CARRY OUT BASIC MEASUREMENTS AND CALCULATIONS FOR RESIDENTIAL BUILDINGS
CERTIFICATE II IN BUILDING AND CONSTRUCTION
(PATHWAY – PARAPROFESSIONAL)
30011
LEARNER’S GUIDE
BUILDING AND CONSTRUCTION

BC1940
Carry out basic measurements and calculations for residential buildings

30011

Learner’s guide
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Annex D – Assessments

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Welcome

This learner’s guide will provide you with an introduction to carrying out basic measurements and calculations for residential buildings.

Areas of explanation include:

- taking measurements from plans
- taking physical measurements
- performing calculations
- calculating material quantities.

Qualification overview

This unit of competency, 30011 *Carry out basic measurements and calculations for residential building*, forms part of Certificate II in Building and Construction (Pathway – Paraprofessional) and is aimed at those people who are considering a paraprofessional career in the residential building industry (as opposed to the trade sector).

The course consists of 12 units of study and a period of work placement. These two components, study and work, will provide you with an introductory background to the paraprofessional side of the residential building industry.

To progress further in the industry, beyond this introductory level, you will then need to specialise in a particular field of study, such as building, estimating, scheduling, drafting or building design. Courses for these careers usually commence at Certificate IV level and progress through to diploma or even advanced diploma levels at a registered training provider who delivers these programs.

Some areas of study, such as architecture, interior design and construction management, can then be studied further at degree level at university.
Unit overview

This unit of competency specifies the outcomes required to carry out basic measurements and perform common calculations to determine task and material requirements for a typical job in residential building without the need to go onto a work site.

Competence in this unit will be demonstrated by successful completion of three open-book assessments requiring you to:

- carry out calculations using a calculator
- apply formulas and units
- calculate perimeter, area and volume
- calculate material quantities.

Unit summary

Some basic information about this unit of competency is provided below. You can find the full unit details at Annex A at the back of this guide.

<table>
<thead>
<tr>
<th>Unit title</th>
<th>Carry out basic measurements and calculations for residential buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor</td>
<td>This unit of competency specifies the outcomes required to carry out basic measurements and perform common calculations to determine task and material requirements for a typical job in residential building without the need to go onto a work site.</td>
</tr>
<tr>
<td>Employability skills</td>
<td>The following employability skills are an integral part of the delivery of this unit. They include: communication; teamwork; problem solving; initiative and enterprise; planning and organising; self-management; learning; and technology.</td>
</tr>
</tbody>
</table>
| Pre/co-requisite units | BSBOHS201A Participate in OHS processes  
CPCCCM2001A Read and interpret plans and specifications |
| Application | This unit of competency supports achievement of skills to take measurements and use these to calculate material qualities and perform calculations for tasks commonly used and applied in residential building construction work. It includes taking measurements from plans as well as making physical measurements. |
### Element 1 Determine work requirements

1.1 Read and understand appropriate drawings or plans

1.2 Interpret *information* regarding levels, heights, gradients and other measurements

1.3 Check that measuring and calculating *equipment* selected to carry out tasks is consistent with job requirements, is serviceable, and any faults are rectified or reported

1.4 Work in accordance with *safety* policies

### Element 2 Obtain measurements

2.1 Select and apply appropriate industry methods of measurement

2.2 Obtain *measurements* by physical measurement or from plans or other documentation to required degree of accuracy

2.3 Confirm measurements, including *areas and volumes*, and record correctly

### Element 3 Perform calculations

3.1 Select appropriate *calculation factors* and use correct methods for achieving required result

3.2 Apply calculations to *basic estimating activities* related to residential building

3.3 Calculate *material quantities* for the project correctly using appropriate factors

3.4 Check, confirm and record results

### Skills recognition and recognition of prior learning (RPL)

You are encouraged to discuss with your lecturer any previous courses or work experience in which you have participated so that it can be recognised. Evidence must be provided.
Resources

Required

Your lecturer will provide you with:

• construction plans
• measuring tapes.

