Demonstrate knowledge of construction and manufacturing materials used in BCATS projects

Unit Standard – 24355

Level 1, Credit 4

Name: _____

Contents

Published by: **Building and Construction Industry Training Organisation (BCITO)**
Level 5, 234 Wakefield Street
PO Box 2615
Wellington

What you need to do

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

- establish job requirements and select construction and manufacturing materials for a practical project; and
- describe the properties of 4 materials (including timber) and evaluate their suitability to meet job requirements.

How you will be assessed

You will be assessed by a combination of oral and/or written assessments. If you have the opportunity to undertake a project, this could also be a part of your assessment.

To achieve this unit standard, you need to prepare a project plan where you can establish job requirements, and select construction and manufacturing materials based on their properties and suitability for the job.

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

- read or listen to the instructions for the job and work out what you need to do;
- choose the right materials for the job and explain why you chose them;
- for each of **4** different materials (timber, plus three others such as manufactured board, metal, plastic, glass, concrete, mechanical fasteners, adhesives, finishing materials, upholstery fabric/leather), explain:
    - its properties – what it looks like, what it's like to work with, how strong and stable it is;
    - what you'll use it for;
    - 3 of its features – for example, design, aesthetics, ergonomics, cost, availability, jointing methods, durability, health and safety requirements; and
    - how it compares with another material.

Your project plan may come from an Assessment Record Sheet for Materials that your teacher/tutor can provide.

Glossary of Terms

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

Introduction

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

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

Job Specifications

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

Job specifications are instructions about:

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

  materials; and

  finishes etc.

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

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

Drawn information includes:

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

Written information includes:

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

Verbal information includes:

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

Using the job specifications

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

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

Materials

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

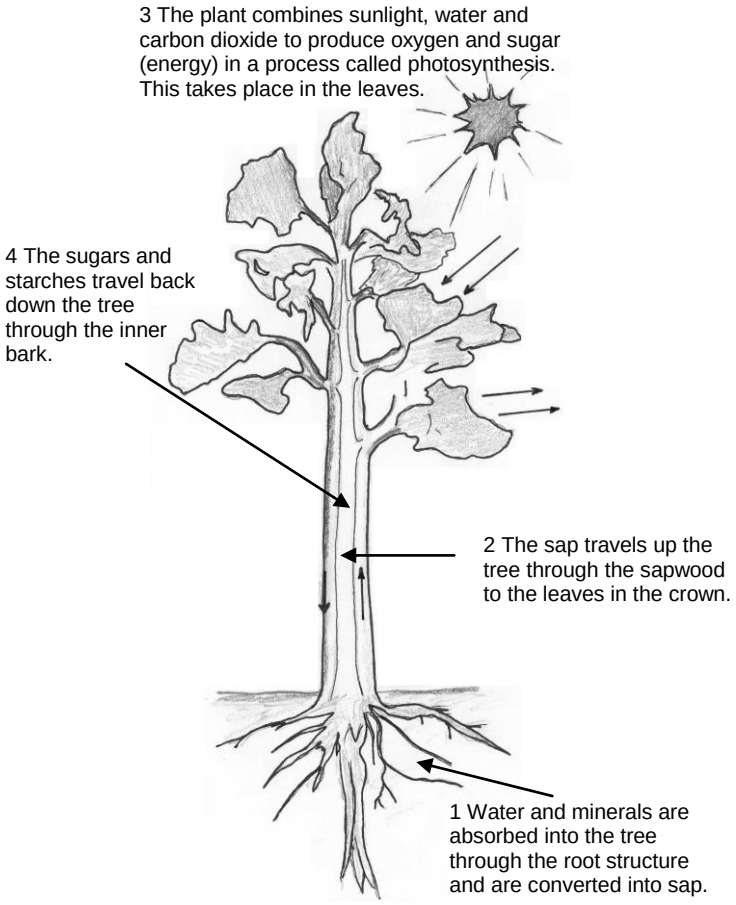
- material type – e.g. plaster board;
- material brand – Winstone Gibraltar Board; and
- material size – 16mm.

