First Published March 2016

This work is copyright. Any inquiries about the use of this material should be directed to the publisher.

Edition 1 – March 2016

Conditions of Use:

Unit Resource Manual

Australia Competency Training Courses

This Student's Manual has been developed by BlackLine Design for use in the various Australian Competency Training Courses.

Additional resource units can viewed and be ordered at www.acru.com.au

Copyright © BlackLine Design 2016

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher, except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law. For permission requests, write to the publisher, addressed "Attention: Permissions Coordinator," at the address below.

Email: blakline@bigpond.net.au

Statutory copyright restrictions apply to this material in digital and hard copy.

Feedback:

Your feedback is essential for improving the quality of these manuals.

This unit has not been technically edited. Please advise BlackLine Design of any changes, additions, deletions or anything else you believe would improve the quality of this Student Workbook. Don't assume that someone else will do it. Your comments can be made by photocopying the relevant pages and including your comments or suggestions.

Forward your comments to:

BlackLine Design

blakline@bigpond.net.au

Sydney, NSW 2000

Corporate Licenses

State and National TAFE Colleges and Institutes, and Registered Training Organisations are eligible to purchase corporate licenses.

All licenses are perpetual and allow the licensee to upload the material onto a delivery system (Moodle etc), print the resource in book form and sell or distribute the material to enrolled students within their organisation. The license allows the holder to re-badge the material but must retain acknowledgment to BlackLine Design as the original developer and owner.

Aims of the Competency Unit:

The unit of competency specifies the outcomes required to safely select and use carpentry tools and equipment. It includes hand tools, power tools, pneumatic tools, plant and equipment and supports achievement of skills in identification, correct and safe use and maintenance of hand and power tools commonly used in the construction industry.

Unit Hours:

36 Hours

Prerequisites:

CPCCOHS2001A	Apply OHS requirements, policies and procedures in the construction industry

Assessment:

A student can be assessed as Competent based on the Review Questions and Skill Practice Exercises submitted during the course. A student should obtain at least 90% of answers correct in the Review Questions and Skill Practice Exercises to be assessed as Competent.

Elements and Performance Criteria

1.	Plan and prepare.	1.1 Work instructions and operational details are obtained, confirmed and applied from relevant information to undertake planning and preparation.
		1.2 Safety (OHS) requirements are followed in accordance with safety plans and policies.
		1.3 Signage and barricade requirements are identified and implemented.
		1.4 Plant and equipment, is selected to carry out tasks are consistent with job requirements, checked for serviceability, and any faults are rectified or reported prior to commencement.
		1.5 Material quantity requirements are calculated in accordance with plans, specifications and quality requirements.
		1.6 Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use.
		1.7 Environmental requirements are identified for the project in accordance with environmental plans and statutory and regulatory authority obligations, and are applied.
2.	Identify and select hand, power and pneumatic tools.	2.1 Hand, power and pneumatic tools, their functions, operations and limitations are identified and selected.
		2.2 OHS requirements for using hand, power and pneumatic tools are recognised and adhered to.
		2.3 Lubricants, hydraulic fluid and water are checked according to manufacturer recommendations.
3	Use tools.	3.1 Hand tools used are appropriate to the task and materials and are in accordance with OHS requirements.
		3.2 Power and pneumatic tools are safely and effectively used in accordance with manufacturer recommendations and state or territory OHS requirements.
		3.3 Tools are sharpened and maintained according to manufacturer recommendations.
4	Identify, select and use plant and equipment.	4.1 Plant and equipment are selected and used consistent with OHS requirements and the needs of the job.
		4.2 Lubricants, hydraulic fluid and water are checked according to manufacturer recommendations.
		4.3 Plant and equipment are maintained in accordance with manufacturer recommendations and standard work practices.
5	Clean up.	5.1 Work area is cleared and materials disposed of, reused or recycled in accordance with legislation, regulations, codes of practice and job specification.
		5.2 Plant, tools and equipment are cleaned, checked, maintained and stored in accordance with manufacturer recommendations and standard work practices.

Required Skills and Knowledge

Required skills include:

Required skills for this unit are:

- Communication skills to:
    - Determine requirements
    - Enable clear and direct communication, using questioning to identify and confirm requirements, share information, listen and understand
    - Follow instructions
    - Read and interpret:
        - Documentation from a variety of sources
        - Plans, specifications and drawings
    - Report faults
    - Use language and concepts appropriate to cultural differences
    - Use and interpret non-verbal communication, such as hand signals
- Numeracy skills to apply measurements and make calculations
- Organisational skills, including the ability to plan and set out work
- Planning and organising skills to prepare for work tasks
- Teamwork skills to work with others to action tasks and relate to people from a range of cultural and ethnic backgrounds and with varying physical and mental abilities
- Technological skills to:
    - Use a range of mobile technology, such as two-way radio and mobile phones.
    - Voice and hand signals to access and understand site-specific instructions.

Required knowledge includes:

Required knowledge for this unit is:

- Carpentry materials
- Carpentry tool use techniques
- Construction terminology
- Job safety analysis (JSA) and safe work method statements
- Material safety data sheets (MSDS)
- Materials storage and environmentally friendly waste management
- Plans, specifications and drawings
- Processes for the calculation of material requirements
- Quality requirements of carpentry tools and equipment
- Relevant Acts, regulations and codes of practice
- Tools and equipment safety manuals and instructions
- Types, characteristics, uses and limitations of plant, tools and equipment
- Workplace and equipment safety requirements

Lesson Program:

Unit hour unit and is divided into the following program.

Topic	Skill Practice Exercise
Topic 1 – Materials, Basic Tools & Marking Out:	CPCCCA2002-RQ-0101 to CPCCCA2002-SP0103
Topic 2 – OHS & Basic Tools (Hammers & Saws):	CPCCCA2002-RQ-0201 to CPCCCA2002-SP0202
Topic 3 – Environmental Requirements & Shaping:	CPCCCA2002-RQ-0301 to CPCCCA2002-SP-0303
Topic 4 – Construction Site Safety & Clamping:	CPCCCA2002-RQ-0401
Topic 5 –Authorities, Chisels & Setting Out:	CPCCCA2002-RQ-0501 to CPCCCA2002-SP-0502
Topic 6 – Quality Requirements and Hand Planes:	CPCCCA2002-RQ-0601 to CPCCCA2002-SP-0602
Topic 7 – Plant and Equipment and Power Tools:	CPCCCA2002-RQ-0701 to CPCCCA2002-SP-0703
Topic 8 – **Environmental Requirements & Leads**:	CPCCCA2002-RQ-0801
Answers:	

Contents:

Topic 1 – Materials, Basic Tools & Marking Out:

Required Skills:

On completion of the session, the participants will be able to:

- Use a variety of marking out tools to produce workpieces in accordance with sketches, plans and specifications.
- Materials appropriate to the work application are identified, obtained, prepared, safely handled and located ready for use.
- Follow instructions.
- Set out site for development/construction.
- Use of tools for setting out, marking out and levelling.
- Maintain equipment according to manufacturer's recommendations or organisational requirements.

Required Knowledge:

- Safe work procedures related to using carpentry tools and equipment.
- Personal protective clothing and equipment prescribed under legislation, regulations and workplace policies and practices.
- Various materials used in carpentry and woodworking operations.
- Organisational skills, including the ability to plan and set out work.
- Plans, specifications and drawings.

Materials:

A large variety of materials are used in the construction of modern buildings including timber and reconstituted timber products, bricks, concrete components, concrete masonry units, glass, insulation, joinery units, metal sheeting, paints and sealants, plaster or fibre cement sheeting, reinforcement materials, scaffolding components and structural steel sections.

Bricks:

One of the oldest yet simplest of all building materials, bricks is solid, long-lasting and requires very little maintenance. With a history dating as far back as 12,000 BCE, the clay brick has quite an intriguing and exotic background. 4500 years ago the Egyptians, using mud from the River Nile combined with straw, built the Sakkara pyramids; these Pyramids are still standing today. The Romans, seeing the versatility of bricks, copied the idea from the Egyptians. After conquering Britain in the year 45 CE, the Romans began using bricks not only for housing but also for structures like viaducts, vaulted ceilings and colonnades. Following the 1666 fire that ravaged the great city of London, King Charles II ordered all future rebuilding to be of brick or stone. Bricks being able to stand the test of time are evidenced in buildings around the world, and secure their standing as the most popular building material in Australia.

In the early years of the colony, all bricks were hand formed but as equipment became available, the bricks were mechanically pressed. The use of quality clay and the introduction of machinery in the late 1800's has improved the production rate and reduced the cost. The process of brick manufacture remained relatively unchanged until after the Second World War when the extruded wire cut was introduced. Although extruded wire cut bricks are not an improvement in the quality of the brick, the process allows for a more controlled manufacture and wider range of colour and texture.

Terminology:

Arris	The edge or angle formed by two meeting faces of a brick.

Bat	Portion of a brick cut across its width that is greater than ¼.
Bed	The bottom surface of a brick
Bed Joint	The horizontal joint of mortar.
Bevelled	The edges of the face of some bricks are bevelled or sloped, providing a softer decorative effect.
Bond	The arrangement of bricks overlapping one another in a definite pattern.
Cavity	The space left between internal and external leaves of brickwork or wall.
Closer	A brick cut to an odd length to complete a course of bricks
Commons	Bricks that are to be covered up, or used where they are not seen.
Corner or Return End	Section of wall that changes direction.
Course	A row of bricks along the path length and thickness of a wall.
Damp Course	A course, or layer, of impervious material in a wall or floor to prevent the migration of moisture. Also called 'damp-proof course' or DPC. The Building Code of Australia requires the DPC to visibly extend beyond the mortar.
Joint	How the layer of mortar between two bricks is finished.
Mortar	A mixture of lime, cement, sand and water.
Perpend	Vertical mortar joint on the face of a wall.
Pressed Bricks	Solid bricks that are made by pressing clay into individual moulds
Quoin	The vertical external angle of a wall.
Straight Joint	A vertical joint running through two or more courses. Such joints should be avoided as they are weak in bond.
Wirecut Bricks	Also called extruded bricks, these are bricks with holes made by forcing a column of clay through a die, and then cutting with a wire

Types of Bricks:

Three types of commercially manufactured brick are commonly used in the construction of residential dwellings in Australia, clay, calcium-silicate and masonry.

Clay:

Bricks have been made in Australia since the first few months of settlement in 1788. Mixing high quality clay and slate or sand, with water then forming the shape of the brick by pressing or extruding, makes clay bricks. The bricks are then fired in a kiln at approximately 1200°c for 7 days before being cooling.

Dry Pressed Bricks:

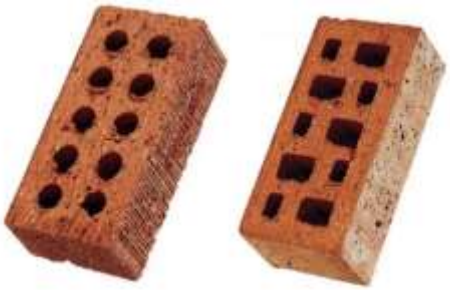
Dry pressed bricks contain clay to shale ratio of 30-70 with the clay containing a water content of 10% to 12%, to form and bond the brick. The clay mixture is placed in moulds and pressed (hand or mechanical) into shape. Pressed bricks can be identified by

the indentation on the top face which is formed by the press and assists in evenly distributing the clay. The indentation is called the *frog*.