You will need to provide:

• a USB thumb drive
• an A4 notepad
• an A4 file for notes, handouts and other printed documents
• a scale rule
• a basic calculator
• pens, pencils, eraser and highlighters.

Recommended

Some of these resources may be useful or of interest. Your lecturer will provide access to them if they are required.

<table>
<thead>
<tr>
<th>Information area</th>
<th>Resource</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>All residential buildings covered by regulations</td>
<td>National Construction Code Series 2012, Volume Two, Building Code of Australia: Class 1 and Class 10 Buildings</td>
<td>Australian Building Codes Board</td>
</tr>
<tr>
<td>Australian Standards®</td>
<td>Varies with topic</td>
<td>SAI Global</td>
</tr>
</tbody>
</table>
Legislation

The following is a list of legislation relevant to the residential construction industry in your state or territory. These documents may be referred to during the course.

- Building Act
- Building Regulations
- Health Regulations
- Occupational Health and Safety Act and regulations
- Safe Design of Buildings and Structures (Code of Practice)
- Residential Design Codes

Websites

The following is a list of websites that contain further information relevant to the construction and residential building industries.

- Australian Building Codes Board (ABCB) <www.abcb.gov.au>
- Building Designers Association of Australia (BDAA) <www.bdaa.com.au>
- Housing Industry Association (HIA) <www.hia.com.au>
- Master Builders Australia (MBA) <www.masterbuilders.com.au>
- SAI Global <www.saiglobal.com>

Common abbreviations

Throughout this guide you’ll come across some abbreviations. Below is a list of the most commonly used ones.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHD</td>
<td>Australian Height Datum</td>
</tr>
<tr>
<td>BM</td>
<td>Benchmark</td>
</tr>
<tr>
<td>RL</td>
<td>Relative level</td>
</tr>
</tbody>
</table>
Self-checklist

As you work through this guide you are advised to return to this checklist and record your progress. Where you understand something and think that you can perform it ‘easily’, congratulations. Where your response is ‘with help’, review the material in that section and/or discuss it with your lecturer or other learners in your group.

<table>
<thead>
<tr>
<th>30011 Carry out basic measurements and calculations for residential buildings</th>
<th>I understand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element 1 Determine work requirements</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Read and understand appropriate drawings or plans</td>
<td>Easily</td>
</tr>
<tr>
<td>1.2 Interpret <em>information</em> regarding levels, heights, gradients and other measurements</td>
<td></td>
</tr>
<tr>
<td>1.3 Check that measuring and calculating <em>equipment</em> selected to carry out tasks is consistent with job requirements, is serviceable, and any faults are rectified or reported</td>
<td></td>
</tr>
<tr>
<td>1.4 Work in accordance with <em>safety</em> policies</td>
<td></td>
</tr>
<tr>
<td><strong>Element 2 Obtain measurements</strong></td>
<td></td>
</tr>
<tr>
<td>2.1 Select and apply appropriate industry methods of measurement</td>
<td>Easily</td>
</tr>
<tr>
<td>2.2 Obtain <em>measurements</em> by physical measurement or from plans or other documentation to required degree of accuracy</td>
<td></td>
</tr>
<tr>
<td>2.3 Confirm measurements, including <em>areas and volumes</em>, and record correctly</td>
<td></td>
</tr>
<tr>
<td><strong>Element 3 Perform calculations</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Select appropriate <em>calculation factors</em> and use correct methods for achieving required result</td>
<td>Easily</td>
</tr>
<tr>
<td>3.2 Apply calculations to <em>basic estimating activities</em> related to residential building</td>
<td></td>
</tr>
<tr>
<td>3.3 Calculate <em>material quantities</em> for the project correctly using appropriate factors</td>
<td></td>
</tr>
<tr>
<td>3.4 Check, confirm and record results</td>
<td></td>
</tr>
</tbody>
</table>
About the icons

Note that not all icons may appear in this guide.

**Performance criteria**
This icon indicates the performance criteria covered in a section. The performance criteria contribute to the elements of competency that you must demonstrate in your assessment.

