Use joints for a BCATS project

Unit Standard – 25920

Level 1, Credit 3

Name: _____

>>B CONSTRUCTIVE

Contents

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What you need to do

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

- identify and describe types of wood and metal joints;
- select jointing methods;
- use timber and metal joints; and
- complete work operations.

How you will be assessed

You will be assessed by a combination of practical and written and/or oral assessments.

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

- identify and describe types of wood and metal joints
- establish jointing requirements from job specifications
- select the appropriate jointing methods for a project
- set out and cut the joints to the project specifications
- assemble the joints
- complete all operations safely
- clean and store tools, plant and equipment correctly

Your teacher/tutor may provide you with a worksheet that will help you record what you have learned.

Glossary of terms

Term	Meaning
Acetylene	A colourless, odourless gas when combined with oxygen and ignited is used for metal welding and cutting.
Adhesive	The generic term for any substance capable of holding materials together by surface attachment.
Alloy	A combination of 2 or more metals that can be used for special purposes.
Architrave	The decorative moulding surrounding a door or window
Dowel	A timber pin or rod used to strengthen a timber joint.
Hazard	A hazard is something that can cause harm.
Job specifications	A detailed and exact statement of particulars identifying materials, dimensions and instructions for a project to be built, installed or manufactured.
MDF	Medium Density Fibreboard. A manufactured board made from wood fibres which are held together with a combined resin and wax binder
MIG Welding	Metal Inert Gas. A welding process where a continuous filler wire electrode and a shielding gas are fed through a welding gun under a constant electric current.
Oxy-acetylene	A mixture of oxygen and acetylene which can produce a flame temperature of 3300°C on ignition
Rail	The horizontal member in the structural framework of a door, window sash or frame.
RCD	Residual Current Device. An electrical safety device that disconnects as soon as it detects a current leakage through a person's body to the earth and reduces the harm caused by electric shock.
Sash	A framed glass window unit that can be moved either by pivoting or sliding.
Solder	A metal alloy of tin and lead used during the soldering process to join metals.
Stile	The vertical member in the structural framework of a door, window sash or frame.
TIG Welding	Tungsten Inert Gas. A welding process that uses a tungsten electrode, a shielding gas and a constant electric current to produce a weld.
Working Drawings	The set of precise scale drawings with dimensions, details and notes which provide sufficient information to allow a project to be constructed accurately.

Wood joints

Wood joints have been used by woodworkers around the world for many thousands of years to join pieces of wood together. Some wood joints rely on metal fasteners or adhesives for strength, while for many traditional techniques the joints are made entirely from wood.

The most crucial part of any project is the preparation of the timber. When working with wood it is important that each piece is sawn and planed so that it is accurate and square. Always select timber that is long enough to allow the ends to be squared off to remove any defects there may be in the timber. Next, lay out your timber and carefully select the best for where they will be seen such as the fronts and tops of the project. Look for any defects and blemishes that may affect the final appearance and place these in a less visible place. Also visually check the grain patterns so they can be placed where they can be seen to the best advantage.

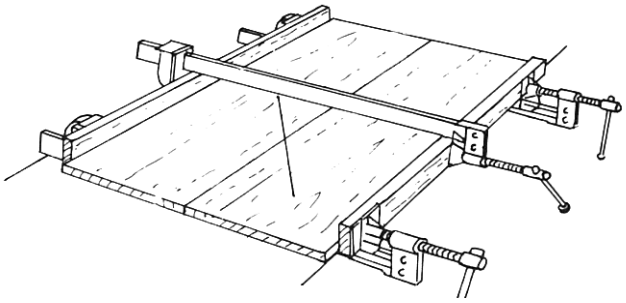
Edge to edge joints

Edge to edge or butt joints are used to assemble boards to create a larger surface area, such as a coffee table top. The boards can be held together just with glue or reinforced with dowels or tongues set into grooves.

Method of construction

Prepare each piece of wood by carefully planing the edges straight and ensuring the thickness is consistent. After the boards have been prepared lay them out on support battens with the best sides facing up.

Before applying the glue check for any gaps along the length of the joint by clamping the boards lightly together. Place a batten between the cramp heads and the work to prevent the cramp heads marking the edges of the timber.



Undo the cramps and stand the boards on edge and apply the glue evenly with a brush. Check that the cramp beds are level before placing the boards back on the cramps.