Timber

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

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

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



Parts of a tree

Trees are made up of the following parts.

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

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

Sapwood

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

Heartwood

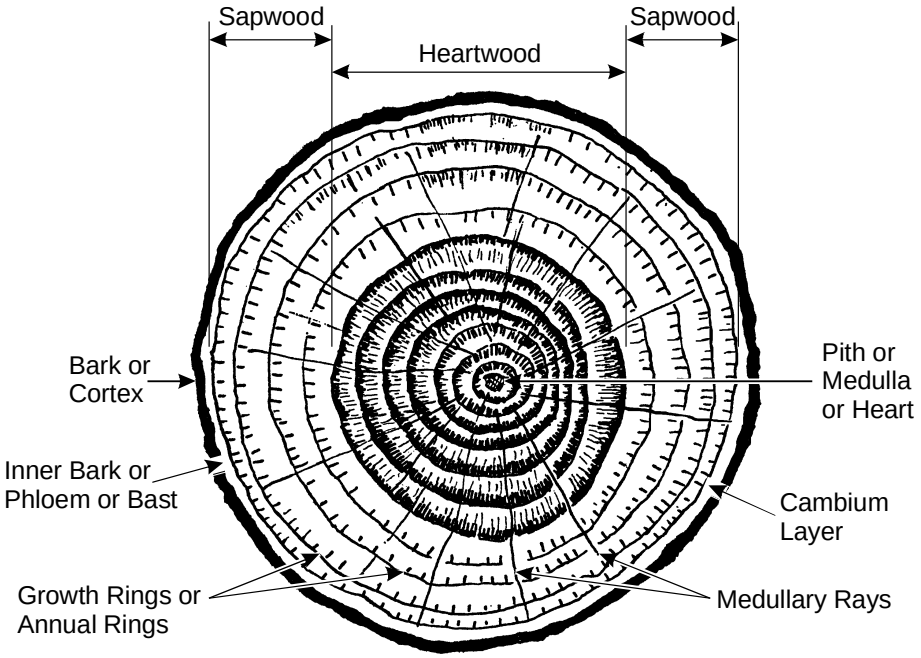
The heartwood lies between the sapwood and the pith and is made up of older inactive layers. Its main function is to help the tree to remain straight and upright. This section of the tree generally produces timber which is more durable and resistant to decay and insect attack.

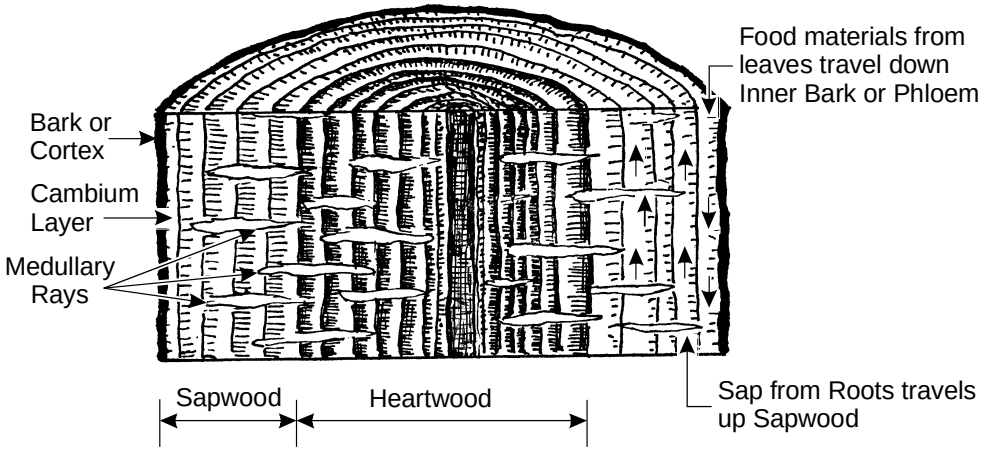
Cambium layer

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

Bark

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


Sapwood
Heartwood
Sapwood
Bark or Cortex
Pith or Medulla or Heart
Inner Bark or Phloem or Bast
Cambium Layer
Growth Rings or Annual Rings
Medullary Rays

