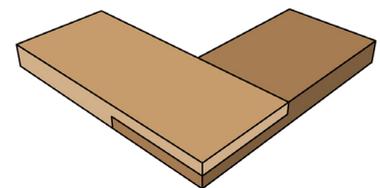
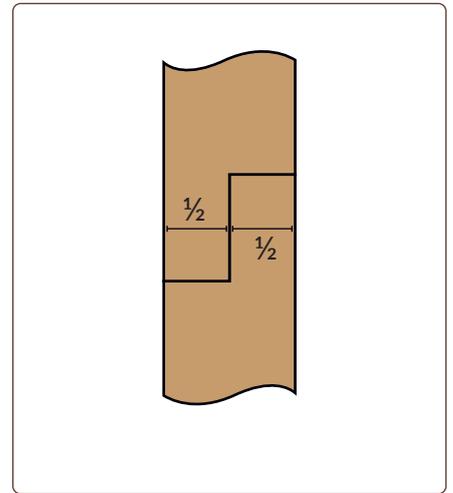
Halving joints

This joint is mainly used for light frames where the joint will not be put under too much strain.

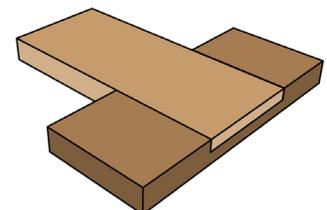
It is made by removing the same amount of timber from each component to be joined so all surfaces will be flush when the joint is assembled.

There are several types of halving joint, each with a specific purpose:

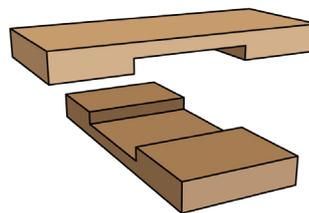
- > **Angle halving** – where the two components form a corner (usually 90°).
- > **Tee halving** – where one of the components ends at the joint.
- > **Cross halving** – where you join two components that cross over each other.
- > **Dovetail halving** – used to resist forces that could pull the joint apart.



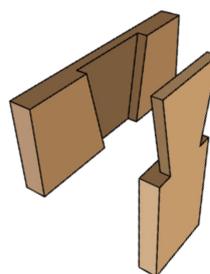
Angle halving



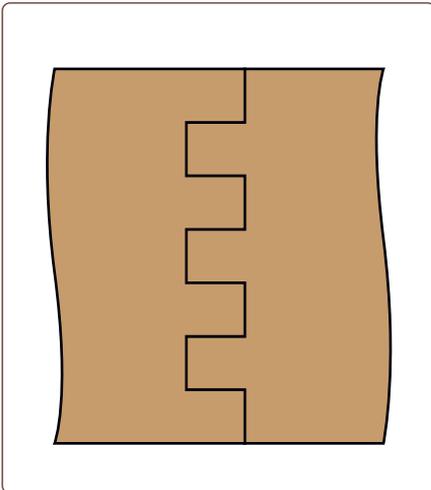
Tee halving



Cross halving



Dovetail halving



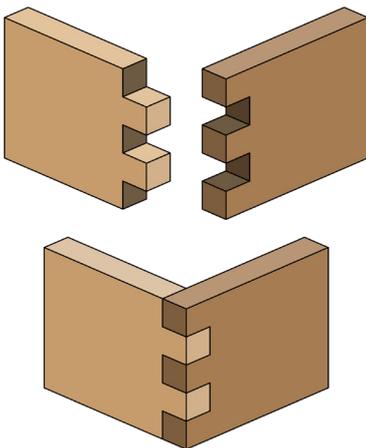
Box joints

This type of joint gets its name as it's often used to make boxes and drawers. Box joints are also called 'finger' joints.

A series of notches are cut into the ends of two timber components and they fit together to form a strong joint.