Place one cramp under each end of the work and, depending on the length of the work, alternate cramps over and under to keep the surface of the joint straight. Apply the clamping pressure gradually being careful not to over tighten them.

Mitre joints

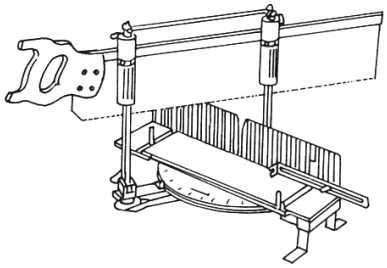
A mitre joint is used to connect 2 pieces of timber together. Each piece is cut at an angle of 45deg so when they are fitted together they form a 90deg corner. Mitres can be cut for other angles but the most common is the 90deg joint.

This joint is used mostly to join architraves around doors and windows as well as mouldings around picture frames and in panelled doors.

Method of construction

There are a number of different ways to cut mitres:

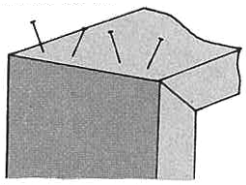
- by setting the cross cutting slide on a bench saw to 45deg.
- by using a mitre or compound mitre saw locked in at 45deg.
- by hand, using an adjustable mitre box with a fine toothed saw which can be set at any angle to make square as well as angled cuts, as shown.



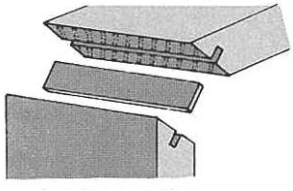
Because glued end grain has very little holding power, it may necessary to reinforce the joints in some way when using mitre joints for a box construction.

The easiest method to fix the corners is by skew nailing with panel pins or finishing brads. To avoid splitting and provide added strength to the joint, drill small pilot holes so the nails can be driven in at a slight angle.

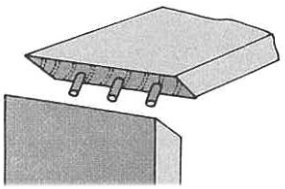
Another method is the **splined mitre joint** where a small piece of plywood is inserted into matching grooves cut along the length of both mitre cuts. Evenly spaced short dowel pegs can also be used to strengthen a mitre joint.



Skew nailed



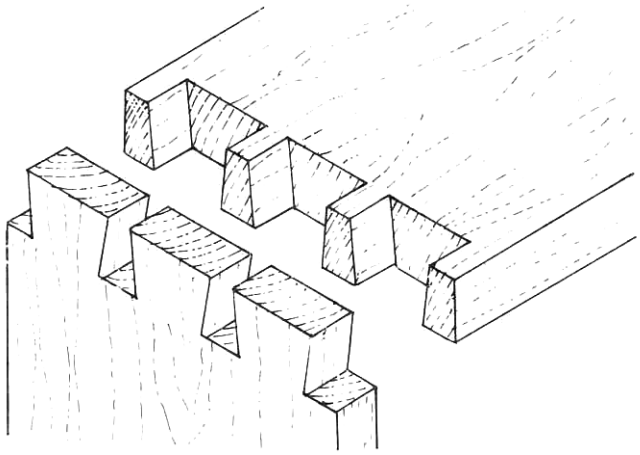
Splined



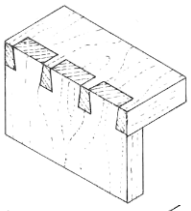
Dowelled

Dovetail joints

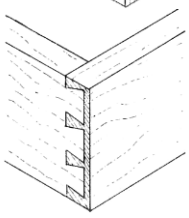
Dovetail joints are shaped so that the 2 pieces of timber that makes up the joint cannot pull apart. This makes this type of joint ideal for drawer fronts where they are subject to repeat pulling and the dovetailed joint prevents the front from coming away from the drawer side.



There are many different variations of the dovetail joint, with the most common being the through dovetail where the dovetail is visible on both faces. This is often used where the dovetail joint is a decorative feature of a project.



A lap dovetail is where the joint is hidden on one face of the joint and is most commonly used to connect the drawer sides to the front so the joint construction is not visible.



In many projects the dovetail joint can be used as a decorative feature by varying the sizes and shapes of the pins in the joint.