Extruded Wire Cut:

Extruded bricks have a mixture of materials similar to dry pressed bricks but due to the greater accuracy of proportioning the maw materials, the bricks have a higher average compressive strength. Extruded bricks have a higher water ratio than dry pressed bricks, 15% to 25%. The clay mixture is processed and extruded or forced through a dye in a continuous length and cut by a wire to create the brick. The bricks are then placed in a kiln and fired. Extruded bricks are distinguishable from dry pressed bricks the holes running through the brick; the number of holes depends on the manufacturer.

Dry Pressed Brick



Extruded Wire Cut Brick

Calcium-Silicate Brick

Calcium-Silicate:

Calcium-Silicate bricks are manufactured by mixing sand, cement and lime with water. The mixture is then pressed into shape and cured under steam pressure in an "*Autoclave*".

Calcium-Silicate bricks have the advantage of being able to be sawn and drilled using normal hand tools while nails and screws can be easily driven into place resulting in structural members or fittings being screwed or nailed in place without the need of special fasteners. The disadvantage is that being porous, the surfaces require sealing before painting to prevent moisture seeping through the wall.

Calcium-Silicate bricks are bonded together using a special adhesive with the faces of each brick touching, there is no gap separating the bricks as in standard clay brickwork.

Masonry Blocks:

Masonry blocks are a made by placing a mixture of cement, aggregate and water into moulds and allowing to cure until set.

Masonry blocks have been generally been overlooked in residential construction due to the lack of available colours and surface texture, most construction was restricted to commercial projects or as a secondary choice of construction material. With the introduction of a variety of colours and surface textures, masonry blocks are now being used more widely in the construction of residential buildings.

Masonry blocks are available in a range of sizes and most are constructed with large one or two square holes through the centre, the wall thickness of the blocks are generally approximately 25 mm. Decorative masonry blocks are available for feature walls and landscaping.

Masonry Blocks

Roof loads over window and door openings are supported using manufactured lintel beams. The lintel beam is made by supporting lintel blocks over the opening, placing reinforcing bars in the hollow then filling the hollow with concrete. When the concrete has set a strong continuous beam has been created.

Modular Sizes:

The size of bricks has been developed to form standard 600 mm modules when the bricks are laid and separated by the mortar joint. The following table shows the number of bricks/blocks required to form a 600 mm x 600 mm module:

Brick Type	Length	Height
Standard Metric	2½	7
Metric Modular	2	6
Metric Modular	2	3

Standard Sizes of Bricks:

Standard Metric Brick: 230 x 110 x 76

Metric Modular Brick: 290 x 90 x 90

Metric Brick: 290 x 90 x 65

Standard Sizes of Masonry Blocks:

Masonry blocks are available in a wide range of sizes and are fully modularised.

Lengths: 90, 190, 290, 390

Heights: 40, 90, 190

Widths: 90, 140, 190, 240, 290, 390

Concrete:

A product composed of fresh cement, sand and gravel or other coarse aggregate. When clean water is mixed in with this product, it activates the cement, which is the element responsible for binding the mix together to form a solid mass.

Portland Cement – is a blend of very finely ground limestone, shale and gypsum.

Coarse Aggregate – or stone provides much of the bulk of concrete.

Fine Aggregate – is sand and acts as a fill material between the larger aggregates.

Water - reacts with the cement, binding the aggregate and sand together to harden and form a solid matrix.

Admixtures – are mainly liquids that are added to the mix to enhance concrete properties

Uses of Concrete:

The primary use of concrete is in the construction industry where the footings, floors, walls, and columns of buildings are constructed from concrete; however, it is also used extensively for paths, swimming pools, retaining walls, roads and curbs, grain silos, bridges and dams. Concrete is used where durability, strength and fire resistance is required.

Types of Concrete:

The most common types of concrete are high strength concrete, high performance concrete, lightweight concrete, self-consolidating concrete, sprayed concrete, water-resistant concrete and micro reinforced concretes.

High Strength Concrete:

High strength concrete is the most basic and important property of concrete is its compressive strength. Concrete with a compressive strength of 40Mpa is called high strength concrete.

High Performance Concrete:

High performance concrete is a new term for some concretes being developed. It is a fairly broad term that describes concretes that outperform "normal", everyday concrete in one or more characteristics such as lifespan, lifespan in corrosive environments, permeability, density, ease of placement, or many other parameters.

Lightweight Concrete:

Lightweight concrete is made by using small, lightweight aggregates, such as small balls of Styrofoam or by adding foaming agents to the mix of concrete. Lightweight concretes have low structural strength, and are used mostly in non-structural elements. The best is example is aerated autoclaved concrete (AAC) blocks used for making walls. Also called cellular concrete or aerated concrete.

Self-Consolidating Concrete:

Self-consolidating concrete is also known as self-compacting concrete (SCC) and is a highly flowable, non-segregating concrete that spreads into place, fills formwork, and encapsulates even the most congested reinforcement, all without any mechanical vibration. It is defined as a concrete mix that can be placed purely by means of its own weight, with little or no vibration. As a high-performance concrete, SCC delivers these attractive benefits while maintaining all of concrete's customary mechanical and durability characteristics. Adjustments to traditional mix designs and the use of superplasticizers creates flowing concrete that meets tough performance requirements. If needed, low dosages of viscosity modifier can eliminate unwanted bleeding and segregation.

Sprayed Concrete:

Sprayed concrete, also called shotcrete, can actually be sprayed onto a surface to form a thick, uneven coating. The process is different from other concreting methods in that the concrete is not poured into a form or mould but sprayed directly onto a surface, and is used in infrastructure projects and to repair old, cracked concrete surfaces.

Water-Resistant Concrete:

Water-resistant concrete normal concretes are permeable to water; that is, they allow water to pass through. Water resistant concretes are engineered to have fine particle cement replacements that do not allow water to pass through; these are very useful for construction below ground, like basements, as well as water retaining structures like water tanks and dams, and of course marine structures like jetties and bridges.

Micro Reinforced Concrete:

Micro reinforced concretes are a new generation of high-tech concretes and contain small steel, fibreglass or plastic fibres that dramatically alter the properties of concrete. Fibres have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks while in the 1900s, asbestos fibres were used in concrete until the dangers were realised and other materials used. In the 1950s, the concept of composite materials came into being and fibre-reinforced concrete was one of the topics of interest

Self-Consolidating Concrete

Sprayed Concrete

Advantages:

- Concrete can be cast or poured in any quantity or shaped mould (formwork) to enhance the appearance of the building.
- It can be coloured by adding pigments or dyes to blend into bush settings or standout and become an individual object from those near.
- The surfaces are easy to maintain and with a wide range of finished surfaces available to add aesthetics to the building.
- It can be strengthened in any direction by the placement of reinforcing materials to carry greater loads.
- Concrete is an excellent heat insulator, sound insulator and is easy and quick to work.

Disadvantages:

- Concrete requires a lengthy period to reach its full strength.
- Concrete lacks attractive natural appearance without adding expensive pigments and dyes.
- It is not strong when subjected to tensile stresses.

Concrete Components:

The use of precast concrete components used in building construction can save valuable time and money. Typical common components are precast beams, precast columns, precast floor slabs, precast walls, precast stairs and steps.

Concrete's high initial embodied energy can be offset by its extended life cycle (up to 100 years) and high potential for reuse and relocation.

Beams:

There are two main categories of beams, internal beams where floor loading is approximately symmetrical and external beams where floor loading is predominantly non-symmetrical.

Precast Beams can be used for a number of applications from parking structures to the structural framework of commercial buildings. Precast beams are perfect for below grade parking situations to help eliminate the need for a parking lot and reducing the size of the lot needed. Create an ideal framework for hanging Precast Structural and Architectural Wall Panels and setting Hollowcore Floor and Roof Plank.

Advantages of Beams:

- Precast prestressed beams provide unlimited flexibility in design, shape and application.
- They are extremely compared to alternative building materials. Beams are produced indoors with high-strength concrete creating a quality, strong and durable product with no need for extra fireproofing.
- Beams work well with other precast components such as wall panels hollowcore and double tees to form a total precast application.
- Precast prestressed beams provide a clean, finished look for the structural component of the building.


Internal Beam


External Beam

Columns:

Like precast beams, precast columns can be used for a number of applications from parking structures to the structural framework of commercial buildings. Precast columns are perfect for below grade parking situations to help eliminate the need for a parking lot and reducing the size of the lot needed. Create an ideal framework for hanging Precast Structural and Architectural Wall Panels and setting Hollowcore Floor and Roof Plank. Precast columns are manufactured in circular and square profiles.

Advantages of Columns:

- Precast prestressed columns provide unlimited flexibility in design, shape and application.
- They are extremely compared to alternative building materials. Columns are produced indoors with high-strength concrete creating a quality, strong and durable product with no need for extra fireproofing.
- Columns work well with other precast components such as wall panels hollowcore and double tees to form a total precast application.
- Precast prestressed columns provide a clean, finished look for the structural component of the building.


Circular Column


Square Column

Floor Slabs:

Hollow core slabs are precast, prestressed concrete elements that are generally used for flooring. Some of the advantages are as follows:

- Long spans, no propping.
- Flexible in design.
- Fast construction.
- Light weight structures.
- Floor voids and penetrations are available.
- Trimmer Beams can also be used.

The slabs have between four and six longitudinal cores running through them, the primary purpose of the cores being to decrease the weight, and material within the floor, yet maintain maximal strength. A core is a hollow section running the length of the slab. To further increase the strength, the slabs are reinforced with 12 mm diameter steel strand, running longitudinally.

The common slab thicknesses are 200, 220, 300, 320 and 400 millimetre slabs, widths of 1200 mm and spans of up to 18 metres depending on the manufacturer. Depending on the project requirements, in particular span and loading performance, a particular slab depth is chosen.

Precast hollow core floor slabs help shorten construction schedules due to their rapid installation, the possible absence of any need for further finishing and the fact that the floors are then immediately ready for use. Their relatively large spans allow the number of support points to be reduced yielding optimal design flexibility. Cores can be used for services and for passive heating and cooling.

Walls:

Precast concrete offers durable, flexible solutions walls and even roofs in every type of domestic construction from individual cottages to multi-storey apartments.

Common production methods include tilt-up (poured on site) and precast (poured off site and transported to site). Each method has advantages and disadvantages and choice is determined by site access, availability of local precasting facilities, required finishes and design demands.

The advantages of precast concrete include:

- speed of construction
- reliable supply — made in purpose-built factories and not weather affected
- high level performance in thermal comfort, durability, acoustic separation, and resistance to fire and flood
- inherent strength and structural capacity able to meet engineering design standards for housing ranging from individual cottages to multi-storey apartments
- highly flexible in form, shape and available finishes
- ability to incorporate services such as electrical and plumbing in precast elements
- high structural efficiency, low wastage rates on site
- minimal waste, as most waste in the factory is recycled
- safer sites from less clutter
- ability to incorporate waste materials such as fly ash
- high thermal mass, providing energy cost saving benefits
- simply designed for deconstruction, reuse or recycling.

The disadvantages of precast concrete include:

- Each panel variation (especially openings, bracing inserts and lifting inserts) calls for complex, specialised engineering design.
- It is often more expensive than alternatives (can be offset by reduced construction times, earlier access by following trades, and simplified finishing and services installation).
- Building services (power, water and gas outlets; conduits and pipes) must be accurately cast in and are difficult to add or alter later. This requires detailed

planning and layout at design stage when plumbing and electrical trades are not usually involved.
- Erection requires specialised equipment and trades.
- High level site access and manoeuvring room for large floats and cranes free of overhead cables and trees is essential.
- Panel connection and layout for lateral bracing requires detailed design.
- Temporary bracing requires floor and wall inserts that have to be repaired later.
- Detailed accurate design and pre-pour placement of building services, roof connections and tie-down are essential.
- Cast-in services are inaccessible and more difficult to upgrade.
- It has high embodied energy.