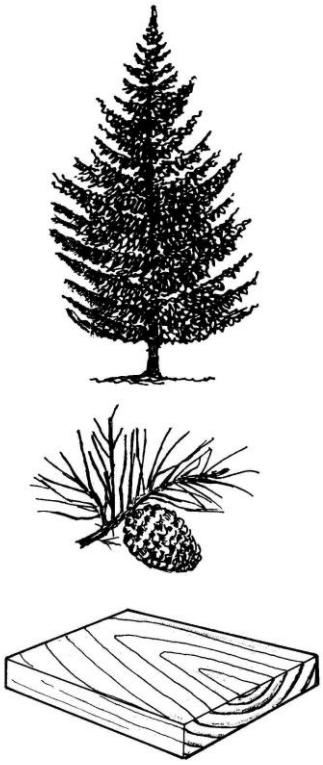

Food materials from leaves travel down Inner Bark or Phloem
Bark or Cortex
Cambium Layer
Medullary Rays
Sapwood
Heartwood
Sap from Roots travels up Sapwood

Classification of timber

Timber is divided into two classes – softwoods and hardwoods.

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

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



Softwoods – are usually cone-bearing, evergreen trees with needle-like leaves.

The timber is generally lighter, softer and weaker than hardwoods.

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

For example, an acorn is the seed from an oak tree.

The timber is generally harder, denser and stronger than softwoods.

The timber is often more difficult to season and treat with preservatives.

Trees are further classified as indigenous, exotic or imported.

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

Indigenous timbers (native)

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

There is a thriving furniture industry based around recycled timbers, notably rimu, kauri and matai.

Native softwoods

Rimu

Appearance	Warm golden colour. The heartwood has a beautiful grain pattern that has been described as one of the most attractive timbers in the world.
Working quality	The heartwood is a fine-grained, medium- density timber. The sap wood is softer and susceptible to insect attack.
Strength	The bending strength, stiffness and resistance to creep (i.e. gradual increase in deflection) when the timber is under constant load.
Structural stability	Very stable when dry.
Design	Can be worked with a range of wood working tools in art, furniture etc.
Aesthetics	Used almost exclusively for high-quality furniture manufacture.
Cost	New timber is expensive. Much timber used in furniture manufacture is recycled.
Availability	Available in small quantities from sustainably managed native forests and recycled materials.
Durability	Moderately durable.
Uses	Furniture, benchtops, interior panelling.

Totara

Appearance	Reddish brown and straight-grained.
Working quality	Easily worked, durable and stable, but becomes brittle when dry. Requires special primers when painting.
Strength	Strong and weather and rot resistant.
Structural stability	Stable, endures all weathers.
Uses	The wood is hard and straight-grained and very resistant to rot. Due to its durability, totara is often used for window sashes and sills, feature joinery and carving.
Availability	Available in small quantities from sustainably managed native forests.

Kauri

Appearance	Light brown with a light speckle.
Working quality	It is straight grained, easily worked. Moderately durable and stable.
Uses	Restricted to high quality furniture manufacture, boat building and joinery.
	Swamp kauri is prized as a material for high quality woodturning.
Strength	Very hard. Slow groth rate provides a strong timber.

Native hardwoods

Tawa

Appearance	White to pale brown heartwood.
Uses	Flooring, internal panelling.
Working quality	Straight grained and easy to work. It is used in high quality furniture manufacture, flooring, dowelling manufacture, and for veneers.
Strength	Relatively hard.
Availability	Available in small quantities from sustainably managed native forests.

Exotic timbers

Trees that are native to another country, now grown in New Zealand. Treated exotic timber is now commonly used for construction.

