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

Demonstrate knowledge of timber and other construction materials used in BCATS projects

Unit Standard – 24360

Level 2, Credit 5

Name: _____

Contents

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What you need to do

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

- types of timber, the parts and structure of a tree and the strength and working qualities of sawn timber boards;
- common structural defects in timber, forms of insect and fungal attack and environmental causes of timber deterioration;
- the conversion, treatment, handling and storage of timber; and
- structural properties, safe working and handling procedures, and basic storage and care of three other construction materials; for example, metals, glass, concrete, composite materials, plastics or manufactured boards.

How you will be assessed

For assessment, your teacher/tutor will give you a worksheet that you need to complete, which your teacher/tutor will mark.

Glossary of Terms

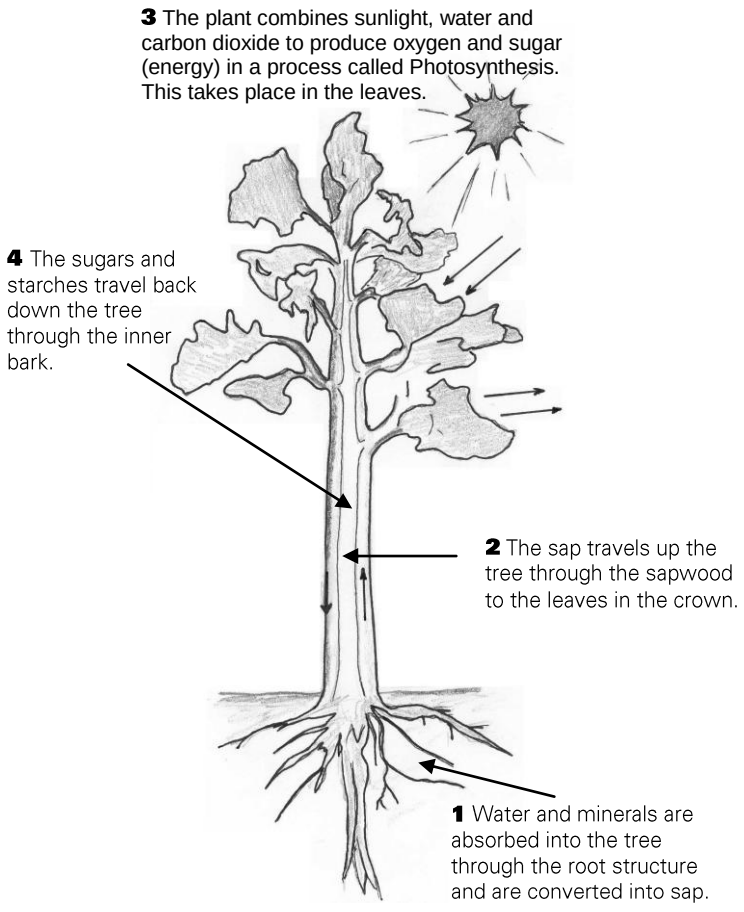
Term	Meaning
Air seasoned	Dried under natural atmospheric conditions by stacking in the open air
Blemish	Anything that adversely affects the appearance of timber
Borer	The larvae of a wood boring insect which tunnels into wood
Checking	As it pertains to knots
Clear	Timber which is almost free of visible defects
Dressed	Timber planed to a smooth finish
Durability	The ability of timber to resist deterioration
Equilibrium moisture content	The state of timber when its moisture content equals that of its surrounding environment
Fillets	Small pieces of timber used as vertical separators in stacking timber
Formwork	Temporary support structure for retaining concrete
Grade	An established quality classification of timber
Green timber	Freshly sawn timber
Kiln dried	Timber seasoned in a kiln
Medullary rays	Sheet of vascular tissue separating the vascular bundles.– parenchyma cells in plant root and stems that originate from the centre and travel outwards
Photosynthesis.	The process a plant uses to combine sunlight, water and carbon dioxide to produce oxygen and sugar (energy)

Timber – Growth and Structure

Growth

The following process provides the nourishment needed to feed the tree and to support growth. This process, which is called photosynthesis, takes place in the leaves and involves:

- light – usually from the sun;
- chlorophyll – the green pigment in a leaf, which acts as a catalyst for the reaction that converts:
    - carbon dioxide, which the plant absorbs through its leaves; and
    - water into the plant's sap, which contains nutrients converted 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. Each part performs a function to protect or support the growth of the tree.

Bark: protects the tree from external injury.

Inner bark or phloem: conveys food down the tree.

Cambium layer: special cells that form new wood and bark.

Sapwood: new wood that conveys sap from roots to leaves.

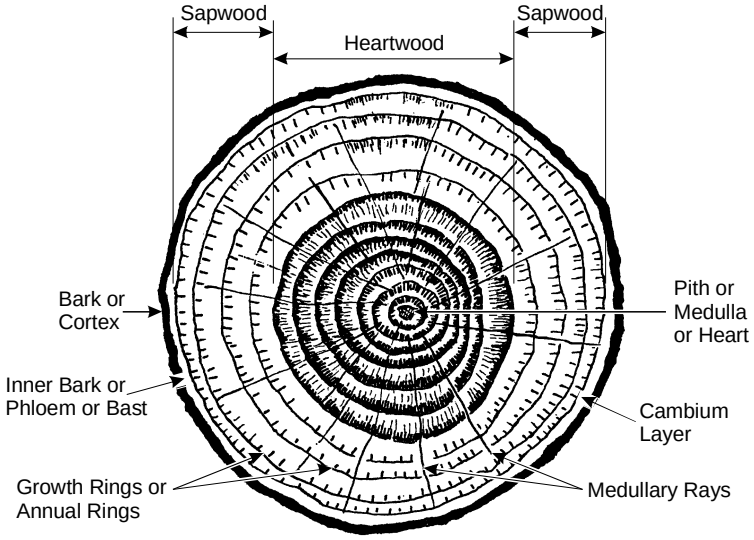
Heartwood: mature, inactive wood that strengthens and supports the tree**.**

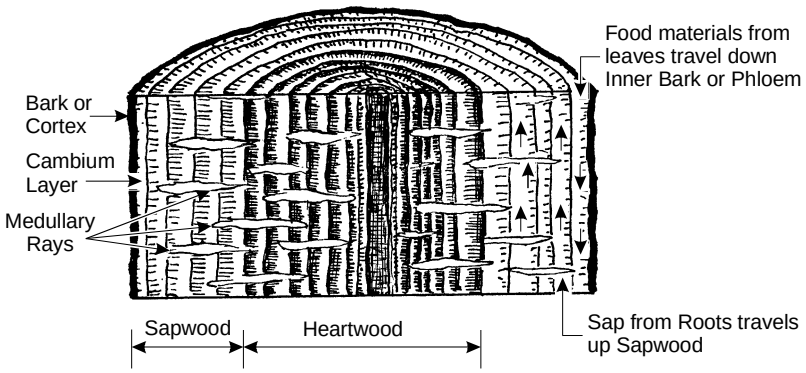
Growth rings: rings formed by seasonal growth of the tree. They indicate age.

Medullary rays: these are visible in a cross-section of a tree, and radiate out from the pith to the bark. The tree uses them to store starch and convey food towards the centre of tree.

Pith: the decaying remains of the original sapling.

Knot: a portion of a branch of a tree that forms a mass of woody fibre running at an angle with the grain of the main stock, which makes a hard place in the timber.





Timber Production Methods

Man made plantation forests cover a large part of New Zealand. Radiata pine is the most commonly grown species. The trees are planted at evenly spaced intervals and pruned to encourage straight timber with few defects. Trees are usually harvested by clear felling when they are 18 to 25 years old.

Radiata pine is different in its structure from most timbers because the best and cleanest timber comes out of the sapwood. This occurs through the combination of the tree's very rapid growth and the practice of trimming the branches, which produces low density, knotty heartwood.

Selective logging is used to mill native trees and rarer timbers. It is often carried out in the bush with portable mills cutting the timber on site. Alternatively, some logs are recovered by helicopter and transported to the mill. This method makes the timber very expensive because the costs must be recovered from the consumer.

Milling

The milling, or conversion, of timber is the sawing of the logs into workable sizes.