Precast Panels:

Precast panels are a popular method used in the construction of many hotels, educational institutions, cinemas, shops, warehouses and retail centres. By producing precast concrete in a controlled environment, the precast concrete is afforded the opportunity to properly cure and be closely monitored by plant employees. Utilizing a Precast Concrete system offers many potential advantages over site casting of concrete. The production process for Precast Concrete is performed on ground level, which helps with safety throughout a project and leads to a greater control of the quality of materials and workmanship in a precast plant, rather than on a construction site. Financially, the forms used in a precast plant may be reused hundreds to thousands of times before they have to be replaced, which allow cost of formwork per unit to be lower than for site-cast production.

A modern trend in the construction is the introduction of "Sandwich Panel Wall" which provides a superior energy-efficient solution for exterior walling, whilst also being durable and fire resistant. Precast sandwich panels are typically made of an external concrete layer (non-loadbearing), an insulation layer and an internal concrete layer (loadbearing); these 3 layers are then connected using connectors that are placed during casting. The sandwich panel can be used as the entire wall structure (internal and external) with no need to plaster line internally (due to their high quality) to maximise thermal mass benefits. A range of external finishes is available.

The dimensions of precast panels depend on the design and the lifting capacity on site. Having assessed the maximum panel weight that can be lifted, the panel dimensions can be determined by considering the wall height and lengths required, and any openings to be included; generally speaking, panel widths are limited to 900 mm.

Transporting Wall Panels

Fitted Wall Panels

Tilt-Slab:

Tilt-up construction is a common method of construction throughout Australia. Tilt-slab or tilt-up is a building construction technique using concrete where the concrete elements (walls, columns, structural supports, etc.) are formed horizontally on a concrete slab; this normally requires the building floor as a building form but may be a temporary

concrete casting surface near the building footprint. After the concrete has cured, the elements are "tilted" to the vertical position with a crane and braced into position until the remaining building structural components (roofs, intermediate floors and walls) are secured.

A tilt-up construction project begins with job site preparation and pouring the slab. During this phase of the project, workers install footings around the slab in preparation for the panels. The crew then assembles the panel forms on the slab. Normally, the form is created with wooden pieces that are joined together. The forms act like a mould for the cement panels and provide the panels' exact shape and size, doorways and window openings, and ensure the panels meet the design specifications and fit together properly. The next stage is the workers tie in the steel grid of reinforcing bars into the form; they install inserts and embed for lifting the panels and attaching them to the footing, the roof system, and to each other.

The slab beneath the forms is then cleaned of any debris or standing water, and workers pour concrete into the forms to create the panels.

Once the concrete panels have solidified and the forms have been removed, the crew connects the first panel to a large crane with cables that hook into the inserts. The size of the crane depends on the height and weight of the cement panels, but it is typically two to three times the size of the largest panel. The crew also attaches braces to the tilt-up panel. The crane lifts, or "tilts up," the panel from the slab into a vertical position above the footings. Workers help to guide the concrete panel into position and the crane sets it into place; they connect the braces from the tilt-up panel to the slab, attach the panel's embeds to the footing, and disconnect the cables from the crane. The crew then move to the next panel and repeats this process.

Once all the tilt-up construction panels are erected, the crew apply finishes to the walls with sandblasting or painting, caulk joints, and patch any imperfections in the walls.

Tilt-Slabs on Floor Ready for Pouring

Raising Tilt-Slabs

For additional reading go to the National Code of Practice for Precast, Tilt-Up and Concrete Elements in Building Instruction manual at the following email address:.

https://www.commerce.wa.gov.au/sites/default/files/atoms/files/code_tiltup_precast_.pdf

Stairs:

Stair wells and stair flights (including stair landings, treads and stringers) are able to be manufactured in precast concrete providing an efficient solution to stairways on multi-storey buildings. Often precast concrete manufacturers have stairway moulds that are already available; however special styles can also be produced to allow for designs that are more specialised. Precast concrete stairs are used in commercial offices including high-rise, hotels, retail and bulky goods, industrial warehouses and factories, car parks, multi-unit residential, education, housing, cinemas and theatres.

There are many advantages with the use of precast stairs, over in-situ stairs.

Some of these are as follows:

- Stairs provide immediate access to working levels as construction proceeds.

- Off-site production allows for rapid change in stair profiles.
- Quick erection, therefore earlier project completion and preventing site obstruction, as in-situ stair forms do not need to be set and poured.
- Faster construction time.
- Less weather dependent.
- Simplified and safer construction process
- Fewer trades on site.
- Less exposure to WHS and industrial relations risks.
- Less waste.
- Less materials handling.
- Many surface finishes, shapes and patterns available.
- Quality product
- Off-site manufacture means high quality
- Durable, High strength, factory produced, long life precast concrete offering the ultimate outcome with minimal maintenance.

Stacked Stairs

Stairs being Installed

Steps & Treads:

Concrete steps reduce the construction costs by eliminating the formwork which would be needed for small jobs and can be purchased from all the main chain hardware stores and private hardware shops throughout Australia.

Precast concrete steps and treads are manufactured in Australia to a range of sizes including 760, 914, 990, 1065, 1220, 1525, 1800 & 2100 mm wide with a height (or rise) of 170 mm.

Concrete steps only require a brick retaining/support wall and mortar to fix the steps in position. The height of 170 mm fits 2 brick courses.

Concrete treads are simply drilled and bolted to the supporting timber, metal, or concrete rails.

Concrete Steps

Concrete Treads

Glass:

It is a common belief that glass is a modern material but glass making is a very ancient process, with archaeological evidence of glass making dating back to before 2500 BCE. The raw materials of glass are clear sand, calcium oxide and sodium carbonate. After mixing and melting the ingredients, the molten glass is then floated on molten tin to form glass of desired thickness.

Properties of glass include:

- Transparency: Allowing visual connection with the outside world.
- U value: The measure of how much heat is transferred through the window.
- Strength: Glass is a brittle material but with the advent of science and technology, certain laminates and admixtures can increase its modulus of rupture or the ability to resist deformation under load.
- Greenhouse effect: The greenhouse effect refers to circumstances where the short wavelengths of visible light from the sun pass through glass and are absorbed, but the longer infrared re-radiation from the heated objects are unable to pass through the glass.
- Workability: It is capable of being worked in many ways. It can be blown, drawn or pressed. It is possible to obtain glass with diversified properties; clear, colourless, diffused and stained.
- Recyclable: Glass is 100% recyclable; scraps of broken or waste glass can be gathered for re-melting and used as raw materials in glass manufacture, as aggregates in concrete construction etc.
- Solar heat gain coefficient: It is the fraction of incident solar radiation that actually enters a building through the entire window assembly as heat gain.
- Visible transmittance: Visible transmittance is the fraction of visible light that comes through the glass.
- Energy efficiency and acoustic control: Energy-efficient glazing is the term used to describe the double glazing or triple glazing use in modern windows in homes. Unlike the original single glazing or old double glazing, energy-efficient glazing incorporates coated (low-emissivity) glass to prevent heat escaping through the windows. The air barrier also enhances acoustic control.

Types of Glass:

Float Glass:

Float glass is also called soda lime glass or clear glass and is produced by annealing the molten glass and is clear and flat. Its modulus of rupture is 34.5 to 41.5 kPa. The glass is very strong and is available in standard thickness ranging from 2mm to 20mm and has weight range in 6-26 kg/m². Its disadvantage is that it has too much transparency and can cause glare. Float glass is used in making canopies, shop fronts, glass blocks, railing partitions, etc.

Tinted Glass:

Certain additions to the glass batch mix can add colour to the clear glass without compromising its strength. Iron oxide is added to give glass a green tint; sulphur in different concentrations can make the glass yellow, red or black while copper sulphate can turn it blue.

Toughened Glass

Toughened glass glass is tempered, may have distortions and low visibility but it breaks into small dice-like pieces at modulus of rupture of 25 kPa which is why it is used in making fire resistant doors and formerly car windows. The glass is available in the same weight and thickness range as float glass.

Laminated Glass:

Laminated glass is made by sandwiching glass panels within a protective layer. It is heavier than normal glass and may cause optical distortions as well. It is tough and

protects from UV radiation (99%) and insulates sound by 50%. Used in glass facades, aquariums, bridges, staircases, floor slabs and car windows etc.

Shatterproof glass:

By adding a polyvinyl butyral layer, shatter proof glass is made. This type of glass does not from sharp edged pieces even when broken. Used in skylight, window, flooring, etc

Extra clean glass:

Extra clean glass is hydrophilic i.e. The water moves over them without leaving any marks and photocatalytic i.e. they are covered with nanoparticles that attack and break dirt making it easier to clean and maintain.

Double Glazed Units:

Double glazes units are made by providing air gap between two glass panes in order to reduce the heat loss and gain. Normal glass can cause immense amount of heat gain and up to 30% of loss of heat of air conditioning energy. Green, energy efficient glass can reduce the impact.

Chromatic glass:

Chromatic glass is a type of glass that can control daylight and transparency effectively. The glass is available in three forms, photo-chromatic (light sensitive lamination on glass), thermos-chromatic (heat sensitive lamination on glass) and electro-chromatic (light sensitive glass the transparency of which can be controlled by electricity switch.) Chromatic glass is extremely good installed in meeting rooms and ICUs.

Glass wool:

Glass wool is a thermal insulation that consists of intertwined and flexible glass fibres, which causes it to "package" air, and consequently make good insulating materials. Glass wool can be used as filler or insulators in buildings, also for soundproofing.

Glass blocks:

Hollow glass wall blocks are manufactured as two separate halves and, while the glass is still molten, the two pieces are pressed together and annealed. The resulting glass blocks will have a partial vacuum at the hollow centre. Glass bricks provide visual obscuration while admitting light and used extensively in residential and commercial projects to cut out unsightly views from the windows; a palm gently moving in fornt of the window looks relaxing and beautifies the aspect.

Insulation:

Insulation is material designed to prevent heat or sound from being transmitted from one area to another. Thermal insulation is normally used to retain heat during winter/cold conditions or cooling in summer/hot days. Acoustic insulation is used to reduce sound from entering buildings, or to confine it to certain parts of buildings. Insulation can work in a number of different ways, but it most commonly incorporates materials that consist of millions of tiny pockets of air. Still air is an extremely good insulator, and trapped pockets of air are what give most types of insulation their high thermal resistance.

Forms of Insulation:

Different Types of Insulation include Loose-fill / blown-in, Batts and rolls / blanket, Foam, rigid board and Reflective.

Batts and Rolls Insulation:

Batts and roll insulation is also known as blanket insulation, batts and rolls insulation is ideal for spaces that are free of obstructions and sort of resembles a blanket and is laid out flat and fitted between joists, studs, and beams. Blanket insulation can be used for floors, ceilings, and unfinished walls.

Rigid Board Foam Insulation:

Rigid board foam insulation is typically used by builders to insulate air-conditioning ducts and the back of vinyl wall cladding. Rigid board foam insulation is usually made from polyurethane and is ideal for new construction projects, or extensions.