**Activity**
This icon indicates that there is an activity for you to do.

**Computer-based activity**
This icon indicates that there is an activity for you to do on the computer.

**Discussion**
This icon indicates that there will be a discussion, which could be with a partner, a group or the whole class.

**Research**
This icon indicates that you are to do a research activity using the internet, texts, journals or other relevant sources to find out about something.

**Case study**
This icon indicates that there is a case study or scenario to read.

**Think**
This icon indicates that you should stop and think for a moment about the point being made or the question being asked.

**Assessment task**
This icon indicates that an activity or task is part of your assessment.
Carry out basic measurements and calculations for residential buildings
Section 1 – Drawing types

Introduction

In the building industry, most of the information required by the people performing any of the work related to a construction project comes from project documentation. So it is extremely important for you to be able to read and interpret plans, drawings, details and specifications correctly.

Plans and drawings are used to communicate great amounts of technical information between the designer and builder. This technical information must be able to be communicated without any misunderstandings, which can only happen if the technical language of plans and drawings is understood by everyone who uses them. For this reason, the technical language uses standardised layouts, symbols and abbreviations, so that things look similar in any plan or drawing. With study, practice and experience, you’ll get to know and understand this language.

Performance criteria

1.1 Read and understand appropriate drawings or plans
1.2 Interpret information regarding levels, heights, gradients and other measurements

Types of plans and drawings

There are many types of plans and drawings that may be created for a building project. The size and complexity of the project will determine which ones are required. The minimum set usually includes:

- a site plan
- a floor plan
- elevations
- sections.

Others that may be required, depending on the project, include:

- details
- electrical plans
- hydraulic plans
- engineering plans.
Users and uses

When plans and drawings of a proposed building or structure have been prepared, many copies are made for the people who will use them. Table 1.1 shows who might use them and for what purpose.

<table>
<thead>
<tr>
<th>User</th>
<th>Use plans to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner/client</td>
<td>to see that the design is as they imagined it</td>
</tr>
<tr>
<td>Structural, electrical and mechanical engineers</td>
<td>to design their part of the structure</td>
</tr>
<tr>
<td>Council health and building surveyors</td>
<td>to make sure that the building conforms to building codes and council regulations</td>
</tr>
<tr>
<td>Council town planning officers</td>
<td>to make sure that the building conforms to council planning regulations</td>
</tr>
<tr>
<td>Financial institution officers</td>
<td>to decide whether approval for finance for construction will be given</td>
</tr>
<tr>
<td>Builder/estimator</td>
<td>to cost the building and to prepare a quote</td>
</tr>
<tr>
<td>Builder</td>
<td>to construct the building</td>
</tr>
<tr>
<td>Subcontractors such as concreters, bricklayers, electricians, tilers and painters</td>
<td>to prepare their quotes to carry out their part of the construction</td>
</tr>
<tr>
<td>Suppliers of prefabricated building components such as roof trusses, windows, air conditioning and heating</td>
<td>to calculate their prices for their part of the job.</td>
</tr>
</tbody>
</table>

Table 1.1: Key users and uses of drawings.
Finding information

The unit CPCCCM2001A Read and interpret plans and specifications goes into much more detail about the information found on plans and drawings and how to interpret it. You should already have completed this unit or be enrolled in it now. Try Activity 1.1 to check your knowledge about finding information on plans and drawings.

### Activity 1.1 Information on plans and drawings

In the table below, four types of plans or drawings are listed across the top and 11 items of information that can be found on them are listed down the left-hand side. For each piece of information, decide which plan or drawing it is shown on and place a tick in the corresponding box. Some information appears on more than one plan or drawing, so you may need two ticks for those. The first one has been done for you as an example.

<table>
<thead>
<tr>
<th></th>
<th>Site plan</th>
<th>Floor plan</th>
<th>Elevation</th>
<th>Electrical plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of paths</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall width of building</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height of windows</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of ceiling fans</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of sink cupboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing trees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of windows</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitch (slope) of roof</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of front door</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of WC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of light switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Measurements

Plans and drawings show things that are to be constructed, such as foundations, walls and fences. They also show what is already on or near the site, such as trees, services and neighbouring buildings.