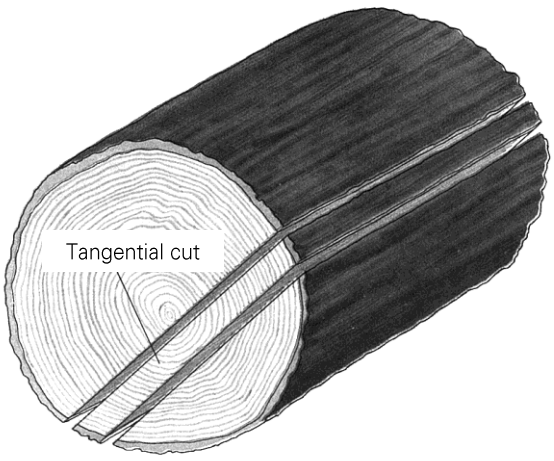
In the conversion process, both flat and quarter sawn boards are produced. The difference between each type is dependent upon the direction of the growth rings in relation to the wide surface of the timber.

Flat or tangential sawn

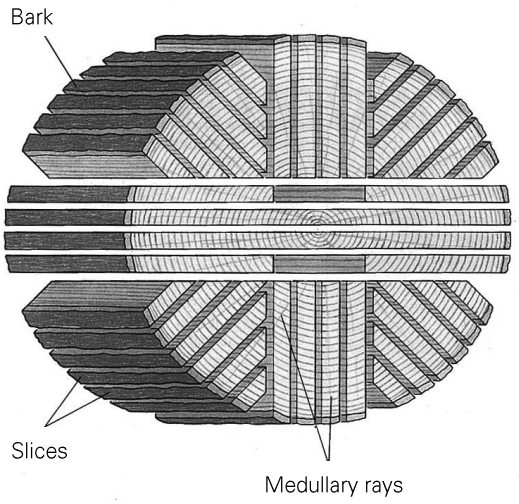
- The surface of the board has an attractive grain pattern.
- This type of cut is strong and suitable for beams etc. (note diagram below)
- More likely to shrink and cup away from the heart.
- The growth rings are tangential to the surface of the board.

Quarter sawn or radial cut

- A straight-grained effect is obtained on the surface of the board.
- A better wearing surface is obtained, which is more stable. (note diagram below)
- The growth rings pass through the thickness of the board.
- Medullary rays are almost parallel to the face of the timber and produce an attractive effect on some timbers.



Flat or tangential cut



Quarter saw or radial cut

Rough sawn timber

Rough sawn timber has a rough surface. It is abbreviated to RS.

Dressed timber

Dressed timber is machined so it is smooth. It is usually dressed on four sides (abbreviated to D4S). The finished size of dressed timber is smaller, e.g. 100 x 100 RS timber is about 90 x 90 D4S timber.

Activity 1

1. Explain why sapwood is wetter and softer than the heartwood.

2. Explain why the heartwood of the tree is harder and more durable than the sapwood in most timbers.

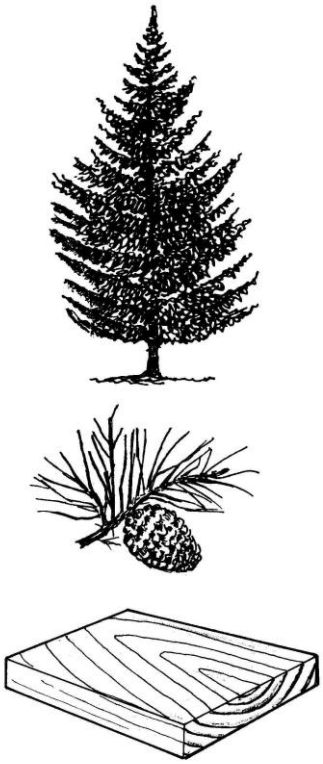
3. Find a quarter sawn board and a flat sawn board in your workshop.

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)

Indigenous trees are those 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 is the most widely grown of all New Zealand native trees. It was extensively used for construction until recent logging restrictions reduced its availability. The heartwood has a beautiful grain pattern that has been described as one of the most attractive timbers in the world. The heartwood is a fine-grained, moderately durable, medium density timber. The sapwood is softer and susceptible to insect attack. Rimu is now used almost exclusively for high quality furniture manufacture.

Totara is reddish brown and straight grained. It is easily worked, durable and stable, but becomes brittle when dry. The timber is used in boat building, joinery and carving.

Kauri is light brown with a light speckle. It is straight grained, easily worked, moderately durable and very stable. It was used extensively by early settlers, but is now restricted to high quality furniture manufacture, boat building and joinery.

Native hardwoods

Tawa has a white to pale brown heartwood. It is relatively hard, straight grained, and easy to work. It is used in high quality furniture manufacturing, flooring, dowelling manufacture, and for veneers.

Exotic timbers (introduced)

Exotic timbers are from 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 a fast growing tree from North America. It is the most common commercially grown timber in New Zealand, with plantations covering large areas of both the North and South Islands.

The timber is lightly coloured with an even texture and very little heartwood.

Its natural durability is low, but is easily treated to resist fungal and insect infestation.

It is moderately strong and has excellent gluing, nailing and machining properties.

It is used for building and construction, furniture, joinery, for veneers for plywood and in manufactured boards, such as particle board and MDF.

Douglas fir (Oregon) is moderately strong and used for structural applications.

It is difficult to treat with preservatives and is unsuitable for many applications.

Cyprus is a group of timbers including macrocapa and Lawson's cyprus. They have an attractive grain, medium to low density, natural durability and excellent stability.

The wood is highly suitable for joinery, furniture making and boat building.

The wood is prone to splitting when nailed.

Exotic hardwoods
Eucalyptus, Walnut and Oak trees are grown in New Zealand in limited quantities.

Imported Timbers

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

Measurement and Costing

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

a) cross section in millimeters; and
b) lineal measurement of length in metres to one decimal place.

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

- Each size and grade usually has a quoted price per lineal metre.
- Timber, such as fence posts or rails, have 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

It is important when ordering timber 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 or RS	Rough sawn	MG	Machine gauged
D4 or D4S	Dressed four 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 200 x 40DG=180 x 35 or ex 100 x 50MG=94 x 47)
NZO	New Zealand Oregon	TAN	Tanalised

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 four 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)

Activity 2

1. Explain the following terms

Indigenous:

Exotic:

Imported:

2. Name the most commonly grown timber in New Zealand.

3. Name or list the following timbers or their uses.

The timber most commonly used by early Maori for carving.

An imported hardwood that is used for decking and outdoor furniture.

List five uses for Radiata Pine:

i)

ii)

iii)

iv)

v)

4. Identify the following abbreviations:

RS	D4S
Tan	RAD
KD	MG

5. Abbreviate the following as used for a timber order.

a) New Zealand Oregon, 75 x 50, Number 1 grade, dressed four sides, air dried, selected lengths, 2 lengths @ 5.4 metres, 5 lengths @ 4.8 metres.

b) Radiata pine, 150 x 50, rough sawn, treatment level H4, tongue and grooved, random lengths to 45 metres).

Seasoning Timber

- Trees contain large amounts of moisture or sap.
- When the tree has been felled, this moisture begins to leave the timber.
- Seasoning is the process of drying out the timber until the timber's moisture content equals that of its surrounding environment (equilibrium moisture content).

Reasons for seasoning

- Timber with equilibrium moisture content is more stable (will move/shrink less).
- Seasoned timber is lighter to handle and easier to transport.
- Seasoned timber is stronger.
- Seasoned timber is less corrosive to metals.
- Seasoned timber is harder.
- Seasoned timber will take paint and other finishes.
- Seasoned timber allows easier and smoother machining and sanding.
- Timber is free from attack by fungus when moisture content is below 20%.

Methods of seasoning timber

There are two main methods used to season timber:

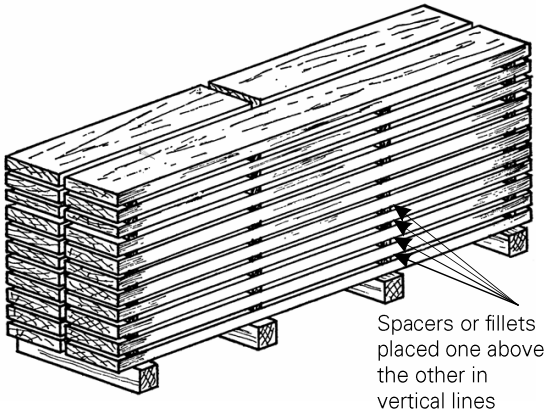
- air seasoning (natural seasoning); and
- kiln seasoning (artificial seasoning).