Reflective Insulation:

Reflective insulation is typically installed in attic ceilings under the roof, reflective insulation works like it sounds. It helps reflect heat from the sun rather than absorb it. Foil-faced paper, plastic film, polyethylene bubbles, or cardboard, is fitted between roof battens of roofs, directly under the sheetmetal cladding.

Loose-Fill/Blown-In Insulation:

Loose-fill or blown-in insulation is one of the most common types of insulation and works exactly how it sounds. It is blown into a wall cavity or designated space using special equipment. Loose-fill insulation is used for:

- Open new wall cavities
- Enclosed existing walls
- Unfinished attic floors and walls
- Areas that are hard to reach

Insulation Materials:

A variety of insulation materials are available for the building industry including fibreglass, cellulose, radiant barrier, foam and wool.

Fiberglass Insulation:

Fiberglass insulation is made out of tiny fibres of glass that trap hot air, it is the fluffy pink insulation commonly seen in hardware stores. Fiberglass insulation can be either blown-in/loose-fill or a blanket system, and great for all different types of areas, from the roof spaces to the exterior walls.

Cellulose Insulation:

Cellulose insulation is one of the most environmentally friendly types of insulation on the market; cellulose is made of up to 80% recycled material, mostly tiny bits of newspaper. Like fiberglass, cellulose insulation works well in all types of areas and is ideal for soundproofing.

Radiant Barrier Insulation:

Radiant barrier insulation is installed in roof spaces and is a common type of reflective insulation and keeps buildings comfortable when it's hot outside, which is much of the year round in Australia! In fact, homes with radiant barrier insulation are about 10 degrees cooler than homes with no roof space insulation.

Foam Insulation:

Rigid board is available as a foam panel that can be cut, and the panels vary in thickness and width. Rigid board insulation is usually installed in new homes and can help maximize energy efficiency.

Wool:

Wool insulation is made from sheep wool fibres that are either mechanically held together or bonded using between 5% and 15% recycled polyester adhesive to form insulating batts and rolls. Batts are commonly used in timber-frame buildings and rolls for roof spaces. Wool insulation is used for thermal and acoustic insulating applications.

Sheep wool is a natural, sustainable, renewable, theoretically recyclable material and totally biodegradable that does not endanger the health of people or the environment. Wool is a highly effective insulating material that has been used for years insulating people in the form of clothing.

Joinery Units:

Joinery units cover a host of furniture and fittings found in offices, residential, commercial, retail and industrial buildings. Items can be manufactured from solid timber, plastic, moisture resistant sheeting, plywood, metal, glass or a composite of some/all materials. The list of joinery units is extensive; television units, sound systems, wardrobes, bedroom suites, wall units, kitchen cupboards, bathroom cupboards, laundry cupboards, tables, chairs etc.

Metal Sheeting:

Metal sheeting is being used extensively in the Australian building industry. The days of using "galvanised iron" for a roof have nearly disappeared; instead, a vast range of profiles and colours are available for use on roofs, walls, architectural features and fences.

Metal sheeting offers many cost-saving benefits, including:

- Better life cycle return-on-investment than other materials: today's metal construction products are protected by highly durable paints and coatings that can ensure a service life of 40 years or more.
- Lower maintenance costs.
- Can be designed to withstand severe acts of nature
- Decreased heating and cooling expenses.
- Saves time on installation.

Metal sheeting is one of the most energy-efficient and sustainable building materials available. Today's metal construction products can contain 25%–95% of recycled materials and are virtually 100% recyclable.

Designers and building owners can achieve virtually any look they desire due to the flexibility of metal and variety of finishes available. Metal is the most versatile building material, considering:

- Metal roof systems offer a wide range of options in applications for substrates, colours, shapes, seams, styles, module widths, profiles and rib patterns.
- Metal wall systems offer a wide range of products, colours, panel sizes, finishes, profiles, textures, and vertical and horizontal installations.
- The harsh Australian environment, metal sheeting can protect a home from bush fires and ember flare-ups better than most other materials, especially timber.

Paints and Sealants:

Paints and sealants protect surfaces.

Paint:

Paint is more than just the colour for decorating buildings; it is a material that is applied as a liquid and dries by a variety of chemical processes to a solid to assist in the protection of materials, whether timber, sheetmetal, or cement sheeting. Paint typically consists of pigment, resin, solvent and additives.

The basic choice of paints is between water-based and oil-based paints. Water-based paints are easy to clean up with fresh clean water, quick drying, provide an elastic, flexible finish resistant to cracking and retain a stable colour over time, without yellowing. Oil-based paints are good "levelling" (brush strokes fill themselves in to create a smooth finish), and provide a hard, durable finish.

Paints are available in a range of finishes and types including:

- Gloss: by tradition, gloss paints have been oil-based and include resin to give them a hard wearing quality. Some are still oil (solvent) based paints whilst water based gloss paints are also available. Liquid gloss needs an undercoat but gives the more traditional high gloss finish and is extremely hard wearing and resistant to dirt.
- Satin: is a durable gloss paint that gives a more subtle sheen than the conventional shiny gloss effect, however, it is not usually as hard wearing.

- Matt: a matt, non-shiny finish that is good for not showing small imperfections on the wall or ceiling. (The shinier finishes reflect back more light and highlight any imperfections). Generally speaking, however, it does not wear as well as the glossier emulsions.
- Satin: gives a subtle soft-sheen finish and is a more durable surface than vinyl matt. It is suitable for areas that might need to be occasionally lightly washed or sponged.
- Silk: gives a high sheen finish and is the most durable of all the emulsion paints. It is good for rooms that are subject to a lot of moisture i.e. condensation. Some manufactures make specific Kitchen & Bathroom paint which is ideal for areas of high humidity.
- Primer: may be oil or water based and is used to seal unpainted surfaces to prevent following coats of paint soaking in. The appropriate type of primer should be used for the surface being painted, timber, metal, plaster or tiles. There are some "all-purpose primers" available which are designed for two or more of these surfaces.
- Undercoat: usually oil-based, undercoat is applied on top of the primer. The undercoat should be of the correct colour to provide the right colour base for the finishing coats.
- Anti-condensation: for use in humid conditions such as in kitchens and bathrooms, this paint ii specially formulated to prevent the surface becoming cold to the touch and therefore less conducive to condensation. It is not a cure for condensation; only a way of reducing its effect on painted surfaces and often includes a fungicide. Normal emulsion paints may be satisfactory in these conditions providing that the level of condensation is not too high.
- Fire-retardant: These special paints contain an additive to provide a fire-resistant quality; they do not resist fire completely, but has a greater flame resistance than ordinary paint and will reduce their spread.
- Bituminous: although often not considered as paint, bitumen is used where a water proof coating is required. Bitumen does not dry in the normal sense used with paint, it can crack if stressed when frozen and will run (or at least become sticky to the touch) in hot weather. Thick and usually black, bitumen is for areas where high water resistance is needed and appearance is not important, such as on the inside of cast iron guttering and metal cold water tank.

Sealants:

Sealant is a substance used to block the passage of fluids through the surface or joints or openings in materials and a type of mechanical seal. Sealants may be weak or strong, flexible or rigid, permanent or temporary. Sealants are not adhesives but some have adhesive qualities and are called adhesive-sealants or structural sealants.

Sealants, despite not having great strength, convey a number of properties:

- They seal top structures to the substrate, and are particularly effective in waterproofing processes by keeping moisture out (or in) the components in which they are used.
- They can provide thermal and acoustical insulation, and may serve as fire barriers.
- They may have electrical properties, as well.
- Sealants can also be used for simple smoothing or filling. They are often called upon to perform several of these functions at once.

A corking sealant has three basic functions: It fills a gap between two or more substrates; it forms a barrier through the physical properties of the sealant itself and by adhesion to the substrate; and, it maintains sealing properties for the expected lifetime, service conditions, and environments. The sealant performs these functions by way of correct formulation to achieve specific application and performance properties. Other than adhesives, however, there are few functional alternatives to the sealing process.

Different materials often require different sealants, so it should come as no surprise that there are several types available. Most vary based on the materials they are best at sealing, which usually includes materials found around a typical household. Some of the most common types of sealants on the market include those for decks, concrete, tile grout, and walls.

A deck sealant typically is best for exterior timber. Its specialty is improving the durability of timber while combating decay over time; it usually is clear so that the natural beauty of the timber can shine through. Deck sealants not only typically protect timber from water damage such as mildew, but they should also guard it from sun damage. A penetrating deck sealant is absorbed into the material, while a film-forming sealant creates a barrier around the timber.

Concrete sealants work similarly to those intended for decks, but they work best on concrete. Though concrete usually lasts a long time, a sealant meant just for this material can lengthen its lifespan even more. One of the main points of a concrete sealant is to protect it from extreme weather, such as the expanding and cracking that melted ice and rain often cause. It can also guard concrete from salt, chemicals, and stains. Such sealants can be clear or coloured, and often are either petroleum-based or water-based.

Nearly every sealant requires users to ensure that the surface is clean and dry before applying the product; also, the majority of sealant manufacturers advise that sealants be applied in an inconspicuous test spot first to avoid accidental staining of the area.

Typical sealants available are polyurethane sealants, driveway sealants, paint sealants, asphalt sealants, sealants, spray sealants and acrylic sealants.

Plaster and Fibre Cement Sheeting:

Plaster and fibre cement sheeting are used for lining internal and external walls.

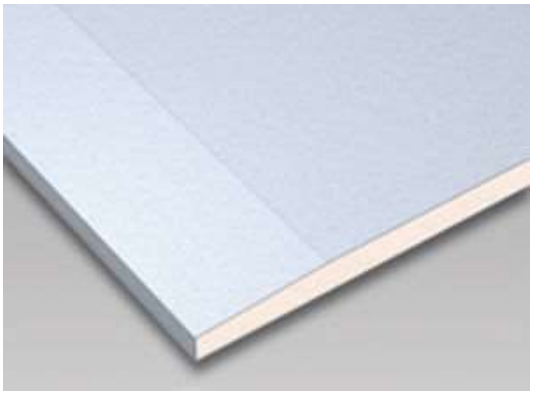
Plasterboard:

Plasterboard is manufactured with paper on both sides and a gypsum plaster centre and gained popularity because of ease of installation, compared to plastering. Plasterboard allows walls to be covered quickly and is used for walls and ceilings of Bedrooms, Lounge and Dining rooms, Halls, Offices, Family Rooms and Garages; dry areas of Kitchens are also lined with plasterboard.

The traditional gypsum board panel size is 10 mm and 13 mm thick; 900 mm, 1200 mm and 1350 mm wide and come in lengths of 900, 2400, 2700, 2740, 3000, 3600, 4200, 4800, 5400 and 6000 mm.

Specialty plasterboard grades include sound proofing, water resistant, impact and fire retardant.

The tapered edges along the length of the plasterboard allow a finishing compound to be placed without creating much of a raised surface between the adjacent boards. Due to these tapered edges, a more true (or straight) wall can be built. Since the ends of plasterboard are not tapered but are square, it's desirable to eliminate end butt joints when possible. When building rooms with dimensions 2.4 m or smaller, plasterboard can be hung horizontally (1.2 m wide boards for a 2.4 m ceiling height and 1350 mm wide boards for a 2.7 m ceiling height) with the appropriate length board to not have any butt joints. Even in larger rooms, hanging the gypsum board horizontally has become more popular, because the butt joints can be staggered, which seems to create less of a visibly noticeable joint.