Exotic softwoods

Radiata Pine is the most common commercially grown timber in New Zealand with plantations covering large areas of both the North and South Islands

Appearance	Lightly coloured with an even texture and very little heartwood.
Uses	Used for building and construction, furniture, joinery, for veneers for plywood and in manufactured boards, such as particle board and MDF. Suitable for practically all building components if correctly processed.
Working quality	Excellent gluing, nailing and machining properties.
Strength	Moderate to low.
Availability	Grown extensively in New Zealand and readily available.
Durability	Natural durability is low, but readily accepts all levels of chemical treatment to resist fungal and insect infestation.
Health and safety requirements	Need to use appropriate breathing protection when cutting and sanding particleboard and MDF.

Douglas fir (oregon)

Appearance	A heartwood species, with a rich, red colour, highly textured due to the pronounced early wood/late wood contrast.
Uses	Widely used in the construction industry for light and heavy framing, piling and plywood, such as roof trusses, wall frames, large beams and concrete formwork.
Working quality	Used for structural applications.
Strength	Strong.
Structural stability	Stable structural timber even in subtropical climates.
Durability	Difficult to treat with preservatives so is often unsuitable for many applications. Suitable for internal use providing it is out of ground contact and protected from the weather and damp conditions.

Cyprus is a group of timbers including macrocarpa and Lawson's cyprus

Working quality	The wood is prone to splitting when nailed.
Strength	Medium to low density.
Structural stability	Excellent stability.
Uses	Internal and exterior joinery, built-in furniture, exterior weather boards, framing, decking and boat building.
Durability	Natural durability.

Exotic hardwoods

A number of exotic hardwoods such as eucalyptus, walnut and oak trees are commercially grown in New Zealand but only in limited quantities.

Imported Timbers

Imported timber is grown in another country and brought into New Zealand in a finished state. Imported timbers would include mahoganies, walnut, oak, jarrah and kwila.

The following examples show how these timbers apply to the New Zealand market:

- The boat building industries, in particular the super yacht manufacturers, often import high-quality timbers to meet requirements for particular jobs.
- Increasing amounts of furniture are being constructed in India and Asia and imported into New Zealand.
- Kwila is commonly used for decking and outdoor furniture.
- Flooring timbers and veneers are often imported from Australia and America.
- Packing cases and pallets, used in the importation of goods from overseas, are often constructed out of quality timbers. It is worth noting that only 5% of the world's mahoganies are used for quality furniture.

Ethical considerations:

Some imported timbers originate from endangered tropical rain forests. It is therefore important that careful consideration is given to the use of these timbers.

Measurement and costing

Timber is measured and ordered in the original green, rough sawn size by its:

a) cross section in millimetres; and

b) lineal measurement of length in metres to one decimal place.

***Example**: 4.800m of 75mm x 50mm*

- Each size and grade usually has a quoted price per lineal metre.
- Timber, such as fence posts or rails, has a quoted price per item.
- Timber can be purchased in packet lots or as selected individual pieces.

Timber grades

Grades are used to describe the quality of timber.

Board grades – native	**Board grades – exotic**
Clear	Finishing
Dressing A	Factory
Dressing B	Dressing
	Merchantable

Ordering timber

When ordering timber it is important to indicate all the relevant information necessary to meet the job requirements. This should include:

- nominal size (this may not be the finished size);
- finish (rough sawn or dressed);
- grade;
- species;
- treatment;
- number; and
- lengths of pieces.