Air seasoning

The boards are stacked with spaces both horizontally and vertically between them to allow for natural air flow over a period of time to dry the boards out.

Can be indoors or outdoors provided there is an adequate air flow through the stack.

If the stack is outdoors it needs to be covered to protect the timber from the elements.



Lowest boards must be well off the ground.

Seal ends of boards with paint, wax or cleats to prevent them from drying out too rapidly.

Fillets should be of an even size and stacked vertically one above the other to keep the boards straight.

Longest lengths and heaviest boards should be stacked at the bottom.

Kiln seasoning

The boards are stacked in the same manner as air seasoning and placed in a kiln that heats the timber to dry out the moisture.

Conditions needed for kiln seasoning are:

1. heat to evaporate surface moisture;
2. low humidity so the air will absorb the moisture; and
3. air circulation, to remove the evaporated moisture.

Combined seasoning

A combination of the two methods, which involves the timber being air seasoned for some time before being kiln dried. This saves kiln time and money.

Comparison between methods

Air seasoning	Kiln seasoning
Advantages	*Advantages*
Buildings are not needed	Quicker and more controlled
No artificial heat required	Dried to an exact moisture content
Method is cheap	Timber can be supplied all year round
No risk of case hardening	Timber is temporarily sterilised. (Wood boring insects will be killed during the seasoning process but they can re-infest the timber at a later date.)
Disadvantages	*Disadvantages*
Slow and reliant on weather	Expensive
Large area of land is required	Can lead to damage of timber if dried out too quickly
Impossible to dry to an exact moisture content	
Exposure to weather will darken the timber	

Moisture content (MC)

A term used to describe the amount of moisture or sap in timber. It is always expressed as a percentage of the timber's dry weight; for example, 25% moisture content.

Timber absorbs moisture during wet and damp weather and high humidity. This will cause the timber to swell, which may cause doors and drawers to stick. Alternatively, wet timber will dry out and shrink during hot, dry, windy weather.

The amount of moisture in timber can vary considerably. This amount can be determined by one of two methods:

1. Moisture meter method: measures the electrical resistance of the timber, which increases as the timber dries out. Steel pins are forced into the timber and the resistance to the current flow between the pins is measured.
2. Oven dry method: a sample of timber is weighed then dried out thoroughly in an oven. It is then weighed again. The moisture content is found by using the formula

$$MC(\%) = \frac{\text{Initial weight of sample} - \text{Dry weight of sample} \times 100}{\text{Dry weight of sample} \quad 1}$$

Example

Wet weight of sample (W) 650 gm

Dry weight of sample (D) 500 gm

$$MC = \frac{W - D}{D} \times \frac{100\%}{1}$$

$$MC = \frac{650 - 500}{500} \times \frac{100\%}{1}$$

$$MC = \frac{150}{500} \times \frac{100\%}{1}$$

MC = 30%

Equilibrium moisture content (EMC)

EMC is reached when the moisture in the timber is in balance with the moisture in the surrounding air. No further loss or gain of moisture will take place at this stage.

Movement in timber can be minimised if the timber is seasoned to the atmospheric conditions of where it is to be used.

Application of moisture content levels

The acceptable level of moisture content in timber will vary depending on where the timber is to be used.

Fencing and framing timber – where further drying can take place	20 – 25%
Exterior joinery, gates, garden furniture	16 – 17%
Interior joinery and flooring	13 – 14%
Furniture	12 – 14%
Woodwork in a centrally heated building	10 – 12%

Shrinkage

- Shrinkage will occur in timber during seasoning.
- Free moisture that is contained in the cell cavities can be removed quickly without affecting the timber. It will reduce its weight.
- Fibre saturation point is reached when the moisture content is reduced to approximately 25 to 30% (the remaining moisture in the timber is contained in the cell walls).
- Further drying out below this point will cause the cell walls to release moisture and the timber will shrink.

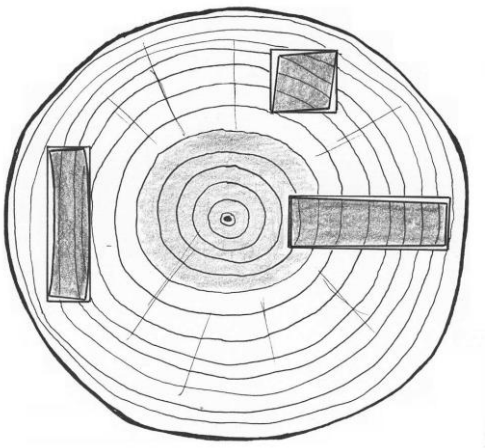
Most of the shrinkage of timber will occur in the sapwood because:

- the sapwood contains the most moisture; and
- it is softer and lighter than the heartwood.

Maximum shrinkage occurs around the curvature of the growth rings,

followed by radial shrinkage. Timber will shrink very little in length.

On a flat sawn board, there are more sapwood cells on the outside of the board causing that area to shrink more than the heartwood area. This results in cupping.



Activity 3

1. Name 3 conditions needed for seasoning timber.

2. Why should the longest lengths of timber be positioned at the bottom of the stack?

3. Why should fillets be placed between the boards when seasoning?

4. Describe the effects on the timber if the fillets are not vertically aligned.

5. Identify 3 advantages of kiln seasoning over air seasoning.

6. Identify 2 methods used to determine the moisture content in timber.

7. Complete the following sentences:

Equilibrium Moisture Content (EMC) is reached when the moisture _____

_____

Most shrinkage of timber will occur in the _____

Shrinkage will start to occur when timber has reached its Fibre _____ _____ which is 25 to _____% MC

8. Describe the consequences of using timber with a moisture content of 25% to construct a cabinet.

_____

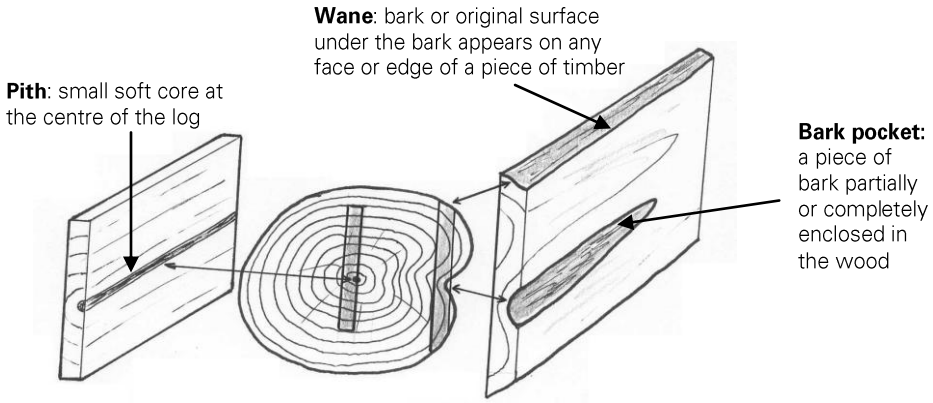
_____

_____

_____

Defects in Timber

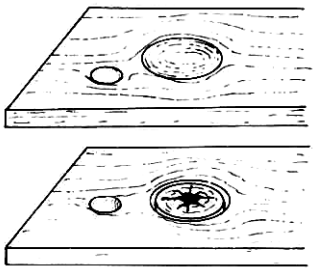
A defect is any irregularity that occurs in or on the timber and has the potential to lower its commercial usability by reducing its strength, usefulness or appearance.



Knots

Knots are formed from a section of a branch that is embedded in the wood of the tree trunk. It is exposed when the log is milled. The timber is weakened around the knot causing:

- reduction of load-bearing capacity;
- distortion of the grain fibres;
- shrinkage around a knot during drying or seasoning; and
- difficulty in dressing and finishing of timber.



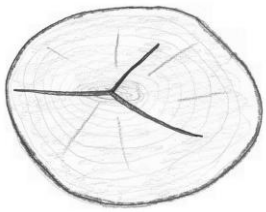
Knots will pose a greater risk when the timber is in tension rather than compression. For example, a knot that is located centrally or in the lower half of a beam or lintel will cause significant structural weakness.