As well as these tangible items (things we can actually see or touch), plans and drawings also show lots of other important information, including levels, gradients, heights and measurements.

Levels

Levels are a very important part of construction. When the first drawings are done for a project, a ‘datum’ is established. The datum is a point that is chosen by the surveyor, assigned a number in metres and then used as the baseline or starting point for all the height measurements, or levels, on the project.

The surveyor chooses a point close to the site to locate the datum, often in the road or on the kerb, and marks it using a nail or a small metal plate. The surveyor then marks the datum on the site plan and gives it a number value, usually 10.00 or 100.00. The number itself doesn’t mean anything, it just provides a point for all other heights or levels on site to be measured against.

For example, if the datum is given the value of 10.00, then a point that is 1000 mm, or one metre, higher than the datum would be given a level of 11.00 on the site plan. A point that is 2500 mm higher than the datum would be given a level of 12.50, as shown in Figure 1.1.

![Figure 1.1: Section through ground showing relative levels (RLs) at three points.](image-url)
The datum can, if necessary, be related to the nearest public datum or permanent benchmark, such as the Australian Height Datum (AHD). The AHD is a geodetic datum for altitude measurement in Australia. It allows the heights of places or points that are not within sight of each other to be compared.

Can you think of an example of a project that might need to use the Australian Height Datum?

**Level line**

A level line is a line that is at a constant height relative to mean sea level (it is therefore a curved line because the earth is curved).

**Level datum**

A level datum is a reference level to which the elevation of other points may be referred. In Australia, the AHD is the commonly adopted reference level. A level datum may also be assigned an arbitrary value.

**Benchmark**

A benchmark (BM) is a fixed point of reference that has a known elevation above (or below) a particular datum.
Gradient

The gradient (also called slope, incline, pitch or rise) of a physical feature refers to the amount of inclination of that surface to the horizontal. It is used in measuring existing physical features (such as hillsides and river banks), and in designing and engineering new elements for construction (such as roads, landscaping and roofing).

Contour lines

These are imaginary level lines that indicate the shape of the land (you might have seen these on maps).

Everything that is done on a construction project relies on accurate heights and levels being used. A lot of this information is found on the site plan.

Activity 1.2 Finding information on a site plan

Find the following items on Figure 1.2. Write the required information next to each one.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The address of the site</td>
</tr>
<tr>
<td>2.</td>
<td>The height of the four corner pegs</td>
</tr>
<tr>
<td>3.</td>
<td>The datum level</td>
</tr>
<tr>
<td>4.</td>
<td>The location of the meter box</td>
</tr>
<tr>
<td>5.</td>
<td>The length of the northern boundary</td>
</tr>
</tbody>
</table>
Figure 1.2: An example of a site plan.

HIA plans have been reproduced with the permission of Housing Industry Association Ltd.
Which units are used?

The metric system is used in Australia. Some other countries use the imperial system (measuring length in feet and inches, for example). Always use the metric system when reading, measuring or calculating quantities for building projects in Australia.

The most commonly used unit of measurement in the construction industry is millimetres (mm). Lengths, widths, depths and heights are usually given in millimetres. Where larger dimensions are shown, such as the length of boundaries on a site plan, metres (m) will be used. Centimetres are very rarely used.

Often the unit itself is not written. For example, everyone just knows that if 3600 is written it means millimetres, whereas if 3.600 is written it means metres.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Abbreviation</th>
<th>Example</th>
<th>Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millimetre</td>
<td>mm</td>
<td>A fence could be 1200 high</td>
<td>1 mm = 0.001 m</td>
</tr>
<tr>
<td>Centimetre</td>
<td>cm</td>
<td>Rarely used in the construction industry</td>
<td>1 cm = 10 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100 cm = 1 m</td>
</tr>
<tr>
<td>Metre</td>
<td>m</td>
<td>A fence could be 14.60 long</td>
<td>1 m = 1000 mm</td>
</tr>
</tbody>
</table>

Table 1.2: Units of measurement.