Gypsum Plasterboard Sheet


Plaster Boarded Walls

Fibre Cement Sheeting:

Compressed fibre cement sheeting is a high density fibre cement sheet which is ideally suited as a structural substrate for interior floors in wet areas of framed constructions; including upper stories and transportable buildings; it is also equally suited for use in the cladding of exterior decks and walls. Fibre cement sheeting is also used for walls of wet areas in Kitchens, Bathrooms and Laundries.

Compressed fibre cement sheeting is manufactured from Portland cement, finely ground silica, cellulose fibres and water. After forming it is compressed to a high density then cured in a high-pressure steam autoclave to create a durable, dimensionally stable product. Compressed fibre cement sheeting is immune to permanent damage from water; it is impact resistant, immune to termite attack, non-combustible and easy to work. The sheets are manufactured to conform to the requirements of AS2908 Cellulose Cement Products, and classified as Type A Category 5 for exterior use.

Sheets of compressed fibre cement for floors are available in thicknesses of 15, 18 and 24 mm; widths of 900 and 1200 mm; and lengths of 1500, 1800, 2100, 2400, 2700 and 3000 mm.

Sheets are manufactured in a variety of profiles and sizes for the construction of fences, external walls and roof cladding.

Up until the mid1970's, compressed fibre cement sheeting was manufactured with asbestos and was called "asbestos cement". Although asbestos is not used today in the manufacture of compressed fibre cement sheeting, many building constructed before 1980 are full of asbestos cement and care must be used when modifying those buildings.


External Deck


Wall Cladding


Roof Cladding

Reconstituted Timber Products:

Reconstituted timber products are produced by reducing woody material to small particles and reconstituting them into large sheets of the desired thickness; these sheet materials are easy to handle and erect, enabling large areas to be covered quickly and economically. The main types of Reconstituted Panel Products available are wet-

processed fibreboards, dry-processed fibreboards (principally MDF), particleboards and synthetic timber.

Wet-Processed Fibreboard:

Wet-processed fibreboard, as produced in Australia, is made from eucalypt fibres. The fibres are suspended in water which gives rise to the name "wet-processed". They are fed onto an endless belt; the water is removed by suction; the ribbon of board is cut into desired lengths and stacked in a hot press to complete the bonding process. Because adhesives are unnecessary, eucalypt-based hardboards have obvious advantages in view of the rapid increase in the cost of bonding agents.

Dry-Processed Fibreboards:

Dry-processed fibreboards are made with a fibre mat containing only about 10 percent moisture. Bonding is achieved by the addition of synthetic resin adhesives which are cured under heat and pressure.

There are a number of different classes of dry-processed fibreboard available, including ultra-low density, low density, medium density and high density classes. AS/NZS 1859.2-2004 provides all relevant properties and specifications for the various classes. The most commonly produced and used class is medium density fibreboard or MDF. Both standard medium density fibreboard (STD MDF) (dry use) and moisture resistant medium density fibreboard (MR MDF) classes of MDF are produced for internal use and are differentiated by the adhesive used during production. Moisture resistant does not mean waterproof.

Wet-processed Fibreboard

Dry-Processed Fibreboard

Particleboard:

Particleboard is a panel product made from relatively large particles instead of fibres and is dependent for its strength and durability on the type and quantity of adhesive used to bond the ingredients together. The Australian Standard AS/NZS 1859.1-2004 describes three types:

- Standard general purpose particleboard (STD), intended for internal use in dry conditions, such as in the construction of furniture (often with a veneer overlay), cupboards and shelving. Urea formaldehyde resin is the usual binder. STD particleboard is sometimes used as a decorative wall facing but it is important that each room be faced with material from the same manufacturer, and preferably the same batch, to ensure uniformity of appearance.
- Moisture resistant general purpose particleboard (MR), intended for internal use in humid conditions where occasional wetting may occur, such as in bathrooms and kitchens. A proportion of particleboard is sold as Low Pressure Melamine (LPM) coated board, often in the form of "whiteboard" where a white overlay colour is used. Again, moisture resistant does not mean waterproof.
- High Performance particleboard (HP) intended for use in:

- Continuously humid conditions such as occurs in tropical climates or where occasional wetting in interior conditions followed by drying may occur.
- Loadbearing applications in dry and humid conditions.

Synthetic Timber:

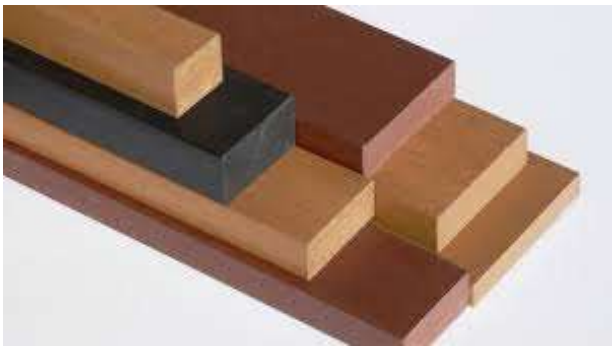
Synthetic timber is a material that is a mixture of wood fibre, plastic, and some type of binding agent; these ingredients are put together to form a material that is denser, stronger, and heavier than timber alone, a timber-plastic composite.

Working with composite timber is similar to working with timber. However, composite timber has the added benefit of being less likely to split or delaminate. Some composite timbers are also engineered to be lighter weight for easier handling. Composite timber is also more stain, scratch, and mould resistant, and is therefore supposed to have a longer life than timber.

Synthetic timber comes from the manufacturer as a finished product; there is no need to stain, sand, or paint the material. Synthetic materials usually cost more than timber, but their long life and low-maintenance requirements could make them more economical in the long run. Many synthetics are often made partially out of recycled plastics and waste timber, which makes them an environmentally friendly, efficient use of resources.

Synthetic timber is usually more costly than normal or treated lumber. Synthetics may last longer, but the initial investment is likely to be higher. Many synthetics are formulated to be fade, scratch, and stain resistant, but no timber is immune to the elements. Although synthetic timber may resist these marring effects better than other materials, it will still show signs of wear over time. Synthetic timber often has a plastic-like or synthetic appearance. Although manufacturers do mould the product with a timber grain or brush stroke pattern, some consumers simply do not like the artificial sheen

Particleboard



Synthetic Timber

Reinforcement Components:

The steel reinforcing used is usually in the form of round bars or mesh made by welding or tying round bars at 90° to each other and evenly spaced to form a grid or mesh.

Square Mesh:

Square mesh is manufactured by welding round bars at 90° to each other and spaced on 200 mm centres.

Rectangular Mesh:

Rectangular mesh is manufactured by welding round bars at 90° to each other. The main bars are spaced at 100 mm centres and secondary bars are spaced at 100 mm distances.

Square Mesh

Rectangular Mesh

Bars:

2 types of bar are used in reinforcing, plain round and deformed bars, and are available in a variety of sizes. Deformed bars have spiral ribs along the side of the bar to assist with grip. Bars are manufactured in 3 stress grades, 250 MPa, 400Mpa and 450Mpa. Deformed bars are located where additional support or protection is required; they are used for edge bars and trimmers around holes and internal corners. Round bars are used to tie a series of main and secondary bars together and supporting any top reinforcing in a slab to the bottom reinforcement in an edge beam.

Fitments:

Fitments are shaped bars used in elements and tie the top and bottom longitudinal reinforcement together to form a cage. Fitments are made from round bar and used where the cage must be assembled on site.

Trench Mesh:

Trench mesh is a ready-made reinforcing cage and consists of top and bottom reinforcement tied together with ties or stirrups. Trench mesh is commercially available in a wide range of sizes and lengths and used in applications where the width of the reinforcing is small compared to the length (e.g. continuous strip footings and edge beams).

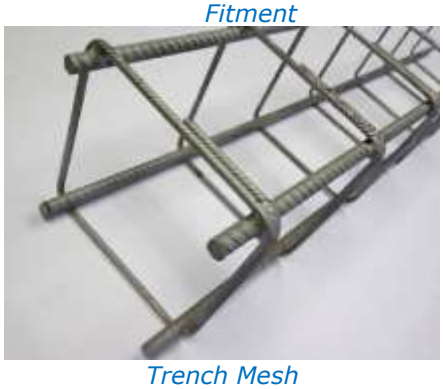
Deformed Bar

Fitment

Fitment

Round Bar

Fitment



Trench Mesh

Reinforcement Chairs:

Reinforcement chairs are available in plastic or steel-wire shapes and are used to support the reinforcing set distances off the bottom of the slab or footing; the height determines the cover to the top of the slab or footing. Plastic chairs normally have a large diameter base for stability but shared legs are also commonly used. The steel-wire spacer's legs

are protected with a film of plastic. Plastic-tipped bar chairs can be used in suspended slabs, beams, vertical walls and slab on ground applications.

- Range of heights from 20 mm to 360 mm
- Ensures consistent placement of reinforcement in slabs
- Requires no adjustment after pouring of concrete

Metal base:

- Metal bases are round metal plates that support wire bar chairs on soft surfaces.
- Prevents the wire spacer sinking into the ground
- Metal base sizes are available to suit bar chairs up to 200 mm in height

Plastic & Metal Reinforcement Chairs

Mesh on Chairs

Scaffolding Components:

When a building is erected, scaffolding is used to provide external structural support for both the building-in-progress and the people working on it. Materials, such as metal piping or tubing, are often used as the back bone of scaffolding, in addition to couplers and boards. Regardless of material, however, scaffolding must adhere to Australian Standards for performance requirements and structural design methods. Because scaffolding must be compatible with a wide array of buildings and structures, there are numerous kinds of scaffolds to meet specific building requirements. However, all scaffolding is comprised of the same basic elements, though the manner in which they are designed and the way such elements fit together can vary.

Basic scaffolding elements include three general components: standards, ledgers and transoms. A standard is a long pipe or tube that connects the mass of the scaffold directly to the ground, and it runs the length of the scaffolding. The base of each standard is connected to a base plate, which helps distribute the weight each standard bears. In between each standard, running horizontally is a ledger, which adds further support and weight distribution. Transoms, placed on top of ledgers at a right angle, come in several different forms. Main transoms provide support for standards by holding them in position as well as supporting boards. Intermediate transoms are placed alongside main transoms to lend additional board support.

In addition to standards, ledgers and transoms, there are several other supportive elements that serve to reinforce the fundamental scaffolding. Braces including cross braces, façade braces, and additional couplers, can be used in varying combinations to support the structure in several ways. Cross braces run diagonally between ledgers and securely attach to standards to increase a structure's overall rigidity. However, they can also secure themselves to ledgers, in which case they are simply called ledger braces. Façade braces help prevent a structure from swaying, and are attached on the face of the scaffold, running the length of the face of the structure and securely attaching at every level.

Couplers help connect structural elements, and come in several variants. To connect a ledger or transom to a standard, a right-angle coupler should be used. If a transom supports a board and must be connected to a ledger, a putlog or single-coupler should be used to connect the ledger to the transom. For any other angle of connection between scaffold piping, a swivel coupler is recommended.

The length, width, and height of each scaffold element can vary with each building, but there are several basic measurements for each basic component. General width of a scaffold is typically determined by the width of the scaffolding boards. The height

between ledgers, also called lift height, is usually between 2 and 2.7 meters. Transom placement depends on board thickness; if the board is 38 mm thick, transoms should be 1.2 meters apart, at the most. A 50 mm thick board requires that transoms be no more than 2.6 meters apart.