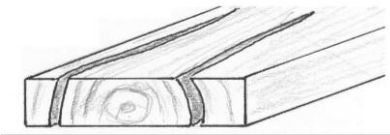
Cross grain

Grain running across the piece of timber from one face to the other or from one edge to the other.

Shake

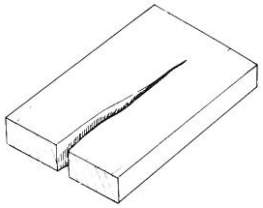
A separation of the wood fibres originating in the standing tree or the felling process. Seasoning does not cause it.





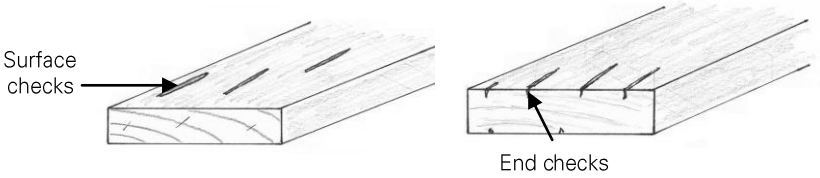
Split

A lengthwise separation of wood fibres extending through a piece of timber from one face to the other. Caused during seasoning.



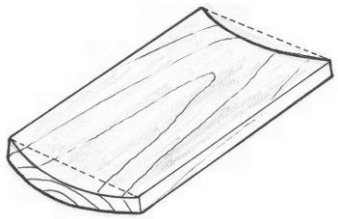
Check

Similar to a split but the separation does not extend right through the timber. Caused during seasoning.



Warp

Any variation from a true flat surface. The four types are:



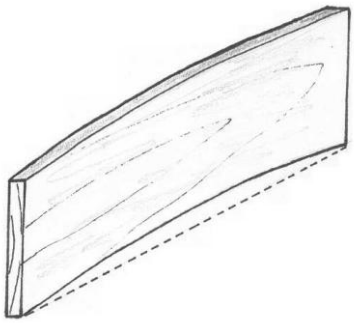
1. Bow: curving flatwise along its length.
2. Crook: curving lengthwise along its length.
3. Cup: curving across its width.
4. Twist: spiral curving along its length.

Decay

The decomposition of wood by fungi.

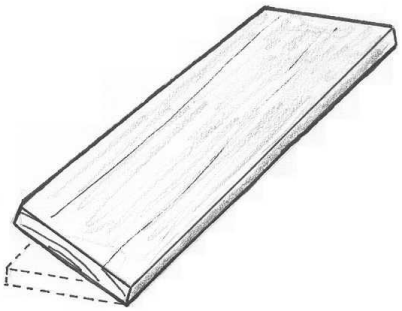
Activity 4

1. Identify and describe each of the following types of warp.



Type: _____

Description: _____
_____
_____



Type: _____

Description: _____
_____
_____

2. Describe the potential consequences of using a beam with a large knot in it.

_____

_____

_____

_____

3. Bark on the edge of a board is called a _____

Timber Handling and Storing

Timber is a relatively soft material and must be handled carefully to prevent damage.

- Timber will absorb a lot of moisture if it is stored directly on a concrete slab.
- Out of level bearers supporting a timber stack will cause the timber to bend or deform.
- Dry timbers may be wrapped in plastic when delivered. Keep the timber sealed until ready for use.

All timber and timber products should be:

- kept clear of the ground or concrete slab;
- stacked on well aligned bearers and carefully placed fillets which line up vertically above the support bearers; and
- covered to protect them from the sun and rain.

There are two main methods used to stack timber:

1. Fillet stacking – as used for air and kiln seasoning.
2. Block stacking – boards of the same width and thickness stacked together, without fillets, and covered.

Advantages of block stacking

- Takes less space.
- Less likely to warp.
- Easier and quicker to store.

Disadvantages of block stacking:

- Further seasoning will be slow.

Well organised timber stacks

Timber block stacked in yard

Insect Attack

There are two main types of timber-destroying insects in New Zealand

1. Borer – there are a number of species.
2. Termites – common in Australia and in some parts of New Zealand.

Comparisons of borers and termites:

Borers	Termites
Borers live as individuals	Termites live in colonies
Damage is usually limited to small tunnels of varying lengths running along the grain	Damage is usually cavities, which can be quite extensive
Flight holes appear on the darker side of the infested timber	There is very little outward sign that the timber is infested

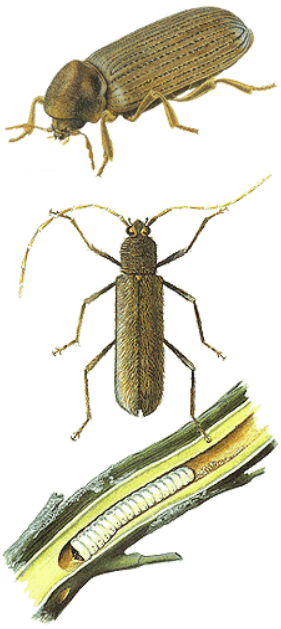
The following are the most common wood boring insects that attack New Zealand timbers.

Common house borer

Anobium Punctatum

This is the common house borer. It attacks old, well seasoned timber, preferring the sapwood of softwood timbers. It is a pest of major economic importance in New Zealand. The beetle is 3 to 5mm long, dark-brown/black in colour.

Anobium Punctatum



The adult house borer lays an average of 30 eggs. The egg, which is 0.55mm long and 0.35mm wide, is laid on the surface of the wood, in a crack, crevices, end-grain timber, split or old flight hole, but never on sealed, painted or varnished surfaces.

After 2 to 3 years of tunnelling inside the wood and feeding on timber, the lava hollows out a pupal cavity just below the surface. The pupa changes into a beetle and chews its own exit hole, a round hole 1 to 2mm in diameter. The adult beetle will frequently gnaw out through paints, wallpapers, varnishes, linoleums, wallboards and plasters. They have even been known to exit through sheet lead and Formica.

The borer flight season is September-April. They emerge to breed and die within 3 to 4 weeks.

Life cycle

- Egg-larvae 14-28 days
- Larvae-pupae 2-3 years
- Pupae-adult 21-60 days
- Adult-beetle 3-4 weeks

Two toothed longhorn.

Ambeodontus Tristis (New Zealand Native)

- 5 to 7 years inside wood.
- Exits March to May.
- Oval holes 2 x 6mm.
- Attacks soft and heartwood.

The two tooth longhorn would be one of the more destructive wood boring insects in New Zealand. This insect prefers the sapwood of softwood timbers but will also attack the heartwood.

Termites

Termites are widespread throughout Australia where they can cause considerable damage in residential and commercial buildings. They can also be found in some parts of New Zealand.

There are a number of different species of termites in New Zealand which can be divided into two categories:

- subterranean (earth-dwelling) termites; and
- wood-dwelling termites.

Subterranean termites (earth-dwelling)

All subterranean termites are native to Australia and have been introduced to this country with the import of hardwood timbers.

They establish their colony under a building. From this colony the workers build tunnels to the source of the wood on which they feed. They will build these tunnels over obstructions and once they gain access to the timber they will remove the interior wood, leaving only a thin exterior veneer or shield.

Wood-dwelling termites

These are a native species of New Zealand which live in the timber. There are two groups:

- dry-wood dwellers – these termites live in seasoned timber.
- damp-wood dwellers – these termites live in damp wood such as dead logs and stumps.

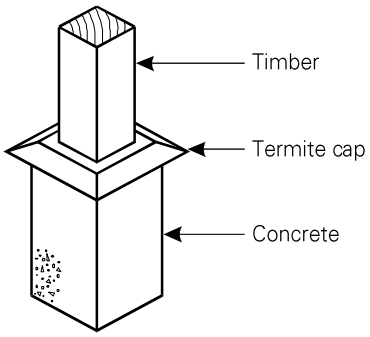
In buildings where attack is localised, if the appropriate measures are taken, they will repay the expenditure of time and money. These measures include:

- removal and replacement of badly infested timber; and
- treatment of infested timber with a reliable preservative.