Method of construction

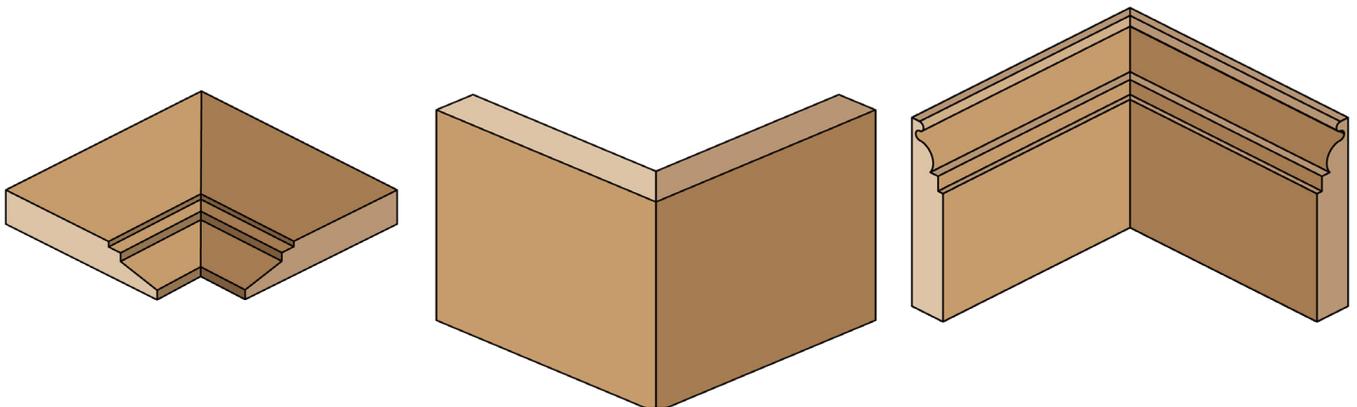
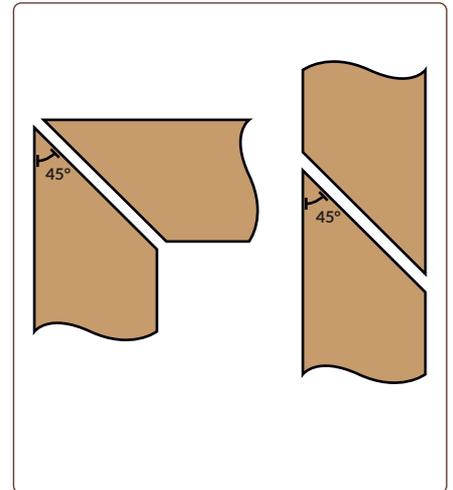
1. Mark where you want to cut the notches on both timber components. The notches should be the same size and evenly spaced.
2. Use a saw and chisel to cut the notches.
3. Check the notches fit together snugly. They should slide together easily and not be too loose.
4. Apply wood glue to the notches and fit the components together. Clamp tightly until the glue dries.



Mitre joints

This type of joint is used to connect two timber components at a corner. Each component is cut at a 45° angle, so they form a 90° corner when fitted together (though they are sometimes cut for other angles too). When you create a mitre joint, you get an almost seamless join that doesn't show any end grain of the two timber components that have been joined.

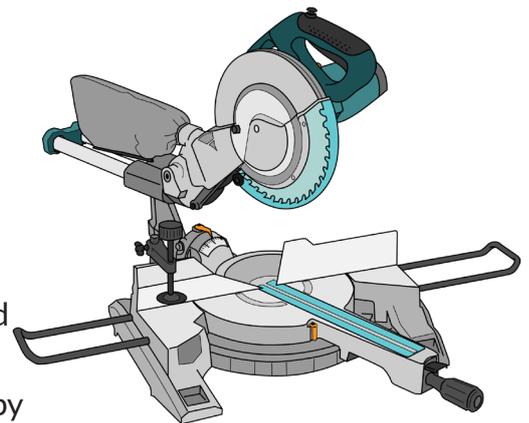
Mitre joints are not as strong as other joints, so they're mostly used for decorative features such as skirting and architraves around doors and windows, mouldings around picture frames, and panelled doors.