Dovetails can be made either by hand, using a dovetail saw (a fine toothed version of a tenon saw) and a chisel, or produced using a router and a dovetail attachment.

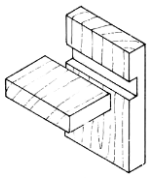
Housing joints

The housing joint is a useful structural joint, particularly in cabinets and shelving units and is basically a trench that is cut across the grain of the timber, into which the end of another similar sized piece is inserted. The difference between a groove and housing is that a groove always runs along the grain, whereas housing runs across it.

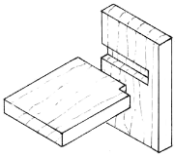
The joint is formed when a trench or channel is cut into one piece of wood so that a second piece of wood fits snugly into it. The trench should be cut no deeper than one-third of the thickness of the piece of wood.

There are 2 main types of housing joints.

The through housing, where the trench is cut across the full face of the board.



A stopped housing, where the trench is stopped back from the front of the board and with a matching step in the piece of timber to be inserted into the groove. This method produces a better finish for display and cabinet work.



The housing can be cut either by hand with a tenon saw and a chisel or by using a router with straight cutter.

Mortise and tenon joints

The mortise and tenon joint has been used for thousands of years to join pieces of wood together. It is simple to construct and can be glied, pinned or wedged to fix it in position

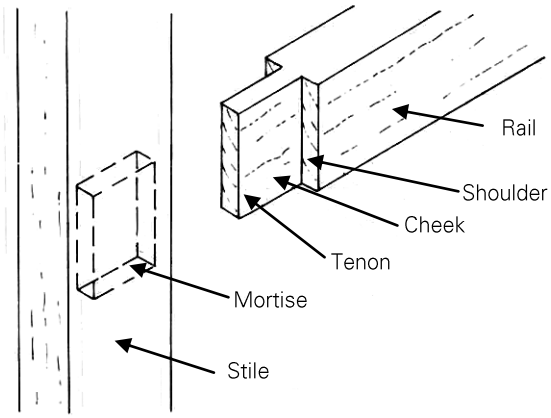
The family of mortise-and-tenon joints is among the strongest joints in woodworking, and because of this strength they are ideal for use in furniture projects such as tables, chairs, and cabinets and in the construction of door frames and window sashes.

All mortise and tenon joints consist of the same basic parts:

- the mortise, which is a slot cut into or through a stile or leg and
- a tenon or tongue at the end of a rail that fits into a mortise.

The joint is constructed by shaping one end of a rail into a tenon to fit into a slot (mortise) cut into the other piece.

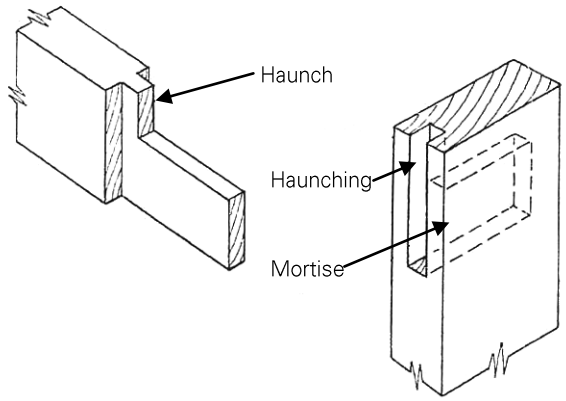
When setting out a mortise and tenon joint proportions are important. The thickness of the tenon must never be more than one third of the width of the timber in which it is being cut. Any wider and the stile will be weakened. The tenon can be made with or without shoulders and the choice of method will depend on the design and the intended use of the project.



There are several types of mortise and tenon joints and all serve the same basic purpose but some are stronger while, in others, the joint construction is hidden. These include:

- **haunched** – stops the rail from twisting
- **stub/stopped/blind** – does not penetrate right through the stile
- **through** – passes right through the stile
- **wedged** – wedges are inserted in the rear of the joint for strength

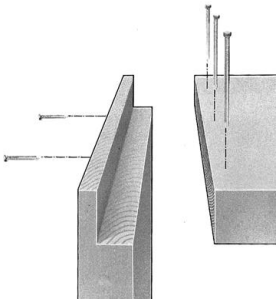
The **haunched mortise and tenon** is the strongest joint and can be used for window sashes, door and furniture construction. The haunching can be either square or sloping and prevents the rail from twisting.