Note: *It is necessary when ordering timber to specify the preservative treatment for the situation in which it is to be used.*

Termite prevention and control

To prevent the attack on timber by termites, unwanted timber should be removed from beneath and around buildings. The reason being, these dark and damp locations are an ideal breeding ground for insect infestation. (Unwanted timber could include scraps that have been left lying around, stacks "put aside for a rainy day" or old tree stumps.) If any timber is found that seems to be infested, it should be burnt. If a termite colony is discovered, the best thing to do is to get in a professional eradicator.



If building in a known termite area, foundation walls and piles should be fitted with termite caps. Caps will help prevent invasion by earth-dwelling termites. They are, however, ineffective against dry-wood species, which enter the timber above the ground.

Additional points of interest

- humidity plays a very important part in the incidence of timber infestations. Damp, humid areas create ideal conditions for borer attack.
- most districts of New Zealand provide the perfect climate for borer.

Worst affected areas:	Central Upper North Island, particularly Waikato.
Least affected areas:	Central Otago. Hot dry climate will not support any significant borer infestations.

Timber that is infested with wood destroying insects should be removed from the job and replaced with treated timber.

Fungal infection (rot)

There are two basic types of fungi that cause rot:

- Soft rot fungi (wet rot) attacks timber with a moisture content between 35 and 50%. Wet rot commonly affects exposed wood, such as external joinery. The timber will be soft, with a bleached, fibrous appearance.
- Brown rot (dry rot) can attack timber with a moisture content between 20 and 50%. It draws the moisture through fine tubes (Hyphae) back into the timber. Affected timber becomes darker and develops cube-like cracking as it dries.

How can you prevent fungi attack?

- Keep the timber dry.
- Ensure adequate ventilation to reduce moisture content.
- Select and use the appropriate grade of treated timber.

What should you do when you find infected timber?

- Remove and replace with sound, treated timber.
- Treat surrounding timbers with a timber preservative.

Wood Preservation (Timber Treatment)

While the heartwood of most native timbers is naturally durable, the sapwood of both native and exotic softwood is not. These timbers are prone to decay and insect attack and must be chemically treated if they are going to be exposed to damp or wet conditions.

Wood preservation is a process where timber is made poisonous to wood destroying organisms. This will make the timber more durable and increase its commercial usability.

There are various types and grades of treatment available, with each grade being suited to a particular situation. The chart below identifies the different grades and their applications.

Hazard Class	Exposure Conditions	Typical Uses	Biological hazard
H1.1	Protected from the weather, no risk of dampness but borer protection required.	**Non-structural**: interior joinery such as door frames, stairs, architraves, skirtings and cornices, built in or freestanding joinery items (excluding timber window reveals and frames).	Borer
H1.2	Protected from the weather, above ground, risk of moisture exposure conducive to decay.	**Structural:** internal wall and floor (excluding piles) timber framing and trusses, plywood sheet bracing, framing for enclosed decks and balconies.	Borer, fungal decay
H2	Similar to H1 but includes treatment against termites		Borer, termites, fungal decay
H3.1	Exposed to the weather, above ground, periodic wetting.	**Non-structural exterior**: timber cavity battens; fascias, weatherboards, facings, exterior joinery, and other painted trim.	Decay fungi and borer
H3.2	Exposed to the weather, or protected from the weather but with a risk of water entrapment, above ground.	**Exterior including structural:** decking, fencing, pergolas, stairs, rafters exposed to the weather, uncoated or stained radiata pine weatherboards and trim.	Decay fungi and borer
H4	Exposed to the weather, in high decay areas such as contact with the ground or in fresh water.	Fence posts, landscaping timbers, retaining wall horizontal members, garden edging, planter boxes.	Decay fungi and borer
H5	Severe decay areas such as in contact with the ground or in fresh water.	**Critical major structural:** house piles, retaining wall poles	Decay fungi and borer
H6	Exposed to regular immersion in sea water or estuarine ground.	**Marine:** wharf piles, sea walls	Marine wood borer and decay

Methods of timber treatment

Preservative application methods used for on-site remedial work include brush-on and dip diffusion. The most successful commercial method is pressure impregnation and the chemicals commonly used for preservation treatment of timber include:

- **Boron salts** –widely used in New Zealand and to a lesser extent in Australia. They are used where the main hazard is insect attack but experience has shown that at a certain level, defined by hazard class H1.2, they also have valuable anti-fungal action. Freshly sawn unseasoned timber is soaked in solutions of boron salts then the timber is allowed to dry. Prolonged exposure to moisture can cause the salts to leach out of the timber so this treatment should only be used on timber that will remain protected from the weather in use.
- **Copper-chrome-arsenate (CCA)** – the most widely used treatment. The chemicals are forced into the timber under high pressure. Once these chemicals become fixed in the timber they won't leach out as a result of wetting under normal conditions. The length of time taken to fix chemicals in the timber varies from weeks to months, depending on weather conditions. Because the treatment is resistant to leaching, it can be used on timber that will be exposed to the elements or used in ground.
- **Copper-based alternatives** (chrome and arsenic-free, such as copper azole CuAz and Alkaline copper quaternary) – these are alternatives where environmental legislation or customer preference restricts the use of CCA. They are applied to the timber under pressure.
- **Light organic solvent-borne preservative (LOSP)** – a solution of fungicides and/or insecticides in a light organic solvent, such as white spirit, is applied by a vacuum process and, because it is spirit-based, it avoids wetting timber that is already dry. LOSP treated timber is unchanged in appearance and does not swell with the treatment so it is used for external joinery such as windows, and house framing. The solvents must be fully evaporated before paint, stain or glues are applied. The chemical preservatives are not fixed and therefore can be leached out by water so LOSP-treated timber must be protected by a three-coat paint system if used externally.

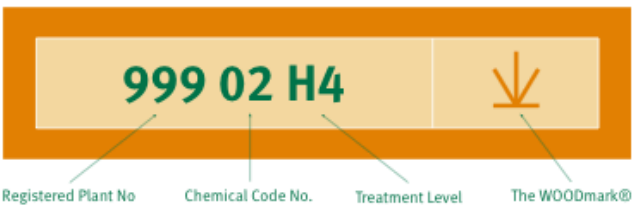
Cut ends

When selecting treated timber it is important to note that:

- if large section timbers are to be cut, chased, bored or machined after treatment from H3 to H6, the area exposed should be protected with a paint-on preservative such as copper napthenate; and
- cut ends of treated softwood posts, stumps and piles must not be embedded in the ground, because site-protected applications cannot give adequate protection.

Marking

Treated timber should be marked clearly with an identification branding mark and colour coding defined in NZS3640. Sample markings are demonstrated on the right.



Safe Handling and Use of Timber

Timber is the most common material used in the New Zealand construction industry. When using any timber product, there are a number of simple precautions that can be taken to prevent injury and long term health problems.

When handling rough sawn timber, wearing gloves and overalls will prevent splinters and the possibility of infection, especially from some of the imported species.

Users of any timber product should always take the appropriate precautions to limit their exposure to wood dust when working with timber.

Treated timber

Timber treatment consists of chemicals that may be harmful. Important measures to take when working with treated timbers are:

- reduce contact with the timber by wearing gloves, long sleeved overalls, goggles and a dust mask;
- wear protective glasses and a filter mask when sawing, sanding or machining;
- don't burn off-cuts or cook with them;
- dispose of waste in an approved landfill;
- wash your hands before using the toilet, smoking, drinking or eating;
- wash work clothes separately;
- never use treated timber for food containers;
- ventilate work spaces as much as you can; and
- working with solvent-damp timber is not advised – solvent damp timber should be allowed to dry properly before use.

If undesirable effects such as skin irritation, headaches or light headedness are experienced when using treated timber, cease handling or using the material and review the type of personal protective equipment (PPE) being used.

Activity 5

1. Identify the following points relating to the Common House Borer

Length of life cycle:

Time of flight season:

Size of exit hole:

Size of adult beetle:

Example of timber attacked:

Control and eradication:

2. What are 3 important practices that should be followed when stacking timber on a building site?

3. Identify the treatment grade that is suited for the following jobs.

Fence posts:

Fence rails:

Decking timber:

Retaining wall:

Interior framing:

4. Why should you never cut post ends that are going to be imbedded in the ground?

5. What should you do when you find timber infected with rot?

Other Construction Materials

The modern construction industry uses an ever expanding range of materials, many of which are manufactured and contain toxic components. Handling and machining of these products without the appropriate personal safety equipment can contribute to long term serious health problems.