Method of construction

There are several different ways to cut mitres:

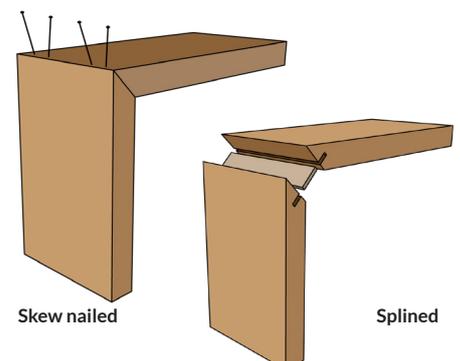
1. By hand, using an adjustable mitre box with a fine-toothed saw. Set the angle to make square or 45° angled cuts.
2. Use a mitre or compound mitre saw locked at 45°.
3. Use a cross-cutting sled on a bench saw set to 45°.

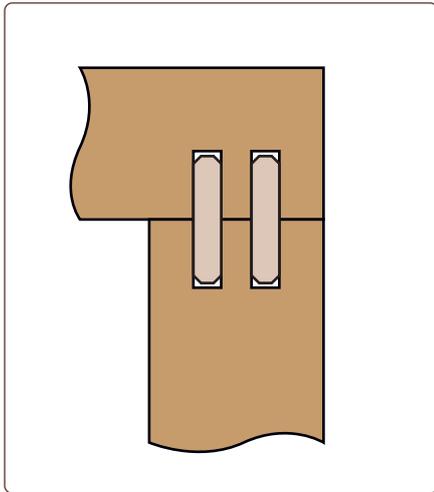


Because glued end grain has little holding power, you may need to reinforce the mitre joint.

The easiest way to provide extra strength is to fix the corners by skew nailing with panel pins or finishing brads. Make sure to drill small holes at a slight angle so the nails can be driven in without splitting the timber.

Another method is the 'splined' mitre joint, where a small strip of timber is inserted into matching trenches cut along the face of both mitre cuts.





Dowelled joints

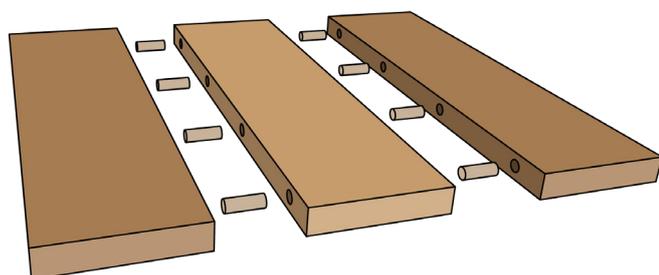
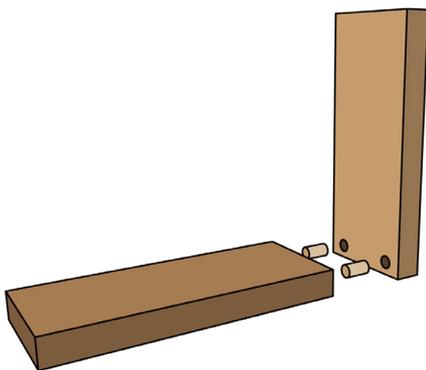
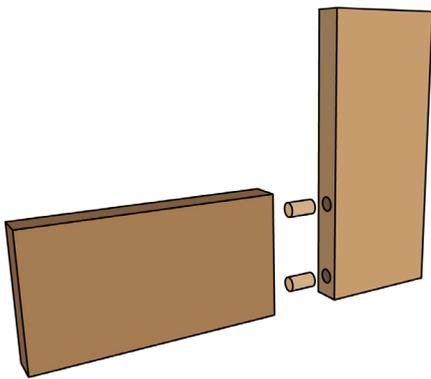
This type of joint uses short circular pins called 'dowels' to increase the gluing surface of a butt joint. This strengthens and reinforces it rather than relying on the adhesive. This is important when attaching end grain components on chairs, cabinets, panels and tabletops.

Because they are a quick and strong joint, dowelled joints are often used in the furniture industry when fastening two timber components together to form a large flat surface.

Accuracy is very important to make sure the components line up perfectly when the joint is assembled. This means taking special care when setting out and drilling. A dowelling jig helps with accurate placement of holes.

Method of construction

1. Drill the dowel holes so there are matching holes in each piece of timber to be joined.
2. Make sure the holes are drilled at 90° to the surface of the timber to be joined and a little deeper than half the length of the dowels.
3. Chamfer each end of the dowels to help during assembly.
4. Insert the dowels into one component with wood glue, then fit the other component over the dowels.
5. Apply clamps to the joint until the glue has dried.