When ordering timber, the following abbreviations can be used to meet specific requirements:

Abbreviation	Description	Abbreviation	Description
R/S	Rough sawn	MG	Machine gauged
D4	Dressed 4 sides	DG	Dressing grade
KD	Kiln dried	DRY	Air dried
GREEN	Timber not dry	FJ	Finger jointed
PKT	Packet (approx 450-500m)	T&G	Tongue and groove
SL	Selected lengths	RAD	Radiata pine
BN	Bull nose	RP	Red pine
H1,H3 H4,H5	Treatment level	BT	Boron treated
RAND	Random (a total meterage of timber made up of varying lengths)	EX	"Out of" (e.g. ex 200x40DG=180x35 or ex 100x50MG=94x47)
NZO	New Zealand Oregon		

Below are some typical timber orders in their abbreviated form:

RAD 100 x 50 No.1 R/S GREEN RAND 100m
(Radiata pine, 100 x 50mm, number 1 grade, rough sawn, not dry, random lengths to 100m)

RAD ex 200 x 40 DG H1 D4 DRY SL 3/3.600
(Radiata pine, out of 200 x 40mm, dressing grade, treatment H1, dressed 4 sides, air dried, selected lengths 3/3.600)

RP ex 100 x 25 BN skirting RAND 38m
(Red pine, out of 100 x 25mm, bull nose, skirting, random lengths to 38m)

NZO 94 x 47 No.1 MG GREEN SL 21/2.400
(New Zealand Oregon 94 x 47mm, number 1 grade, machine gauge, not dry, selected lengths 21/2.400)

Manufactured Boards

Plywood is made from thin sheets of wood veneer glued together under heat and pressure. The veneers are cross-banded with the grain direction of each alternative layer at right angles to the previous layer. This creates a very strong and stable wood-based material that provides equal strength in all directions. Plywood is also resistant to cracking, shrinkage, twisting and warping.

Plywood comes in a range of types and thicknesses. Common types of plywood are interior plywood, construction, exterior and marine plywood.

Particle board is a low density fibre board manufactured from wood particles, such as wood chips, shavings or sawdust, held together by a synthetic resin. Particle Board is made up of larger pieces of wood than medium density fibreboard and hardboard. It is used for flooring, cabinet carcases, vanities and cupboards, wall and ceiling linings.

Comparison of particle board with natural timber:

Advantages	Disadvantages
• Cheaper, denser and more uniform than solid wood. • Used when appearance and strength are less important than cost. • Lightest type of manufactured fibre boards.	• Will swell and distort if wet. • Will crumble and fall apart if waterlogged. • Dressing edges is difficult. Edges need to be covered or protected if exposed.

Medium density fibre board (MDF) is a board manufactured in a process similar to all types of fibreboard. The wood component of MDF is broken down into its fibres and the fibres are mixed with wax and resin before being formed into sheets under high temperature and pressure.

MDF is heavier than particle board and used extensively on interior applications, such as cabinet carcass construction, furniture, wall linings, etc.

Comparison of MDF with natural timber:

Advantages	Disadvantages
• Less expensive. • Generally easier to work. • Is consistent in its strength, and is consistent in its size (width, length).	• Heavier. • Must be painted; transparent finishes are not useful. • When wet, it swells and breaks. • Over time, will warp or expand if not sealed. • Contains a substance called urea formaldehyde, which may cause irritation to the eyes and lungs when the board is cut or sanded.

Hardboard is a high-density fibre board similar to MDF but much harder and denser. It can be used as a base for Formica and vinyl, and in a wide range of applications where a thin, hard-wearing surface is required, such as in construction, furniture, appliances and automobiles. It is also used as the final layer in many skateboard ramps and half-pipes.

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

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

Cutting fibre cement sheets

Fibre cement sheets as an external cladding

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

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

Metals

Mild steel

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

Stainless steel

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

Copper

A reddish coloured metal with excellent heat and electrical conductivity.

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

Brass

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

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

Aluminum

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

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

Plastics

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

Thermoplastics

Polythene

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

Available in:

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

Commonly used as a waterproofing membrane under concrete.

Polystyrene

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

Nylon

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

Available in:

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

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

Thermosetting plastics

Formica

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

Commonly used for hardwearing surfaces such as benchtops.

Epoxy resins

The applications for epoxy-based materials are extensive and include:

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

Surf board fin repaired with epoxy resin

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

Other Materials

Glass

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

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

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

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

Fibre glass

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

Concrete

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

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

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

Reinforcing steel

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

Steel has very high compressive and tensile strength.