Material Safety Data Sheets

The Material Safety Data Sheet (MSDS) is a detailed information bulletin prepared by the manufacturer or importer of a material or chemical that provides comprehensive information on a specific product.

These sheets may include the following information:

- physical and chemical properties;
- health hazards;
- precautions for the safe handling and use;
- emergency and first aid procedures; and
- control measures.

Information contained in an MSDS will help in the selection of safe construction products and assist employers and employees select the appropriate PPE to use when handling or working with the product. It will also help with the preparation of emergency procedures.

The primary focus for students and trainees should be on the protective measures and hazard information.

Concrete

Concrete is one of the most valuable and versatile of construction materials and is used more than any other man-made material. It is used extensively for a wide range of construction work such as foot paths, driveways, roads, dams, residential and commercial construction – floors and walls; foundations and footings for posts, fences and block walls; and even for boat hulls.

Concrete can be purchased ready mixed and delivered to the site in a concrete truck or, for smaller jobs, it can be mixed by hand, usually with a concrete mixer.

Poor concrete is made up of water, cement, course aggregate and sand. Good concrete is made up of exactly the same materials. The difference is that good concrete is made from carefully selected materials and care is taken in proportioning, mixing, placing and curing the concrete.

The ingredients are mixed together in controlled proportions to form a plastic mass.

This combination sets off a chemical reaction which hardens the cement, bonding the other components together and creating a rock-like material.

Cement is the main ingredient of concrete.

- It is used to bond all of the materials together.
- It is supplied in a powdered form, usually in 40kg bags.
- When mixed with sand and water, cement forms mortar, which is used by bricklayers for joining bricks and block work.
- When mixed with the correct quantities of sand, aggregate and water cement forms concrete.

Aggregate is used to form the body of the concrete.

- It consists of stone material, such as rock or crushed gravel.
- The coarser stones provide bulk.
- It must be clean, strong and hard.

Sand is used to fill in the gaps between the coarser stones.

- This adds to the strength of the concrete.
- Like the stones, the sand must be clean.

Water combines with the cement to form a cement paste. The ultimate strength of hardened concrete is determined by the strength of the cement paste. The cement paste strength is governed by its water content. The lower the total mix of water, the greater the ultimate strength potential.

Builder's mix is the term given to pre-mixed sand and aggregate available from building suppliers.

Storage – Cement must be stored off the ground in a dry environment. Sand and aggregate must be covered and stored in containers or on a hard surface.

Ratios: The most commonly used mix by volume is 1:2:4 – one measure of cement, two measures of dry sand and four measures of aggregate. These ratios may vary depending on the task. The ratios are usually written on the bags of cement.

Note: *Too much sand will spread the cement too thinly and a weak mix will result. Too much coarse aggregate will produce concrete that is full of holes.*

Mixing concrete

Hand mixed – either in a wheelbarrow or on a board (on the ground):

- pre-mix the dry ingredients;
- add 10% more cement;
- form a crater and add water gradually; and
- work in water and turn over several times until thoroughly mixed – use a shovel.

Machine mixing – in a concrete mixer:

- add ¾ the volume of water;
- half of the required aggregate;
- all the cement;
- remainder of the aggregate;
- remainder of the water until the mixture falls cleanly from the top of the rotating drum; and
- mix for at least 2 minutes.

Concrete mixer

Placing, finishing concrete

Placing: Place as soon as possible after mixing.

- Deposit carefully to avoid segregation of concrete (large aggregates being separated from fine).
- Work into all corners and around steel.
- Straighten out or level off the concrete by screeding to the formwork.

Finishing: Float the concrete off to obtain a smooth finish. This can be done with a wooden, steel or motorised float. Use long sweeping strokes to gain the best effect.

Curing concrete

Curing concrete is the process which controls the loss of moisture from concrete after it has been placed in position, providing time for the hydration process to occur.

The hydration of cement takes time; days, even weeks, rather than hours. Curing must be undertaken for a specific period of time in order for the concrete to achieve its potential strength.

This period will depend on the properties required for the finished concrete.

Curing is designed to prevent the loss of moisture from the concrete during the period it is gaining strength. There are three methods which can be used. They are:

- leaving the formwork in place and then covering the concrete with a waterproof cover after the formwork has been struck to prevent an excessive loss of moisture for a period of time;
- by continuously wetting the surface, preventing the loss of moisture from the body of the concrete (ponding or spraying the surface are two ”wetting" methods which can be used); and
- by using liquid curing compounds.

Strength: Concrete is strong in compression but weak in tension.

- steel is strong in tension.
- place steel in the lower regions of the concrete to provide added strength.
- steel must be encased in the concrete and well clear of the ground and the face of the concrete, to protect it from exposure to the air which will cause it to rust.

Cement health and safety

Wet cement, especially in plastic concrete, mortar or slurries, can dry the skin and cause caustic burns. Direct contact with the eyes can cause irritation. Cement dust can cause inflammation of the interior tissue of the nose and also the eye cornea.

Where cement dust is likely to be present, the use of an approved disposable respirator (not a dust mask) and tight fitting safety goggles will be required.

The use of barrier creams, impervious and alkali-resistant gloves, boots and protective clothing to protect the skin from prolonged contact with dry cement or cement containing materials is recommended.

After working with concrete or cement, workers should shower with soap and water as cement burns with little heat and no warning.

Storing cement

- Store under cover in a dry place.
- Keep containers closed and airtight when not in use.
- Sweep up any excess and dispose of it at an approved disposal site.

Metal

Mild steel

While steel has been used extensively in commercial construction, residential homes have been traditionally constructed out of timber. Steel framed residential housing is becoming more common, especially following the problems with the leaky houses and the resultant rotten framing timber. Mild steel will rust if it is in contact with water but can be made quite resilient if galvanised.

Galvanised steel can be used in a wide range of outdoor applications that are exposed to all aspects of weather, including, structural framing, hand rails, clothes lines and boat trailers.

Mild steel is available in a wide range of forms including sheet metal, bright and black bar and extruded sections, such as angle, channel and tee.

Mild steel can be jointed by welding, riveting, screwing and bolting members together.

Aluminium

Aluminium is a lightweight, soft metal with a high strength to weight ratio. It is corrosion resistant and is also a good conductor of heat and electricity.

Because of its properties it is extensively used in the boating industry, boat building, joinery and construction and for hardware, such as ladders. It is being constantly developed and modified for use in a wider range of applications.

It is available as sheet, plate, bar and extruded sections, with a wide range of finishes, including powder coating, paint and anodised.

While aluminium is a valuable material it is vulnerable to a chemical reaction, called galvanic reaction, that takes place when it comes in contact with other metals. This reaction will break down or corrode the aluminium.

Aluminium is also more difficult to join than steel. Specialised welding equipment, for example TIG and MIG welding systems, rivets, screws (stainless steel) and bolts are most commonly used.

Stainless steel

Stainless steel is an alloy of steel, zinc and chromium. It is a hard, tough and corrosion resistant material.

It does not stain, corrode or rust as easily as ordinary steel.

It is available as sheet, plate, bar, wire and tubing.

There are various grades of stainless steel available to most applications.

It is widely used where a strong, hardwearing material is required, such as in kitchens and bathrooms, furniture, hardware, industrial equipment and marine assembly.

It is difficult to cut or file and requires specialised welding skills to join it. TIG is the most commonly used welding method.

Copper

Copper is a reddish coloured metal with excellent heat and electrical conductivity properties.

It is corrosion resistant, easy to work and shape.

It can be easily joined using solder or by brazing.

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

Its properties mean that it is 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

Brass is an alloy made up of 65% copper and 35% zinc.

It is corrosion resistant, harder than copper, casts well, is easily joined, and is a good conductor of heat and electricity.

It is used for castings and forgings, such as common tap fittings.

Bronze

Bronze is an alloy made up of 60% copper and 40% tin. Bronze has traditionally been used for casting and sculpturing. Modern bronzes come in a range of variations which can affect the characteristics, whether it is providing a higher resistance to wear, better machinability, less corrosion in water, etc.

Metal health and safety

Handling and working with metals involves a wide range of operations, many of which involve the risk of serious injury.

Accidents happen when metal is handled and worked without the appropriate safety precautions being taken.