Linear measurements

Linear measurements are measurements of lines or distances between two points. They are the most commonly used type of measurement in the construction industry, particularly on plans. Common linear measurements include:

- length
- width
- depth
- height.

Depth can sometimes mean the distance from front to back. For example, a block of land that measures 35.0 m by 55.0 m would be described as 35.0 wide by 55.0 deep, although we would say that the side boundary is 55.0 long.
Converting metres and millimetres

Sometimes it's necessary to convert metres to millimetres. One metre is 1000 times longer than one millimetre, so you just need to remove the decimal point and make sure there are three figures after the metre amount.

For example: 2.657 m becomes 2657 mm
4.32 m becomes 4320 mm.

To convert millimetres to metres, move the decimal point three places to the left, to make the number read as one thousand times smaller.

For example: 2460 mm becomes 2.46 m
12795 mm becomes 12.795 m.

If the number of millimetres is less than 1000, put a zero before the decimal point.

For example: 795 mm becomes 0.795 m.

If the number of millimetres is less than three figures, add zeroes to the left end and then place the decimal point.

For example: 65 mm becomes 0.065 m
8 mm becomes 0.008 m.
### Activity 1.3 Conversions

Convert the following measurements to millimetres. An example has been provided for you.

<table>
<thead>
<tr>
<th>0.756 metres</th>
<th>756 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.46 m</td>
<td></td>
</tr>
<tr>
<td>21.05 m</td>
<td></td>
</tr>
<tr>
<td>14.749 metres</td>
<td></td>
</tr>
<tr>
<td>5.008 m</td>
<td></td>
</tr>
</tbody>
</table>

Convert the following measurements to metres. An example has been provided for you.

<table>
<thead>
<tr>
<th>649 millimetres</th>
<th>0.649 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1840 millimetres</td>
<td></td>
</tr>
<tr>
<td>4550 mm</td>
<td></td>
</tr>
<tr>
<td>12001 mm</td>
<td></td>
</tr>
<tr>
<td>124 mm</td>
<td></td>
</tr>
</tbody>
</table>

You will have more opportunities to practise conversions later in this unit.
Activity 1.4 Interpreting a site plan

These questions relate to the site plan on the following page. Study the plan, and then choose the correct answer for each of the nine multiple-choice questions below.

1. The width of the building (excluding the garage) is:
   a) 11.79
   b) 17.49
   c) 13.55
   d) 13.61
2. The wavy line that runs across the block (with 28.5 written at one end) is:
   a) a contour line
   b) the main sewer line
   c) indicating an existing watercourse (stream)
   d) indicating the position of an old road.
3. The ‘FFL’ under ‘Proposed Residence’ is:
   a) flush floor level
   b) 28.6 m
   c) 28.60 AHD
   d) 28.50 AHD.
4. The front elevation of the house faces:
   a) west
   b) south west
   c) east
   d) south east.
5. The setback of the house from the front boundary is:
   a) 6.795 mm
   b) 1.00 mm
   c) 6.00 m
   d) 2.80 m.
6. The address of the site is:
   a) Lot 259 Caladenia Way
   b) Hopscotch Homes
   c) Lot 92 Bitter Way Beechboro
   d) not shown.
7. The distance from the rear of the house to the back boundary is:
   a) 29.21 m
   b) not shown
   c) 5.255 m
   d) 6.968 m.
8. The distance from the side of the house to the southern boundary is:
   a) 1.50 m
   b) 1.00 m
   c) 1500 m
   d) not shown.
9. The existing ground level of the block is:
   a) dead level
   b) sloped down towards the top right hand corner
   c) sloped down from the rear of the block to the front
   d) unable to be determined.
Section 2 – Equipment for measuring and calculating

Introduction

Several pieces of equipment are available for measuring. Some are better suited than others to particular jobs.