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

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

Activity 1

1. What is the most common exotic timber that is grown in plantations in New Zealand?

2. Name 2 types of New Zealand native timbers that can used for high-quality furniture?

3. Name an imported timber that can be used for decking and outdoor furniture.

4. List 3 types of timber that are commonly used for woodturning.

5. Name a lightweight expanded plastic that is used for insulation in houses as well as for buoyancy in boats.

6. Name a commonly used metal that can be easily joined by welding.

7. List 2 materials that could be used for the walls of a dog kennel.

8. List a hard, transparent material that can be manufactured to be noise-resistant, flat or curved form; polished or textured surface and even bulletproof.

9. Name the plastic sheet material that is commonly used as a waterproof membrane under concrete.

10. What are the 3 main materials that make up concrete?

Joining Materials

Fastenings

Nails

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

Types of Nails:

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

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

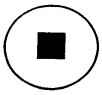
Screws

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

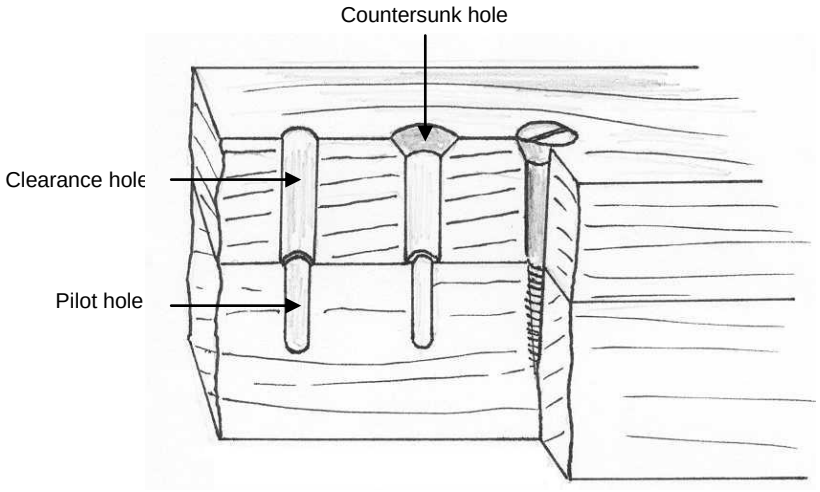
The screw head is specially shaped to allow a screwdriver, or bit, to grip the screw when it is being driven in. It also stops the screw from passing right through the material and provides compression.

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

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

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

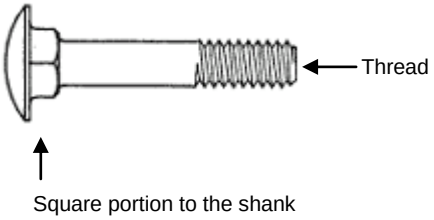
The diagram below shows the preparation of material for the use of a common wood screw.



Bolts

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

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



Rivets

Rivets are used to fasten sheet metals or similar materials producing a very strong and permanent 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.

Pop rivet

Pop rivet gun

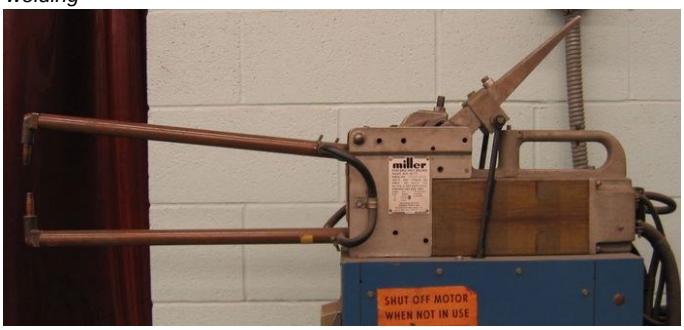
Welding

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

There is a range of welding equipment and methods available – **resistant welding** (spot welding), **gas welding** (Oxy-acetylene) and **arc welding** (manual arc, MIG and TIG).