When working with metals, cuts from sharp edges and burns from heated metals are always a possibility.

Safe work systems are essential and need to be developed and observed for all metal working operations.

Protective clothing, tools and equipment including overalls, face shield/safety goggles, leather apron and gloves, hearing protection and steel capped boots must be worn. As metals generally have sharp edges it's important to wear strong gloves when handling them.

For some work operations (e.g. welding) more specialised safety equipment will be required.

Storage

It is recommended that sheet metal is stored in racks at an angle of 3 to 5° from the vertical and a protective barrier is in place to prevent the sheets from falling sideways.

Steel rod should be stored in vertical wall mounted racks according to size.

Glass

Glass is a versatile, hard and transparent material. It is very brittle, can easily be broken and requires specialist equipment for drilling holes, polishing or bevelling edges.

Its brittleness means safety glass should always be used in situations where it could be broken and injure people.

Basic sheet glass is commonly used in windows, but other grades of glass are manufactured to meet requirements as safety glass, rolled plate, polished plate, float, laminated, self cleaning, soundproof, insulating, tinted or stained glasses. Glass can also have decoratively textured surfaces or be coloured for lead lighting.

Advances in glass-making technology have provided forms of glass that greatly improve the liveability, economical and environmental-friendliness of your home, e.g. for improving the home's energy efficiency.

Cutting glass

1. You must wear safety glasses and sturdy footwear. Use gloves when handling the cut edges.
2. Clean the surface, but only along where you plan to score. To clean the score area, just run your finger along the surface of the glass.
3. Select a good quality glass cutter and hold it like a pencil.
4. Align the wheel to the glass.
5. Pull the cutter along the surface, applying an even pressure. Listen for the clicking or gritty sound of the small carbide wheel permeating the smooth surface of the glass. The less sound, the better the score. If you push too hard (very common), the cut gets "hot", meaning it snaps and pops. You should be aiming for a score that is uniform in depth and width so that the glass will break exactly as desired. If you are too hard in one spot and perfect in another, microscopic imperfections will cause a jagged cut.
6. Score along a straight edge or ruler. Use something with a profile that is high enough not to interfere with the wheel on the cutter. Practise on scrap glass until you feel confident to produce a score that looks like a barely visible scratch.
7. Grasp each side of the cut, as if you were trying to break a potato chip in half with two hands. It takes minor pressure. Simply twist your wrists (your right wrist will turn clockwise and your left will turn anticlockwise) while keeping your elbows fixed in position. The glass should open up along the glass cutter score.
8. Finishing: Use a fine sandpaper or sharpening stone to remove the sharp edge, where the vertical edge meets the horizontal surfaces. This is where you will get cut. Also, sanded glass is less likely to chip along the edges and has some added strength.

Glass health and safety

Handling and working flat glass involves the risk of serious injury. Serious accidents happen where glass is handled and worked without the appropriate safety precautions. The person most at risk is the one using the material; however, they are also the one most able to take the necessary safety precautions when working with glass.

Ordinary window type glass shatters easily, breaking into sharp-edged pieces.

When working and processing glass, cuts from sharp edges are always a possibility. Safe work systems are essential and need to be developed for all operations. Providing the appropriate training, instruction and supervision are key factors in preventing serious accidents.

Protective clothing and equipment including full overalls, face shield, leather apron and gloves must be provided and worn when glass is being handled.

Storage

It is recommended that sheet glass is stored in racks at an angle of 3 to 5° from the vertical and that mesh fencing or another similar type of barrier is in place to prevent the glass from falling out sideways.

Composite Materials

There are many types of composite materials. Only a few are detailed here.

Glass reinforced plastics

Fibre glass is a material made up of extremely fine fibres of glass. It is strong and has excellent insulation properties.

Fibreglass is used extensively in the manufacturing and construction industries; particularly boat building. It comes in a mat form that, when reinforced with polymer or epoxy resins results in a composite material, properly known as glass-reinforced plastic (GRP), or, more commonly, "fibreglass".

As with many other composite materials (such as reinforced concrete), the two materials act together and overcome the deficits of each other. Where plastic resins are strong in compressive loading and relatively weak in tensile strength; the glass fibres are very strong in tension but have no strength against compression. By combining the two materials, GRP becomes a material that effectively resists both compressive and tensile forces.

Carbon fibre refers to carbon filament thread, or to woven cloth made from those carbon filaments. It is also used informally to mean any composite material made with carbon filament; otherwise known as carbon fibre reinforced plastic.

Carbon fibre reinforced plastic or **(CFRP** or **CRP)** is a very strong, light and expensive composite material. Similar to fibreglass (GRP), the composite material is commonly referred to by the name of its reinforcing fibres (carbon fibre). The resin used is most often epoxy, but other resins, such as polyester and vinyl ester, are sometimes used. Some composites contain both carbon fibre and fibreglass reinforcement.

Carbon fiber reinforced plastic has many applications in aerospace, automotive and boat building fields, where high strength and light weight application is required. Other uses include fishing rods, bicycles and laptop computers.

Health and safety

When working with glass reinforced plastics it is recommended that effective control measures are developed and implemented to ensure that the chemicals or substances are used safely.

Suitable PPE must be available and used, including:

- overalls;
- impervious gloves;
- respiratory protection, preferably a replaceable filter respirator where fibreglass dust is likely to be present;
- safety goggles or full face mask; and/or
- hearing protection to be worn when machining.

Safe handling and storage

- Avoid generating dust and work in a well ventilated, specially designated area. Have emergency equipment readily available.
- Clearly label containers and keep them closed when not in use.
- Store containers in a cool, well ventilated area.
- Ensure that a high level of personal hygiene is maintained when using these materials. Always wash hands before eating, drinking and using the toilet.

Fibre cement sheets

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.

Fibre cement products come in a wide range of profiles with some distinct advantages over traditional construction materials. A 16mm thick fibre cement weatherboard won't crack, warp or split. It has strong shadow lines and is virtually indistinguishable from traditional timber weatherboards.

Health and safety

When working with these products it is recommended that exposure to dust be kept to a minimum. Wherever possible, practices likely to generate dust should be carried out in adequately ventilated areas.

When cutting materials with power tools, use dust resistant safety goggles, a filter respirator, and suitable clothing (such as overalls and industrial safety gloves). Always warn others when dust is to be generated.

Good housekeeping practices are necessary where fibre cement products have been cut resulting in dust. A fine water spray should be used to suppress dust before sweeping. Debris should be placed in plastic bags and disposed of in an approved landfill.

Handling and storage

Carry the sheets on their edge to prevent any of the face surfaces being damaged.

Fibre cement sheets must be stored on site using the following guidelines:

- flat and square to each other;
- supported to avoid sagging;
- placed in a dry area, protected from damp floors and clear of the ground; and
- protected from damage to edges, ends and surfaces.

Plaster board

Plaster board, also known as Gibralter (GIB) board, is a flat sheet made up of a heavy paper liner with a plaster inner core. It is available in sheets and is used for the finish construction of walls and ceilings. Plaster board is used on a wide range of building sites.

A range of plaster boards are available, each with different properties that have been developed to provide protection against a number of construction problems.

Examples are:

- **Wet areas,** such as bathroom, kitchen and laundry. The plaster board contains special wax polymers to reduce water absorption.
- **Noise reduction** for quiet areas**,** such as bedrooms, studies and the TV room. A double layer of plaster board on walls and ceiling helps reduce noise entry. A heavier, denser sound reducing plaster board is also manufactured.
- **Hardwearing areas**, for areas subject to high or rough use such, as stairwells, hallways, rumpus rooms, garage and children's bedrooms. A tougher plaster board containing a high density core.
- **Fire resistant** plaster board for use in high risk areas, such as the kitchen. A high density core designed to withstand fire for up to four hours.

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

Health and safety

When working with these products it is recommended that exposure to dust be kept to a minimum. Wher-ever possible, practices likely to generate dust should be carried out in adequately ventilated areas.