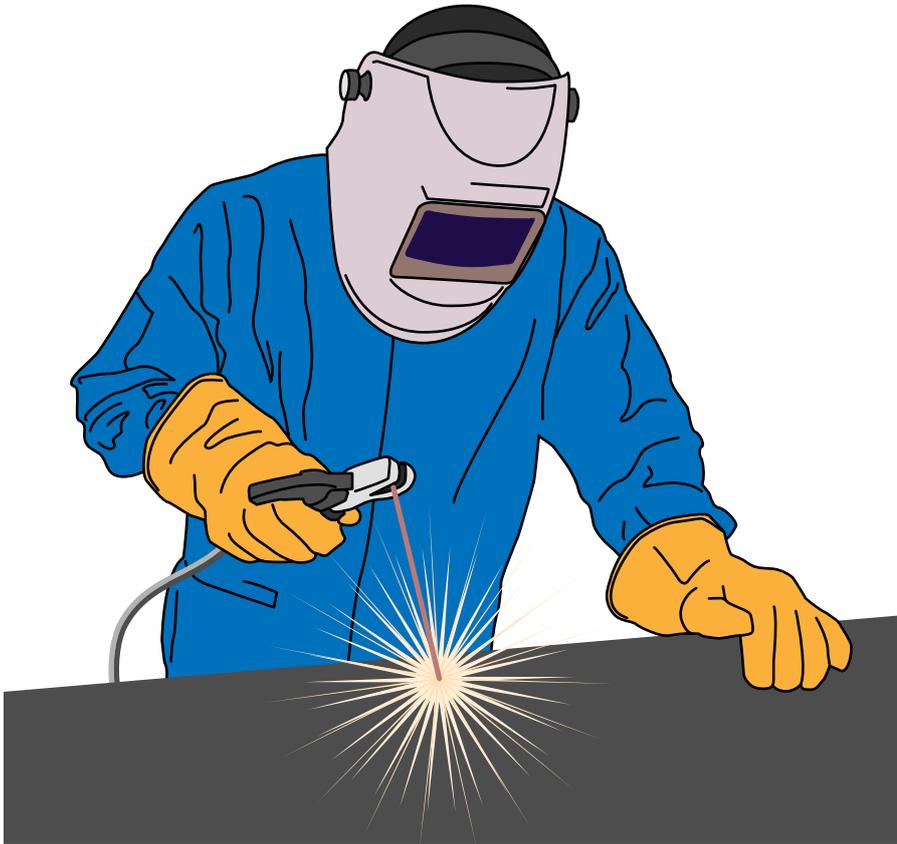
Metal Joints

Metal joints can be used in BCATS projects to create strength and stability. They can also be used to add functional items like hinges, handles or supports.

The most common methods of metal jointing are welding and soldering.

Safety precautions when welding and soldering:

- Always wear appropriate PPE for the process you're working on (i.e. welding helmet/safety goggles, gloves, long-sleeved jacket to protect yourself from sparks and intense light).
- Never touch the element or tip of a hot soldering iron – it is hot enough to give you a serious burn.
- Do not allow the hot tip of a soldering iron or welding gun to touch electrical cords.
- Always use a stand to hold the soldering iron when not in use.
- Work in a well-ventilated area to avoid inhaling the fumes.
- Thoroughly wash hands after using solder.
- Use a residual current device (RCD) to protect against electric shock.

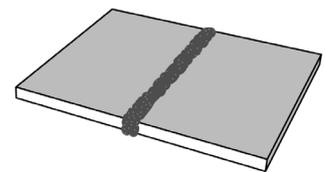


Welding

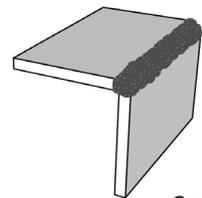
Welding joins metal materials using heat or pressure (or a combination of both). It is the strongest and most common method of joining steel components together.