Manual arc welding

Oxy-acetylene gas welding



Resistant (spot) welder

Brazing and soldering

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

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

Durability:

Durability is a requirement of the Building Code that fastenings must meet a minimum standard when subjected to varying environmental conditions. When timber is wet or damp, and especially if the timber has been treated to H3 and above, a serious corrosion problem can occur.

For most outdoor situations, galvanising is a suitable means of protection.

Where treated timber and galvanised fastenings are used together in outdoor situations such as a pergola, deck or garden furniture and are subject to wet conditions, a second level of protection such as an application of paint or a coating system for the fastenings is recommended, to reduce or eliminate corrosion.

Sea spray zone: *The sea spray zone is defined as being the coastal area within 500m of the sea or 100m tidal estuaries and sheltered inlets. Other corrosion zones in New Zealand reflect the severity of exposure to wind-driven sea salt and also include areas subject to the corrosive effects of geothermal gases. In these areas, stainless steel fastenings are recommended.*

Adhesives

Adhesives can be used to provide a quick and efficient jointing method between a wide range of materials. It is important that you identify and select the correct type of adhesive for the job. There is a wide range of different products available and each has been designed for a specific task.

The most common adhesives used include:

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

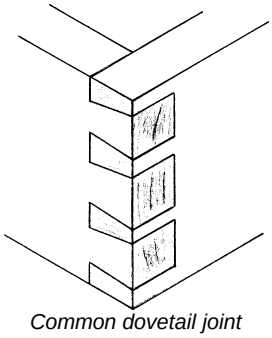
  Ados F2 can be used to join a wide range of materials to either timber or steel. These materials include Formica, plastic laminates, wood veneers and rubber.
- **Araldite®** is the brand name for a range of high-performance epoxy adhesives. Araldite is a two-pack adhesive that is made up by mixing equal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

Note: *Take care to not get hot glue on the skin because the melting process makes it hot enough to cause a significant burn.*

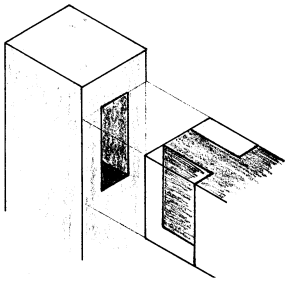
Wood joints

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

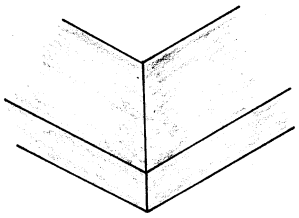
There are many different types of wood joints, including:



Common dovetail joint



Mortise and tenon Joint



Mitre joint

Surface Finishes

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

Paint

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

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

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

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

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

Varnish

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

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

Oil

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

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

Clean brushes in mineral turpentine.

Polish

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

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

Activity 2

1. Identify 3 methods of joining 2 pieces of flat, mild steel bar together.

2. You have to glue a sheet of Formica to a sheet of MDF. What type of glue should you use?

3. What is the function of a primer coat when painting?

4. Identify 3 methods that are commonly used to apply a paint finish.

5. What should metal objects (such as nails that are being used outdoors) be coated with to protect them from rust?

6. Pop rivets are commonly used to hold _____ together.

7. A two-pack glue that is commonly used to join metals together is _____.

8. Name 2 types of polishes and state the advantage that polish has over oil finishes.

Polish 1:

Polish 2

Advantage compared to oil:

9. Name 2 types of varnishes, briefly stating an advantage of each one.

Varnish 1:

Advantage:

Varnish 2:

Advantage:

10. What is the fast-drying glue that is commonly used for making mock-ups?

11. Describe what would happen if PVA glue was used to construct a wooden letterbox.

12. Why should flat headed nails be used on softer timber such as radiata pine?

13. Identify 3 types of wood joints that could be used to provide a decorative finish to a project.

14. Describe the effects of moisture on MDF.