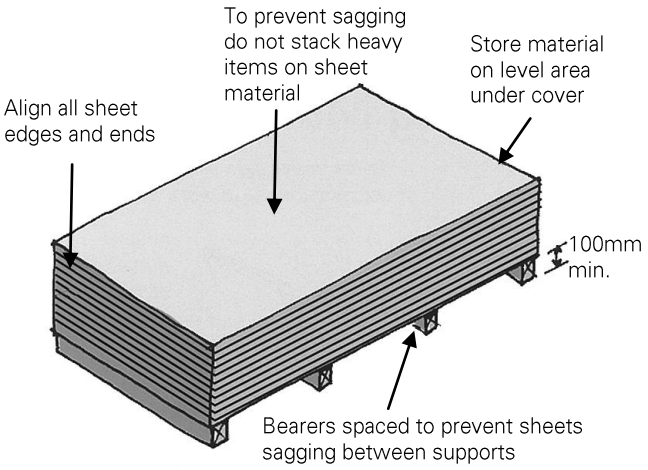
When cutting materials with power tools, use dust resistant safety goggles, a filter respirator and suitable clothing such as overalls and industrial safety gloves. Always warn others when dust is to be generated.

Good housekeeping practices are necessary where plaster board products have been cut resulting in dust. A fine water spray should be used to suppress dust before sweeping. Debris should be placed in plastic bags and disposed of in an approved landfill.

Handling and storage

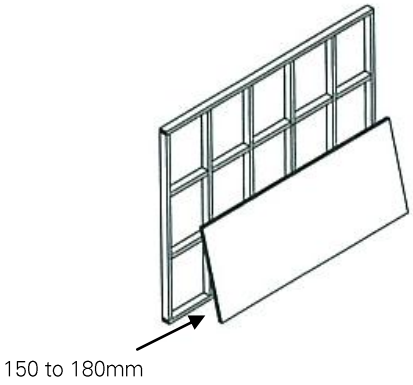
Plaster board sheets should be stored on site using the following guidelines:

- flat and square to each other;
- supported against sagging;
- placed in a dry area, protected from damp floors and clear of the ground;
- protected from damage to edges, ends and surfaces; and
- protected from moisture and direct sunlight penetration.



It's important to consider floor loadings on suspended floors, e.g. stacks of 10mm board should be limited to 30 sheets on suspended floors to minimise the risk of structural damage through point loading.

If floor storage space is unavailable, sheets may be leaned against a wall. A maximum of twenty 10mm or 13mm sheets can be stacked this way, or thirteen 16mm or 19mm sheets. To reduce the risk of toppling, the first sheet must be placed 150 x 180mm from the bottom plate.



Manufactured Boards

Plywood

Plywood is made from thin sheets of wood veneers that are glued together under heat and pressure. The veneers are cross banded with the grain direction of each layer being at right angles to the previous. 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 is produced in a range of grades, from A grade (top grade) to D grade.

Uses:

- **A grade**: high quality face, suitable for a clear finish.
- **B grade**: high quality, suitable for painting.
- **C grade**: non-appearance grade with a solid face – not meant to look attractive.
- **D grade**: low appearance grade with permitted defects.
- **PG grade**: non-structural – for packaging use – unsanded, rough appearance.

The face grade of plywood is always the first designated:

- **A – A** grade has two A (good) faces.
- **A – D** grade has an A face and a D back.
- **B – B** grade has two B (good) faces.
- **C – D** grade has a C face and a D back.
- **D – D** grade has two D (rough) faces.

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

- **Interior plywood**: Suitable for interior use where there is full protection from the weather and high humidity. Commonly used for furniture construction. The glue used is often urea formaldehyde.
- **Construction plywood**: Manufactured in New Zealand from Radiata pine for general usage, such as cladding, flooring, trailers and general building. Available as untreated and treated (tanalised) for long term external exposure.
- **Exterior** (marine bonded): In New Zealand, plywoods in this category are generally of B – C or B – B/C – C grades and are waterproofed the same as marine plywood. There are no restrictions on the type of timber species used and core gaps are allowed.
- **Marine plywood BS 1088**: Some of the main criteria for this grade are that there are no core gaps in the lay up, the face and back veneers must be of a high standard and

the timber used for the plywood is of an approved species, generally a durable one. Marine plywood is sought after for its structural qualities but, contrary to popular belief, it does not necessarily have any natural resistance to rot or decay if exposed to wet or damp conditions. All exposed surfaces and edges must be sealed to prevent moisture uptake and to prolong the life of the plywood.

Particle board

Particle board is a low density fibre board manufactured from wood particles, such as wood chips, shavings, or saw dust, 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 cabinet carcasses, vanities and cupboards, wall and ceiling linings and flooring.

Advantages associated with using particle board:

- Cheaper, denser, and more uniform than solid wood.
- Used when appearance and strength is less important than cost.
- Lightest type of manufactured fibre boards.

Disadvantages associated with using particle board:

- 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 fibreboard

Medium density fibreboard (MDF) is a manufactured board that is formed by breaking wood down into fibres and combining them with wax and resin. The sheets are formed under high temperature and pressure. Similar manufacturing processes are used for making all types of fibreboard. MDF is heavier than particle board.

MDF is used extensively on interior applications, such as cabinet carcass construction, furniture, wall linings, etc.

Comparison of MDF to natural timber

MDF advantages	MDF disadvantages
Less expensive.	Heavier
A wide range of surface finishes can be used including veneers, lacquer, paint and melteca	Must be painted; transparent finishes are not useful
Is consistent in its strength, and size (width, length)	When wet it swells and breaks
Generally easier to work with	Over time, will warp or expand if not sealed.
	Contains a substance called urea formaldehyde, which may cause irritation to the eyes and lungs during cutting and sanding processes

Fixing MDF

A wide range of commercial fastening methods are used:

- **Screwing**: Use twinfast or particle board screws.
- **Gluing**: Most commercial brands of adhesives will provide excellent results. Refer to the manufacturer's specifications.
- **Nailing**: Use either annular grooved or spiral nails. Nails must be at least 25mm in from edge.
- **Stapling**: Pneumatic fastening of MDF is now in common use.

Hardboard

Hardboard is a high density fibre board. It is similar to MDF but is much harder and denser. It can be used as a base for Formica and vinyl. It is used 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 under high temperature and pressure when the board is formed. This gives it more water resistance, hardness, rigidity and tensile strength.

Health and safety

Newly manufactured board and freshly cut surfaces may release small concentrations of formaldehyde gas. These concentrations will increase where the board is stored in confined, poorly ventilated spaces. Formaldehyde has been evaluated as a group 1 carcinogenic to humans.

The potential for the release of formaldehyde gas will be greatly reduced when the boards are sealed with paint, varnish or other decorative surface finishes.

When these boards are cut, drilled or sanded, dust will be given off. This dust may cause irritations of the nose, throat and eyes. Splinters can cause skin infections. Components in these products may result in some people developing allergic dermatitis, resulting in itching and possible skin rash.

All work using these products should be carried out in such a way to minimise the generation of dust, gas and vapours.

In workshops, sawing, drilling, sanding etc. should be carried out with equipment fitted with exhaust extraction systems capable of removing dust, gas and vapours at the source. Portable power tools should only be used in well ventilated areas.

When machining these boards, appropriate PPE should be available and used, including safety non-fogging goggles and a class P1 or P2 full face replaceable filter respirator. Wearing long sleeved overalls and comfortable work gloves will reduce the possibility of skin irritation when handling them.

Storage and handling

These boards should be stored in dry, well ventilated areas and well away from sources of heat, flame or sparks.

Off-cuts must not be burnt in barbeques, stoves or open fires in the home as toxic gases are produced. Dispose of off-cuts and general waste in approved landfill sites.

Dust from the boards should be cleaned up frequently as high concentrations of dust can be explosive.

Activity 6

1. What are the 4 main ingredients needed to produce concrete?

1. _____ 2. _____

3. _____ 4. _____

2. The concrete ratios are 1:2:4. Match the ratios with their correct ingredients

1: _____

2: _____

4: _____

3. How does the inclusion of steel increase the strength of concrete?

4. What type of nails should be used when joining MDF?

5. What type of glue is commonly used on exterior plywood and marine ply?

6. The sheet of plywood you have ordered is an A-D grade. Describe how these grades will determine what the sheet will look like?

7. Describe 2 means of protecting steel from the weather.

8. Describe the consequences of placing aluminium in contact with other metals, such as copper or steel.

9. Using the www.gib.co.nz website as a reference, describe the steps to be taken to fix plaster board sheets to wall framing.