In addition to the basic structural elements of a scaffold, there are multiple kinds of ties that secure a scaffold to the adjoining building. As a general rule, ties are attached every 4 meters on alternating lift levels. However, depending on the kind of scaffold, the tie patterns and types of ties used can vary. Through ties can be used to secure a scaffold to a building by entering a building's open window. Box ties help secure a scaffold by attaching to a building's external features, such as strong pillars.

Building Scaffolding

Connector

Scaffolding

Structural Steel Sections:

Steel sections are manufactured by three methods hot rolled, cold rolled and welded.

Hot Rolled Sections:

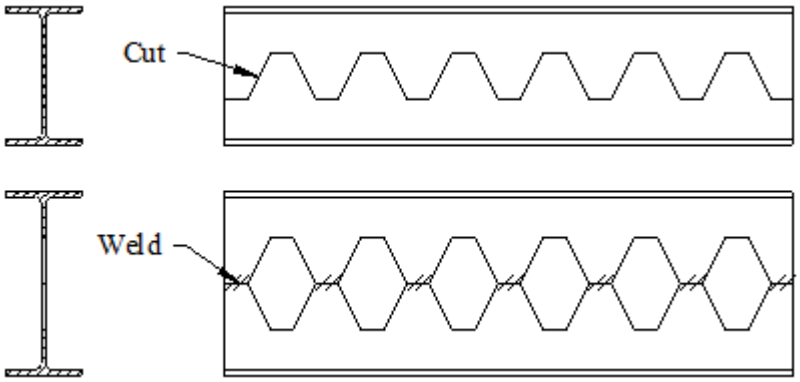
Hot rolled sections are produced by passing a billet or large steel ingot which has been heated to 1200°C, through a series of rolls that changes its shape to the required section. Early rolling methods produced sections with tapered flanges, but parallel flanged sections have largely replaced these. Wear in the rolls leads to variations in the actual dimensions and although they are manufactured to tolerances, the designer, detailer and fabricator must take into account that the sections are never the same exact size or straight.

Cold Rolled Sections:

Cold rolled sections are formed by folding flat sheet steel into a variety of shapes, the commonest of which are sheet decking and cladding, "Z" and channel sections. Cold rolled sections are used extensively in the construction of roofing systems as they have a high strength/weight ratio, can be formed to an accuracy of ±0.25 mm, and are lighter and less expensive than hot rolled steel sections. Cold rolled sections can be fixed to hot rolled sections by welding or bolting.

Welded:

The largest hot rolled section available is 610 mm high Universal Beam, therefore, if a larger beam is required then the beam is cut along a zigzag line through the web. The two halves are then welded together along the crests of the zigzag with the resulting beam being approximately 50% stronger than the original beam. If a stronger beam is required it has to be fabricated by welding flat steel sections to form the web and flanges. Welded sections can be manufactured in a workshop using automatic welding machines and transported to site.



Types of Steel Sections:

Manufacturers produce steel beams in a number of standardized shapes and lengths for different applications. It is also possible to order steel beams which are fabricated to order, which may be necessary when a building is unusual in design. Special shipping is usually required for larger beams, due to their length weight which can make them challenging to transport.

Universal Beams:

Universal beams are horizontal sections used to form support floors and roofs systems. Universal beams consist of two flanges separated by a web; the flanges are generally thicker than the web. Universal beams are identified as "610UB125":

610 represents the approximate depth of the section.

UB denotes the type of section i.e. Universal Beam.

125 designates the mass of the section in kg/m.

Universal Columns:

Universal columns are vertical sections used to support floors and roofs systems and transfer the loads down to the footings and foundations. Universal columns are similar to universal beams and consist of two flanges separated by a web; the flanges are generally thicker than the web. The flange width is approximately the same as the web depth. Universal columns are identified as "310UC158":

310 represents the approximate depth of the section.

UC denote the type of section i.e. Universal Column.

158 designate the mass of the section in kg/m.

Tapered Flanged Beams:

Taper flanged beams consist of two flanges that are tapered at 8° and a web. Universal beams are rapidly replacing tapered flange beams. Taper flange beams require special taper washers when bolting the flanges to other structural sections. Taper flange beams are identified as "125TFB":

125 represents the depth of section.

TFB denotes the type of section i.e. Taper Flange Beam.

Parallel Flange Channels:

Parallel flange channels have two flanges of equal thickness and a web located at one end of the flange. Parallel Flange Channels are identified as "380PFC":

380 represents the depth of section.

PFC denotes the type of section i.e. Parallel Flange Channel.

Equal and Unequal Angles:

Angle sections are available with either two flanges of equal length, or, two flanges of different lengths. The ends of the flanges are called the toe while the other end is called the heel. Equal and unequal angles are identified as "75x75x10EA" or 100x75x10UA":

100 or 75	represents the length of the first flange.
75	represents the length of the second flange
10	represents the thickness of the two flanges.
EA	represents Equal Angle
UA	represents Unequal Angle

Hollow Sections:

Standard hollow sections are available in a rectangular, square and round in range of sizes.

Bar:

Standard bars are available in flat, round, square, rectangular and hexagonal of various sizes.

C & Z Purlins:

C and Z purlins and girts are manufactured from 0.95 to 3.00 mm thick sheetmetal for industrial buildings, garages, verandas, and carports and anywhere that strong, reliable steel framing is required. The purlins are manufactured from quality galvanised steel, this is a fully integrated system allowing for flexible design options; they are supplied plain or punched, galvanised purlins are manufactured from high tensile steel for increased strength, reduced weight, and a long serviceable life.

Universal Beam

Universal Column

Taper Flange Beam

Parallel Flange Beam

Equal Angle

Unequal Angle

Rail

Rectangular Hollow Section

Square Hollow Section

Round Hollow Section

Square Bar

Hexagonal Bar


Round Bar


Z-Purlin


C-Purlin

Timber:

Timber has been used as a building material for thousands of years, being second only to stone in terms of its rich and storied history in the world of construction. The chemical properties of timber are inherently complex, but even in spite of this challenge human beings have successfully harnessed the unique characteristics of timber to build a seemingly unlimited variety of structures. Timber is an exceptionally versatile material which is commonly used to build houses, shelters and boats, but it is also extensively used in the furniture and home decor industry as well.

Perhaps one of the biggest advantages of using timber as a building material is that it is a natural resource, making it readily available and economically feasible. It is remarkably strong in relation to its weight, and it provides good insulation from the cold. Timber is highly machinable, and can be fabricated into all kinds of shapes and sizes to fit practically any construction need. Timber is also the perfect example of an environmentally sustainable product; it is biodegradable and renewable, and carries the lowest carbon footprint of any comparable building material. In addition, no high-energy fossil fuels are required to produce timber, unlike other common building materials such as brick, steel or plastic.

Timber or Wood?

The words "timber" and "wood" are often used interchangeably when referring to timber used in construction work, but there has been considerable debate as to which term should apply in a given scenario. From my boatbuilding days, pieces of material that were "offcuts" and "scrap" pieces, only fit for fires or packing would be referred to as "wood" while the good uncut lengths ready for use were referred to as "timber"; the pieces already cut and shaped were "planks", "ribs" and "strakes" etc. In the building construction field these would be studs, noggings, bearers and joists etc.

Types of Timber:

Timber has traditionally been classified into two primary categories: Hardwood (any leaf-bearing tree) and softwood (any cone-bearing tree). Hardwoods are trees, and include members of the Eucalyptus (most 'gums' and ironbark), Corymbia (spotted gum and bloodwood), Shorea (meranti) and many other genera; the term doesn't imply that the actual timber is necessarily hard; for example, Ochrama spp. (balsa) and Toona ciliata (red cedar) are classified botanically as hardwoods. Softwoods are trees, and their timber, of the gymnosperm (cone-bearing) botanical group and include members of the Pinus (pine), Picea (spruce), Abies (fir), Callitris (cypress) and Thuja (western red cedar) genera; the term doesn't imply that the actual timber is necessarily soft.

Typical timbers used in Australian building construction are:

- North-eastern Australian hardwoods, including spotted gum, blackbutt, ironbark.
- Australian-grown plantation Pinus species, including slash, maritime, radiata and Caribbean pines.
- North American Douglas fir.
- Spruce pine.

Another type of timber commonly used in construction is known as "engineered". As its name implies, engineered timber is the product of a more intricate fabrication process in which various timber strands, fibres, veneers, or other forms of timber are glued together to form a type of composite material that is used for specific construction

applications. Common examples of engineered timber include plywood, glued laminated timber, and particle board. Engineered timber products are commonly used in a wide variety of residential, commercial and industrial construction projects.

Timber Stress Grading:

Structural grading is the process by which timber is sorted into groups, or stress grades, with ideally, similar structural properties in each group. Inevitably there is a very substantial range of properties within a group and significant overlap in properties between the groups. Structural grading can be performed in a number of ways including:

- Visual stress-grading
- Machine stress-grading
- Machine proof-grading

The two most commonly used methods in Australia are visual stress-grading and machine stress-grading, with use of machine proof-grading being limited. In theory, any method that sorts timber into groups of material with similar structural properties could be used. However, in order to be valid, the sorting methods must produce results, which are both consistent and repeatable. To achieve this level of reliability, rules for using acceptable sorting methods have been developed. In most countries, including Australia, these rules are generally either industry standards or national standards.

The relevant Australian Standards are:

- AS/NZS 1748 Timber Stress-graded Product requirements for mechanically stress-graded timber
- AS 2082 Visually stress-graded hardwood for structural purposes
- AS 2858 Timber softwood - visually stress-graded for structural purposes
- AS 2878 Timbers classification into strength groups
- AS 3519 Timber Machine Proof Grading

These Standards are used in production as the basis of fixing a grade stamp to each piece of timber. Design professionals do not normally have to be expert in the use of these Standards, but should be aware of their existence as they are often referred to, or used in materials specifications. A basic knowledge of the principles of visual stress-grading is certainly useful for engineers and architects undertaking site inspections and BCA certification.

Stress Grades:

Stress grades are only used for structural timber products. Appearance grades are not stress grades. The end product of any stress grading system is packages of timber that have been assigned grade properties that can be used for design. While in the past, F-grades have been the common timber grade designations, over recent years other grade designations have been derived for in-grade tested pine (MGP grades), Australian ash (A-grades) and engineered products such as glulam (GL grades), plywood and LVL (which both have their own independent grades).

Two different methods have been used to derive design properties for grades of timber:

- F-grades found in AS 1720.1 Table H2; this information is derived from strengths on the results of tests on small clear specimens and discounted for characteristics such as knots. The properties for lesser grade structural timber (lower than F17) graded in this way have a lower reliability and attract a lower capacity reduction factor AS1720.1 Table 2.1.
- In-grade testing and/or verification, deriving the respective grade properties using in-grade test data.

The F-grade system

An F-grade is a name for the grouping of the timber. The F-grade system gives a key to characteristic design strengths for graded structural timber without having to determine different properties for each of the thousands of timbers milled for structural purposes

worldwide. The F-grades are a series of categories into which different grades of different species can be placed. Once a species has been commercialised, its basic engineering properties can be determined on the basis of a few tests on small clear specimens of that species. The results will determine which series of F-grades will suit that species.

The actual properties associated with the F-grades can be obtained from the Timber Structures Code. For example F8 timbers have the following properties (from AS 1720.1 Table H2.1):

- f 'b = 22 MPa the characteristic bending strength
- f 'c = 18 MPa the characteristic compression strength (parallel to the grain)
- f 't = 13 MPa the characteristic tensile strength (parallel to the grain) - hardwoods
- f 's = 2.2 MPa the characteristic shear strength
- E = 9100 MPa the characteristic modulus of elasticity parallel to grain

However, almost all species have some properties that do not fit the F grade system perfectly. In nearly all cases where there is not a good match with all properties, conservative design properties are used.