There are five basic types of welded joints:

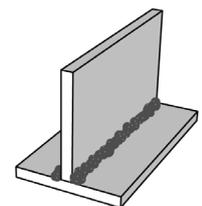
- **Butt joint** – two pieces of metal are placed edge to edge and then welded together.
- **Corner joint** – between two components to be fixed at 90° to each other.
- **Tee joint** – joins two plates at 90° to each other.
- **Lap joint** – joins two overlapping components.
- **Edge joint** – fixes two or more parallel components.



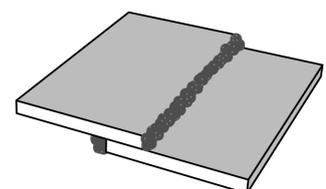
Butt joint



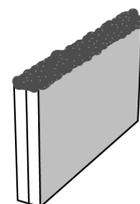
Corner joint



Tee joint



Lap joint



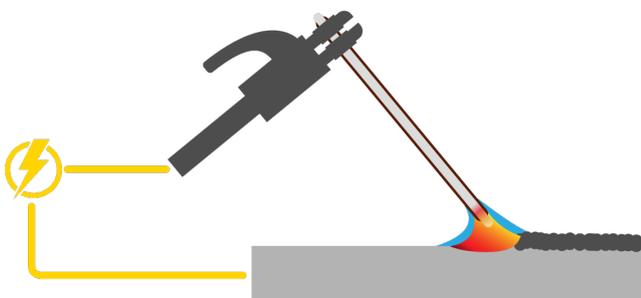
Edge joint

Welding methods:

Arc welding

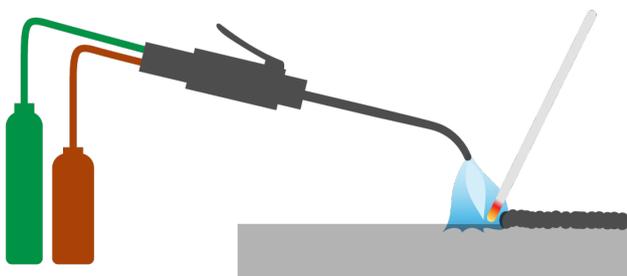
Used in many different situations, especially in schools.

An electric arc at the end of a moving electrode ('welding rod') creates a pool of molten metal in which the pieces of metal and electrode material combine. This forms a solid mass when the weld cools and goes solid.



Gas welding

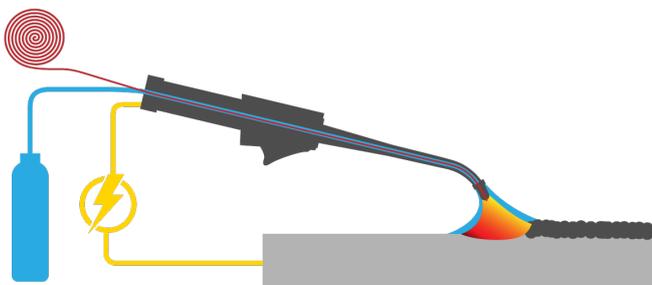
Also called 'oxyacetylene' welding, this is a group of welding processes that use gas as the heat source. Oxyacetylene is used for welding because the flame temperature can reach 3200°C. This is the highest temperature produced by any fuel gas-oxygen combination.



Metal inert gas (MIG) welding

Involves a continuous wire electrode (filler metal) and shielding gas fed through a welding gun. The wire melts and joins two pieces of metal together as it cools.

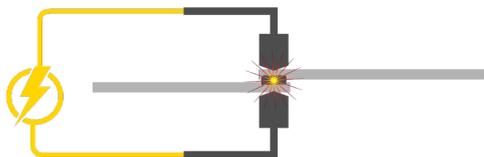
MIG welding is quite easy to learn, and it creates clean, high-quality welds. It can be used on many types of metal, including steel, aluminium and stainless steel.



Resistance welding

Used to join metallic parts using an electric current. There are several types of resistance welding, including spot, seam, projection, and butt welding.

In all forms of resistance welding, the parts are heated until a molten pool forms. The parts are then allowed to cool, and the pool goes solid to form a weld nugget. On a typical machine, the operator has control over the current setting, electrode force and weld time.