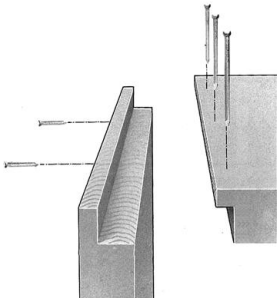
Rebate joints

The rebate joint (lap joint) is one of the quickest and easiest ways of joining 2 pieces of timber together at right angles. Rebate joints can often be substituted for dovetail joints when making projects such as drawers, boxes and other similar projects that will not be subjected to a great deal of stress.

The joint is made by cutting a rebate in one or both pieces of the timber to be joined so that all surfaces smooth and flush when the joint is assembled. The joint can be fixed in place with an adhesive and reinforced with screws or dovetailed nails for added strength.



Single rebate joint



Double rebate joint

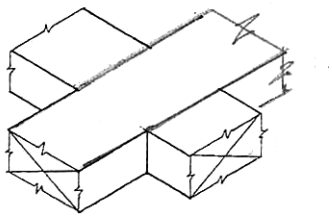
Halving joints

Halving joints are one of the quickest ways of joining 2 pieces of timber together. These joints are mainly used to construct light frames where the joints will not be subjected to too much strain.

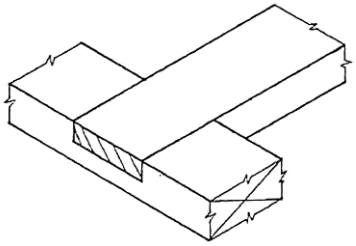
The joint is constructed by removing the same amount of timber from each piece of timber to be joined so that all surfaces will be flush when the joint is assembled.

There are various types of halving joints, each having a specific purpose and with different names. They include:

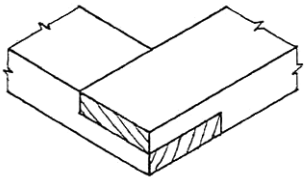
Cross halving – This is the probably the most simple of joints to set out and construct and is used where it is necessary to join 2 pieces of timber that cross over each other.



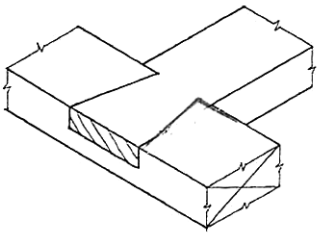
Tee halving – This joint is where one of the members terminates at the joint.



Angle halving – This is a basic framing joint where the 2 members form a corner, usually a right angle.



Dovetail halving – This dovetailed shaped joint is used to resist tensile forces which could pull the joint apart.



Dowelled joints

A dowel joint uses short circular pins to increase the gluing surface of a butt joint in order to strengthen and reinforce it rather than relying on the adhesive on its own. This is especially important when attaching end grain components for chairs, cabinets, panels and tabletop projects.

Because of the simplicity of construction the dowelled joint is often used in the furniture industry as a mortise and tenon substitute when fastening 2 pieces of wood together.

It is a quick, efficient and particularly strong joint and an ideal method of joining 2 or more flat pieces of timber together to form a large flat surface such as a coffee table top.

As with the construction of all joints, accuracy is essential to ensure members line up perfectly when the joint is assembled. This means that special care must be taken during the setting out and drilling stages. The use of a dowelling jig will assist in the accurate placement of the holes.

Make sure that the holes are drilled perpendicular (at right angles) to the surface of the timber to be joined and slightly deeper than half the length of the dowels. Chamfer each end of the dowels to help during the assembly process.

The dowel holes are drilled so there are corresponding holes in each piece of timber to be joined. The dowels are inserted into one board together with an adhesive and then the other board is fitted over the protruding dowels. The joint is assembled and cramps applied until the adhesive has set.

Biscuit joints

Biscuits joints are mainly used to join sheet materials such as plywood, particle board and medium-density fibre board.

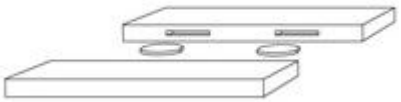
A biscuit reinforced butt joint can be used for solid wood to replace mortise and tenon joints for carcass and frame construction as they are easier to make and almost as strong.