GL Grades:

Glulam products are engineered timber products, made in accordance with AS/NZS 1328.

AS/NZS 1328 defines methods for grading glulam products into GL grades and products complying with them have been included in Section 7 of AS 1720.1; these grades are performance targets which are independent of the species, milling procedure and manufacturing process and are based on a 'standard' beam depth of 300 mm. Design procedure using GL grade properties is similar in principle to that for solid timber.

Any producer of glulam products can manufacture to meet a specified GL grade, with the onus of meeting the performance requirement (characteristic properties) resting with the producer. Glulam must be produced in accordance with AS/NZS 1328 and GL grades can be established and/or verified using in-grade testing or calculations from the properties of the laminates. GLTAA (Glued Laminated Timber Association of Australia) member producers have established an industry regulated quality assurance system, which permits the use of the GLTAA Quality Endorsed Mark.

A-Grades:

A-grades apply to visually graded mixture of seasoned alpine ash and mountain ash. Design properties were awarded and published after extensive in-grade testing at CSIRO in 2000. The timber is produced in Victoria, but marketed elsewhere in Australia. Each piece is marked with a grade stamp and the properties for the A-grades can be found in AS1720.1 Appendix H3.

Other Grades:

Other grade designations or suites of characteristic properties are available for specific timber products such as plywood and LVL.

The characteristic strength properties for many plywood products presented in AS 1720.1 Table 5.1 have been validated by in-grade testing and whilst they use an F-grade designation, they are different properties to F-graded sawn timber and have a high level of reliability. Australian produced plywood is linked to an audited, quality control and product certification system, when designated with an EWPAA (Engineered Wood Products Association of Australasia) Grade Mark.

The characteristic properties of LVL are determined by in-grade testing by each manufacturer; they also have responsibility for verifying the properties of their production by regular testing and associated quality control. Each manufacturer publishes their own set of design properties which means that each LVL product has its own individual grade.

Benefits of Timber in Construction:

Timber carries several benefits that make it an excellent candidate for use in a wide array of construction projects. One such benefit is its thermal properties, which give it an advantage in terms of its resistance to high temperatures. Unlike steel, which can expand or even collapse in high heat, timber actually dries out and becomes stronger as the heat increases. In addition, the heat conductivity of timber is relatively low in comparison to other materials such as aluminium, marble, steel, or glass; this gives timber an advantage in terms of being used in various applications such as matches, hardware equipment handles, wall coverings, and ceilings.

Timber also contains highly-sought-after acoustic properties. It can absorb sound and echoes, and is a favourite material of choice for the construction of structures where proper acoustics is important, such as concert halls. Timber is resistant to electrical currents, making it an optimal material for electrical insulation. Another important characteristic of timber is its tensile strength, which is its ability to bend under pressure without breaking. Timber is exceptionally light in proportion to its tensile strength, making it the preferred construction choice for surfaces that take a constant beating such as basketball courts and bowling lanes. Tensile strength is also one of the main reasons for choosing timber as a building material; its remarkably strong qualities make it the perfect choice for heavy-duty building materials such as structural beams.

Of the many construction materials that a person can choose from, timber stands out as a unique and amazingly versatile product. Its aesthetic appeal, tensile strength, insulation qualities, and ease of fabrication enable it to remain a favourite choice for use in an extensive array of construction applications.

Measuring and Marking Equipment:

In most woodworking projects, measuring and marking linear dimensions is the first crucial step, and depending on the project, it can make for some exacting work. In projects that involve intricate joinery and small, close-fitting parts, measuring and marking errors as small as 0.5 mm can turn up later as gaps in joints, misaligned parts and a host of other less-than-appealing results.

Measuring from point "A" to point "B" is a simple process, but your results still depend on how accurately you are able to translate a measurement into a physical mark on a piece of timber. If you've ever tried to hold a tape measure flat on a board while you accurately mark off a measurement, you know that just getting a clearly defined mark in exactly the right spot can be a surprising challenge. For precise measuring and marking, the tool you use needs to be readable and, of course, accurately calibrated. Going beyond that, the best distance measuring tools offer a little help in getting the mark in the right place.

Marking rules and tapes MUST be accurate, lay flat, and have an easy-to-read scale. A good tool of for linear measuring must have micro fine guide lines positioned at 1 mm increments so that, used in conjunction with a mechanical pencil or a metal scribe, you'd really have to try hard to put a measurement mark anywhere other than exactly where it's supposed to be.

Ruler:

A ruler is an instrument used to measure distances, and determines straight lines. There are many different types of measuring rulers, available in different shapes, sizes and materials; these rulers are used in various occupations and fields of study, such as geometry, printing, technical drawing, building and engineering.

Metric ruler:

Metric rulers are fairly easy to read and deal with millimetres and centimetres only. The small markings are spaced at 1 mm while the long marking are spaced every 10 markings to indicate 1 cm; a number is placed to the left of the centimetre mark indicating the number of centimetres from the start or zero mark. Depending on the

ruler, markings may be indicated half-way between the centimetre marks, i.e. 5, 15, 25,35 mm etc.

Figure 3.1 shows a typical metric timber ruler where the units are marked-off in millimetres and centimetres and lettered arrows at certain distances from the left end of the ruler. Reading a metric measurement is very simple; Point A is located on the long marking for 5, which reads as 5 cm or as there are 10 millimetres in a centimetre Point A can also be read as 50 mm. Point B lies on one of the smaller marks which is half-way between the longer centimetre marks; as there are 10 millimetres in a centimetre, then these lines represent 5 mm. Point B lies midway between the 6 and 7 centimetre marks so the reading is 6.5 cm or 65 mm.

Points C & D both point to the smallest marks; Point C is located on the 2nd mark to the right of the 8 cm mark therefore the reading is 8.2 cm or 82 mm. Point D is located on the 6th mark to the right of the 10 cm mark, or the 1st mark after the 5 mm mark therefore the reading is 10.6 cm or 106 mm.

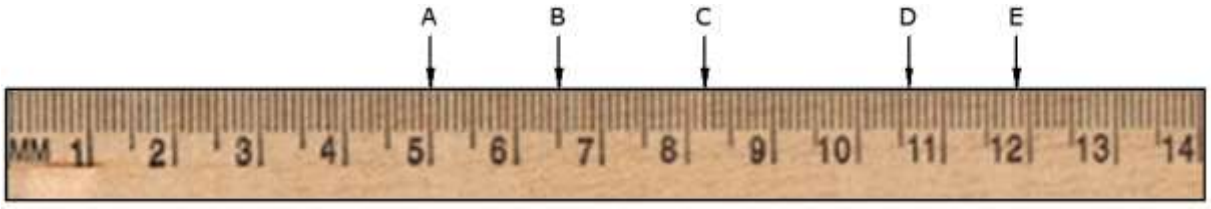


Figure 3.1 - Timber Metric Ruler

Point E lies between the 8th and 9th small marks to right of the 11 cm mark or 1.5 mm to the left of the 12 cm mark; the reading is 11.85 cm or 118.5 mm. Experience can allow a reading to the nearest 0.1 mm however it is not accurate and a precision measuring instrument must be used.

Measuring Tape:

Tape measures are special types of rulers that can be made of metal, cloth, or plastic. All tapes include linear-measure markings, with many including both imperial and metric units. Metric units are used in the S.I. system and are used by most countries outside of Australia; Imperial measurements are only used in the United States, Liberia and Myanmar however many older drawings prepared prior to 1975 were produced using the Imperial system so learning both measuring systems is highly recommended.

Cloth Tape:

Cloth tapes are used in the apparel (clothing) industry by tailors to measure garments and parts of the body. The tapes are very flexible to accommodate the numerous curved of a body. Cloth tapes have metal ends, are available in metric, imperial and a combination of both, and come in a range of colours. The majority of cloth tapes are normally 150 cm or 60-inches long.

Plastic/Fibreglass Tape:

Plastic/Fibreglass tapes are generally used by builders, surveyors and people in civil engineering (road works, dams, bridges). Plastic/Fiberglass measuring tapes are less expensive and will not rust. A disadvantage in the tape is they will stretch if excessive pulling force is applied. Tapes with a high number of fiberglass strands are stronger and will return to the original size after the force is relieved.

The tapes are constructed with enclosed or open case housings although open cases are easier to keep

clean; some cases have a rubber handle for better grip and comfort. Tapes are available from 5 metre to 100 metre in length.

Metal Tape:

Metal tape measures consist of a metal tape and a metal or plastic housing which protects the tape and inner mechanisms from damage and a spring; most metal tape measures also provide a locking device which prevents to tape from retracting.

The tape blade where the measurements are marked is the most important part of the tape measure; cheap tapes have thin metal blades that collapse when extended, wider blades are self-supporting over longer distances. Self-supporting blades are of great assistance especially when working solo and need to measure wide or high spaces.

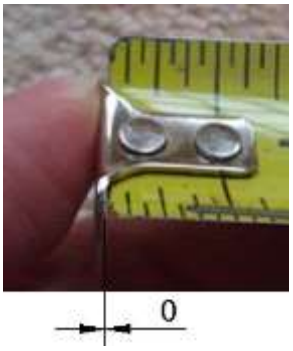


Figure 3.2

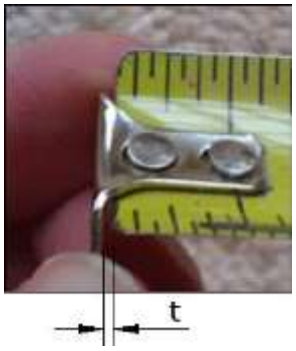


Figure 3.3

The end of the tape has a metal tang that is riveted to the blade and is supposed to be loose; the tang should move slightly and is essential when taking internal and external measurements. The thickness of the tang is the amount of movement in the tang. In Figure 3.2 the tang has been pushed hard against the blade end resulting on a thickness of zero (o); in Figure 3.3the tang has been pulled away from the blade and has travelled a distance of "t" which is the thickness of lip of the tang.

The tang is supposed to be loose. DO NOT try to fix it as the tape could only be used to take one kind of measurement.

The movement in the tang is the same as the thickness of the tang and allows internal and external measurements to be accurately recorded and/or measured. The tang pulls out when taking external dimensions and slides in when taking internal measurements. If the tang was to be fixed, some measurements would be incorrect.

Reading a Measuring Tape:

Reading measuring tapes is exactly the same as reading a ruler.

When measuring between two inside corners, the tape cannot get all the way into the corner for a good measurement. Many people will bend the tape into the corner as tight as they can and then guess what's left. The easiest way is to take two inside measurements. On one side, measure out a distance and make a mark; then measure the other side to the mark and add the two measurements together.

Care of a Measuring Tape:

The metal blade must never be allowed to rapidly spring back into the housing; rapid retraction can lead to damage of the spring or housing and it has been known for the tang to become embedded on the inside of the housing. The blade could also cause injury to the operator if care is not taken. The blade should be retracted slowly.

Tapes should be stored dry, therefore after use, especially in damp or wet conditions; the blade should be wiped as it is being retracted with a dry cloth.

The blades are very robust and can bend and twist however any undue twisting, specifically fatigue twisting, could cause the blade to break. Any tape with a broken blade must never be repaired and should be discarded.