Soldering

This is a technique used to join two metal surfaces with solder. During the soldering process, the metal surfaces are heated, causing the solder to melt and flow between them. Once the solder cools and goes solid, it forms a strong and durable joint.

Soldering works at much lower temperatures than welding (around 190°) and is only suitable for lightweight metal work.

Small mains-powered soldering irons are mostly used. These are generally hand-held with a heated iron tip which heats the joint.

The soldering process always involves the steps below:

1. Preparation

Clean the surfaces: Remove any dirt, grease, or rust from the metal surfaces, including the iron tip itself. Dirty surfaces will stop the solder from properly bonding and lead to a weak joint.

Tin the soldering iron: Apply a small amount of solder to the tip of the soldering iron to improve heat transfer.

2. Heating

Place the soldering iron tip on the joint to heat both metal surfaces evenly and make sure the solder flows properly.

3. Applying solder

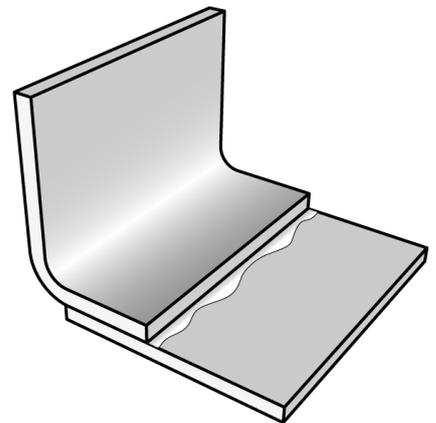
Once the joint is hot enough, apply solder to the joint (not the iron). The solder should melt and flow into the joint, creating a strong bond.

4. Cooling

Take the soldering iron away and let the joint cool. Avoid moving the joint while it cools as this could cause a weak connection.

5. Inspection

Inspect the joint for any gaps or too much solder. A good solder joint should be shiny and smooth.



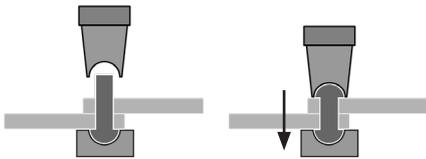
Rivets

A rivet is a permanent mechanical fastening. There are several different types of rivets, each used for a different purpose. Below are two examples.

Solid rivets

One of the oldest and most reliable types of fastenings. They were found in Bronze Age archaeological diggings dating back over 5000 years!

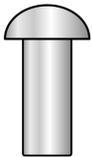
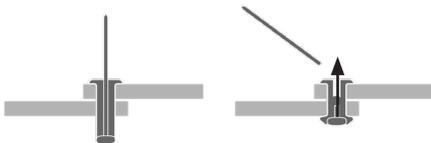
Before being installed, solid rivets are made of a smooth cylindrical shaft with a head on one end. The rivet is placed in a punched or pre-drilled hole and the tail is 'upset' (deformed) so it expands the original shaft diameter and holds the rivet in place.



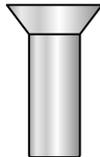
Blind rivets

Also called 'pop' rivets, these are used to fasten sheet metals (or similar), producing a very strong fastening.

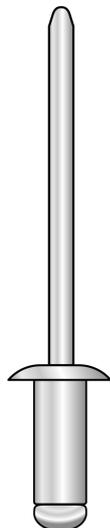
A hole is drilled through the two materials. The rivet is placed in the hole and a pop rivet gun is used to force the end of the rivet to spread out around the edges of the hole.



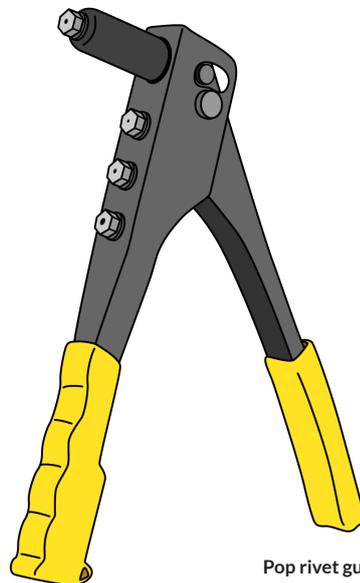
Round head solid rivet



Countersunk solid rivet



Pop rivet



Pop rivet gun