A biscuit is an oval shaped piece of dried and compressed wood which is fitted into matching slots in both of the pieces to be joined.

Biscuit jointer

To make the joint a portable power tool called a biscuit joiner or plate joiner is used. A small 100mm diameter tungsten carbide-tipped circular saw blade is used to cut a crescent shaped hole (called the mouth) in opposite edges of the 2 pieces of wood or wood composite panels to be joined.

An oval-shaped, highly-dried and compressed wooden biscuit (usually beech) is covered with glue, or glue is applied in the slot. The biscuit is immediately placed in the slot, and the 2 boards are clamped together. The wet glue expands the biscuit, further strengthening the bond which may often be stronger than the wood itself.



Biscuits are available in a range of sizes for different purposes. For thicker joints it is common to use more than one biscuit side by side.

Metal joints

Welding

Welding is a process used to join metallic materials by applying heat and pressure or a combination of both.

There are five basic types of welded joints:

Butt joint – Is a joint between 2 pieces of metal placed edge to edge and welding them together.

Corner joint – Is a joint between 2 members to be fixed at right angles to each other.

Tee joint – A tee joint is used to weld 2 plates which are at right angles to each other.

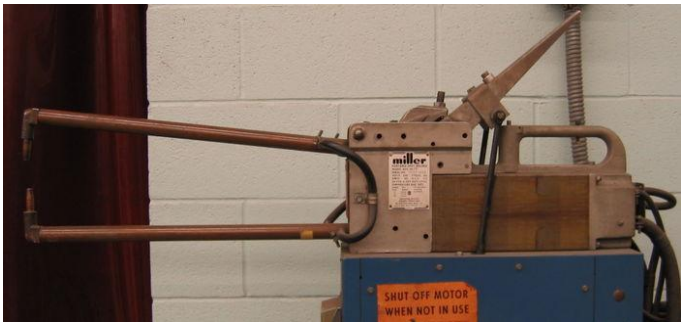
Lap joint – A lap joint is used to join 2 overlapping members

Edge joint – Is a joint used to fix 2 or more parallel members.

The most common welding methods used in schools are:

Manual arc welding MIG and TIG

Oxy-acetylene gas welding



Resistant (spot) welding

When welding, it is important to wear the appropriate Protective Personal Equipment (PPE) to avoid injury. Different welding processes require specific protective clothing and eye protection. To avoid breathing toxic fumes the work area must be properly ventilated.

The strongest and most common method of permanently joining steel components together is by welding. There are many welding techniques that can be used but arc welding is the most important since it is adaptable to a wide range of situations and is relatively cheap.

Arc welding

In arc welding, an electric arc at the end of a moving electrode or welding rod creates a pool of molten metal in which the components and electrode material combine, forming a solid mass when the weld cools and solidifies.

Gas welding

Gas welding, also called oxy-acetylene welding, refers to a group of welding processes that use gas as the source of heat energy. Acetylene is commonly used for welding because, when combined with oxygen, the flame temperature can reach 3,093°C (5,600°F), the highest temperature produced by any fuel gas-oxygen combination.

Resistance welding

Resistance welding is a process used to join metallic parts using an electric current. There are several forms of resistance welding, including spot welding, seam welding, projection welding, and butt welding.

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

To create heat, copper electrodes pass an electric current through the work pieces. The heat generated depends on the electrical resistance and thermal conductivity of the metal, and the length of time that the current is applied.

Copper is used for electrodes because it has a low resistance and high thermal conductivity compared to most metals. This ensures that the heat is generated in the work pieces instead of the electrodes.

Soldering

Soldering is the process of a making an electrical or mechanical joint between certain metals by joining them with a soft solder.

Solder is alloy of lead and tin with a low melting point.

The soldering process always involves the same three steps:

- clean and heat the metal
- apply the solder
- allow the joint connection to cool and harden

The joint is heated to the correct temperature using a soldering iron.

For most work, a small mains powered soldering iron can be used. These have a handle to which heating element is attached. On the end of the heating element is an iron tip which heats the joint.

Care must be taken when using a soldering iron because is hot enough to inflict a serious burn. Solder has a melting point of approximately 190°C. However, because the iron tip needs to heat the surrounding metal as well as the solder, it can reach a temperature of over 250°C.