Diameter Measuring Tape:

A diameter tape (D-tape) are available in cloth, plastic and metal and is mainly used to measure the diameter of pipes and tubes and is also used in forestry industry to measure the diameter of trees. Precision diameter tapes are used for measuring the true diameters of both round and out-of-round forms. In the metalworking industry, the tapes are precision tools made of 1095 clock spring steel.

Figure 3.4

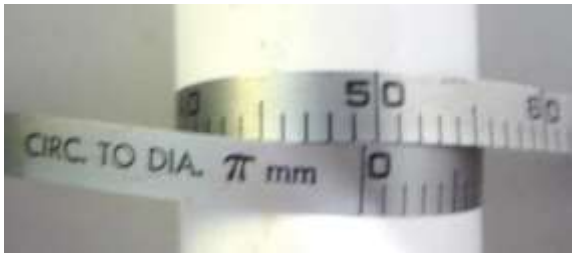


Figure 3.5

The diameter is easily measured because the tape is calibrated in units of 3.14 (pi) millimetres/centimetres. The tape is actually measuring the pipe or tube's circumference but since circumference and diameter are related by pi, the diameter can easily be obtained.

The precision-diameter gauge consists of a narrow metal ribbon bearing special graduations. These graduations are designed to convert circumferential distance into diameter measurement so the observer can read the diameter directly from the scale.

The tapes are checked over master gauges at 0.025 mm accuracy for standard tapes up to 3.5 m.

Study the two tape measures in Figure 3.4, the bottom tape is a standard metal tape covered in para 3.3.3; the tape on top is a diameter measuring tape. Note the 100 mm (10 cm) mark on the metal tape approximately aligns with the 31 mm mark on the diameter measuring tape.

Reading a Diameter Measuring Tape:

To measure the diameter of a pipe, the diameter tape (diameter side facing user) is wrapped around the pipe, in the plane perpendicular to the axis of the pipe. Where the number "0" aligns with the rest of the tape, this is the diameter as shown as shown in Figure 3.5. The measurement reads just over 48 mm, the same pipe measured using a Vernier Calliper reads 48.40 mm.

Measuring Squareness:

All timber must be cut square or at an angle; squares are used in laying out the pattern before the cut, and checking the cuts are square and accurate.

When a square is placed on the end of a board to check the squareness of the cut, you trust the "known" 90° angle of the square give an accurate measurement of timber cut. But how square is a square? The square may have been manufactured square but after several years of work, it may be inaccurate. A simple check can be carried out by simply placing the square on a board then drawing a line. Next, turn the square around so the blade is on the same edge then move the square to the drawn line. If the blade matches the line the square is accurate; if any irregularity, ditch the square and buy a new one.

Steel Square:

The steel square is a tool that carpenters use to lay out a "square" or right-angle. Most squares are made of steel, but the title steel square refers to a specific long-armed square that has additional uses for measurement, especially of angles, as well as simple right-angles. Today the steel square is more commonly referred to as the framing square and consists of a long arm and a shorter one, which meet at an angle of 90 degrees (a right angle).

Steel Square

The squares can also be made of metals such as aluminium, which is light and resistant to rust. The wide arm is nominally 50 mm wide and called the blade; the narrower arm is about 40 mm wide and called the tongue. The square has many uses, including laying out common rafters, hip rafters and stairs.

Try & Mitre Square:

Try and Mitre Squares are very similar and are both used mark right angles and for checking the corner cuts for squareness. Several squares have Rosewood timber handles but the metal squares are more accurate. The heads of try squares are set at 45° to help in marking out mitres. The blade lengths vary between 100 mm and 350 mm.

Try Square

Mitre Square

Combination Square:

A combination square is used in carpentry to help achieve the angles necessary to complete the project. It is typically used for framing houses or in small projects, such as cabinets and dressers.

In addition to helping measure a 90° angles for the pattern being created, the combination square has a 45° shoulder that is used to check and lay out mitres.

Combination Square

The 45° shoulder is useful to the worker because it eliminates the need to use a separate tool for laying out the mitre and is more efficient than other types of squares because it is capable of completing two jobs.

A knob located on the rule-type blade is used to reposition the combination square's head which helps create a tight fit along the desired angle. When purchasing a square, it is essential to choose one that is easy to adjust. Otherwise, the tool can be frustrating and difficult to use.

The combination square also has a spirit level, which is housed in the head, and a vial used to determine if the timber is level and plumb. The level component is useful when creating angles because it ensures they are accurate. Even the slightest inaccuracy can cause the entire project to be flawed. Drawers in small projects may stick or open on

their own, doors in houses may not shut properly, and an entire house can look lopsided or crooked if the square is inaccurate or not used properly.

Bevel Square:

A sliding T bevel, also known as a bevel square, is an adjustable gauge for setting and transferring angles. The handle is usually made of metal, timber or plastic and is connected to a metal blade with a thumbscrew or wing nut. The blade pivots and can be locked at any angle by loosening or tightening the thumbscrew.

The bevel can be used to duplicate an existing angle, or set to a desired angle by using it with any number of other measuring tools (such as a protractor, or framing square).

Bevel Square

Measuring Angles:

Building a roof or cutting stringers for a stairway requires finding angles, marking and cutting them correctly. The angles can be calculated using Pythagorean trigonometrical calculations, however, on a job site, not everyone remembers Pythagorean formulas and may not have a calculator (or phone) capable of handling the functions. In carpentry, the trigonometric functions to find angles are determined by simply use two legs of a protractor to measure and mark the angle. Call one leg the rise, designating the height of the triangle, and the other leg the run, or the length of the triangle. In some cases however, basic trigonometry may need to be used to determine an angle.

Bevel Protractor:

The bevel protractor has a movable arm that can extend to measure through 360 degrees. Bevel protractors are more accurate than a regular protractor as some (especially digital) can measure within 5 minutes (a minute is 1/60th of a degree).

The tool's swivelling bar locks down securely with a mechanism that includes an anchored lock washer to prevent the angle from shifting in the process. A compact protractor tool of this type is practically essential in projects that involve multi-sided objects or corners that meet at odd angles. The sturdy body of the tool is marked out in one-degree increments from 0 to 180 degrees, allowing to quickly and accurately dial in any angle necessary.

Angle Finder:

Angle finders are tools that are calibrated to read both inside and outside corners and quickly not only the angle of the corner, but also offer the correct mitre setting for the saw.

Angle Finder

Protractors:

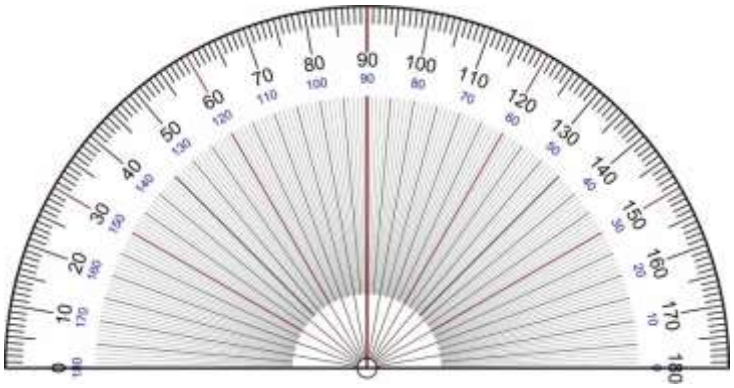
A protractor is a measuring instrument, typically made of transparent plastic or glass, for measuring angles. Most protractors measure angles in degrees (°). Radian-scale protractors measure angles in radians. Most protractors are divided into 180 equal parts; they are used for a variety of mechanical and engineering-related applications, but perhaps the most common use is in geometry lessons in schools.

Some protractors are simple half-discs. More advanced protractors, such as the bevel protractor, have one or two swinging arms, which can be used to help measure the angle.

Vernier Protractor:

A vernier protractor is used to obtain a very accurate measurement of angles through the vernier scale; this type of protractor has a circular dial graduated in degrees. It has a sliding blade that can be set to any desired angle in relation to the stock of the protractor. The back of the dial and blade are flat so the instrument can be placed flat on the work piece. The dial is graduated into 360 degrees and marked from 0 to 90 degrees, then 90 back to 0 degrees.

It has a special plate attached to the bevel protractor and covers an arc of 23 degrees of the main scale. It is divided into 12 equal parts allowing the protractor to measure angles to an accuracy of five minutes (1/12th of a degree).



Protractor

Vernier Protractor

Review Questions:

CPCCCA202-RQ-0101:

1. Name the method of construction shown in the following image.


_____

2. What are the sizes of a standard metric brick?

_____

3. List one of the methods used to determine the stress grade of timber.

_____

4. What are the two types of paints used in decorating the internal and external surfaces of residential buildings?

_____

5. Explain why is the tang on the end of a metal tape moveable.

_____

_____

6. Name the following items that are used in measuring.

A.

B.

C.

D.

A. _____ B. _____

C. _____ D. _____

7. What name is used to denote the vertical mortar joint between bricks on the face of a wall?

_____

8. Identify the material in the following image.

_____

9. What type of insulation would be used to reduce the noise levels within a building?

_____

10. Identify the two bricks:

A.

B.

A. _____

B. _____

11. If High Strength and Sprayed Concrete are two types of concrete, name 2 other types of concrete used in residential construction projects.

_____

_____

_____

12. What condition should exist if anti-condensation paint is to be used?

_____

13. Which room would plasterboard not be used for wall lining?
    A. Lounge
    B. Kitchen
    C. Bedroom
    D. Hall

_____

14. Identify the following types of steel segments.

A.

B.

C.

D.

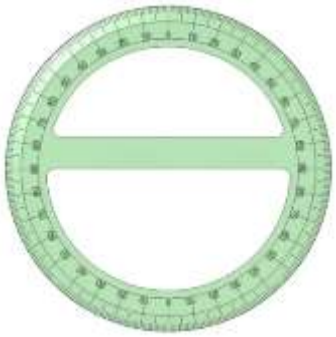
15. What is the rise of a precast concrete step manufactured in Australia?

_____

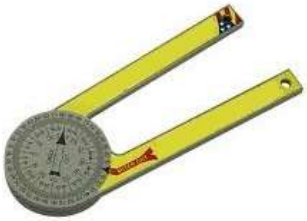
16. Identify the component in the following image.

17. Name the following items that are used in measuring.

A.



B.



C.

D.

A. _____ B. _____

C. _____ D. _____

18. What material is used in a concrete slab to strengthen the concrete?

_____

19. What term is used to denote a row of bricks along the length of a wall?

_____

20. Describe the manufacture of a masonry block?

_____

_____

21. After using a tape to measure the distance along the moist surface, what maintenance should be carried out on a metal tape?

_____

22. What are hollow core floor slabs?

_____

_____

23. What paint should be used to prevent subsequent coats of paint soaking in?

_____

24. Which of the following is the incorrect statement for not using sheetmetal cladding in the construction of a roof?
    A. Withstands severe acts of nature.
    B. High maintenance costs.
    C. Installation time.
    D. High range of colours.

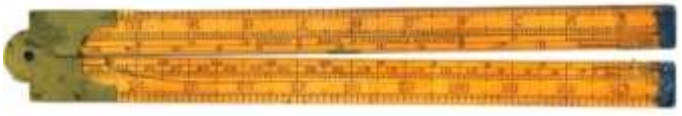
_____

25. Name 2 types of insulation materials.

_____

_____

26. Name the following items that are used in measuring.



A.

B.

C.

D.

A. _____ B. _____

C. _____ D. _____