The first step in the soldering process is to ensure that all parts - including the iron tip itself - are clean and free from contaminants such as grease and oxidation. Dirty parts of the joint will repel the molten solder and it will "bead" into globules, going everywhere except where it is needed.

Always remember:

Dirt is the enemy of a good quality soldered joint!

Soldering fluxes are used to corrosively clean the joint area and to aid in the transfer of heat from tip to joint.

During the soldering process the fluxes will evaporate giving off fumes that are harmful to peoples health, so it is important to always work in a well-ventilated area.

Safety precautions when soldering

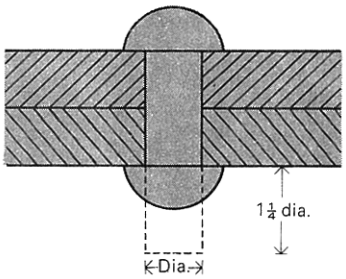
- Never touch the element or tip of a hot soldering iron.
- Take care not to allow the hot tip of the iron to come into contact with electricity cords.
- Always use a stand to hold the iron when not in use.
- Work in a well-ventilated area.
- Thoroughly wash hands after using solder and fluxes.
- Use an RCD to protect against electric shock.

Riveted joints

A rivet is a permanent mechanical fastener. There are a number of different types of rivets, each designed to meet a specific need. Two examples follow.

Solid rivets

Solid rivets are one of the oldest and most reliable types of fasteners, having been found in archaeological diggings dating back over 5000 years to the Bronze Age. Solid rivets are used in applications where reliability and safety are important, such as in the assembly of modern aircraft.



Before it is installed, a solid rivet consists 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 that it expands the original shaft diameter and holds the rivet in place.

Blind rivets or pop rivets

Rivets are used to fasten sheet metals or similar materials producing a very strong and permanent fastening. A hole is drilled through the 2 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.

Job specifications and working drawings

The key to producing a quality product or job is to ensure that all the necessary documentation has been thoroughly prepared before a project is started.

Good documentation should:

- accurately represent the extent and content of the project by defining the scope and quality of the work to be done and the materials and products to be used
- provide all the necessary information for the project to be completed
- ensure there is consistency between the working drawings and specifications
- be presented neatly, concisely, legibly and in a logical sequence

Construction problems can largely be avoided with a good set of working drawings and specifications.

Following the working drawings and job specifications will ensure that the end product will meet the customer's or your personal requirements and that it is produced in accordance with good workplace practice.

Care of plant and equipment

All tools perform better when they are sharp and in good condition but can be very dangerous if they are blunt. Learn the correct methods to sharpen and adjust hand tools such as planes and chisels.

Before storing tools away after use, make sure that they are thoroughly cleaned and metal parts wiped with an oily rag to prevent rust.

Use hooks and shelves to store plant and equipment and a tool box or cupboard for your personal tools. Store all equipment in a dry and secure place.

Check all power tools after use and if any maintenance is required they should be sent to the appropriate dealer for repairs.

When using power tools always use a Residual Current Device (RCD) to prevent electric shock.

Safe working practices

Understanding safety and applying safe work practices when working in workshops or on sites is critical for ensuring that accidents are avoided.

By following some basic rules, such as wearing PPE and applying common sense, you can play an important part in ensuring that every workplace is a safer place to work in.

Hazards continually change because of what people do or do not do, and because the nature of the work may change. The Health and Safety at Work (HSW) Act sets out the minimum legal obligations for identifying and controlling hazards in workplaces (including schools),

Anyone in charge of a workplace must have an effective method in place for identifying hazards. Anyone who is going to be working in the workplace needs to be consulted, trained and involved in the process of identifying and controlling them.

Everyone should be provided with information about the hazard identification procedures, which may include:

- information about hazards that are known to be present in the workshop or on the project site (which could be in the form of a checklist); and
- the process you must follow to identify hazards.

There are several methods which can be used to identify potential hazards. The environment of each workplace will largely dictate the most appropriate method or combination of methods. It is important that a site specific safety plan (SSSP) clearly identifies the hazards, the risk assessment of them and the controls to be put in place at any particular site.

If you haven't already achieved the level 1 safety Unit Standard 24352 (*Demonstrate knowledge of and apply safe work practices in the construction of a BCATS project*) then it is recommended that you work towards completing it either before or at the same time as this one.