Performance criterion

1.3 Check that measuring and calculating equipment selected to carry out tasks is consistent with job requirements, is serviceable, and any faults are rectified or reported

Calculators

A general-purpose calculator is required for calculations. It just needs to be a fairly small, inexpensive one that you can easily get the hang of to perform basic calculations. Later, in more detailed estimating, you’ll use a scientific calculator to perform more complex calculations.
## Activity 2.1 Using a calculator for basic calculations

1. Carry out the following additions.
   a) 17 + 316 + 5311 = __________________________
   b) 4.792 + 12.476 + 0.625 = __________________________
   c) 0.6223 + 5.7744 + 2.998 = __________________________

2. Carry out the following subtractions.
   a) 442 – 78 = __________________________
   b) 7.76 – 1.823 = __________________________
   c) 4969445 – 645.708 = __________________________

3. Carry out the following multiplications.
   a) 62.76 × 35 = __________________________
   b) 26.017 × 3.58 = __________________________

4. Carry out the following divisions.
   a) 1365 ÷ 35 = __________________________
   b) 996.325 ÷ 27.5 = __________________________

5. Carry out the following compound calculations.
   a) 27.5 – (2.5 × 5) = __________________________
      = __________________________
   b) (3.6 × 1.5) + (1.8 × 3.5) = __________________________
      = __________________________
Measuring tapes

A measuring tape is made up of a flexible metal blade housed in a metal or plastic case. The blade is coiled, usually under the control of a strong spring. Tapes are used for measuring long distances with a reasonable degree of accuracy. They offer greater convenience than using a series of measurements made with a shorter steel ruler.

Common types of measuring tapes can be from three to 10 metres long; however, longer lengths, such as 30 metres, are also available.

Retracting mechanisms

Smaller tapes normally retract (pull back) under spring tension once their locking button is released. Care should be taken when doing this, as the tape can snap back violently. To do it safely, hold the end of the tape in your hand, and guide it until it is fully coiled again.
Steel tapes

Steel tapes are used for measuring long distances. They are usually 10 or 30 metres long, but longer lengths are available.

Steel tapes are returned into their case by operating a turning mechanism. The handle can be folded away when not in use.

Steel tape rules

Steel tape rules are available in two, three, five, seven, eight and 10 metre lengths. The three and five metre tapes are the most common.

Steel tape rules have a power return spring which automatically returns the tape blade into the housing. Do not allow the tape to suddenly return, as the hook will break off. A lock is often included to hold the blade in the open position and to slow its return into the case.

Looking after measuring tapes

Measuring tapes will last for many years if you look after them properly.

- Don’t be rough with the blade or the tape housing.
- Retract the blade gently.
- Keep the blade free from grit and moisture.
- Don’t leave the measuring tape exposed for long periods to the direct rays of the sun. This can buckle the blade or degrade the housing.

Using measuring tapes

Measuring tapes can be marked in either metric measurements or a combination of metric and imperial (feet and inches) measurements.

A steel tape can be used in most situations, but it is best used for on site setting out and for taking on site measurements. The fixed end hook on a steel tape compensates for the thickness of the metal when taking inside or outside measurements, so it is important to place it correctly.

A steel tape rule is used for all types of measuring and setting out within the range of its length. The main advantage of using a steel tape rule is to eliminate errors which occur when a steel rule is used for distances longer than its length. Also, curved surfaces can be measured accurately.

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Pictured below are some of the different ways measuring tapes can be used.

Figure 2.2: Using different types of measuring tapes.

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Scale rules

A scale rule is a plastic rule of 150 or 300 mm in length used to scale off dimensions when they are not given on the drawing. They can be triangular shaped or flat, like a standard ruler.

They have a different scale printed along each edge. Some have a single scale per edge, and others have two scales combined on one edge. Different brands may vary in the way the scales are grouped. The most common scales you'll see on a scale rule are 1:1, 1:5, 1:10, 1:20, 1:50, 1:100, 1:200 and 1:500.

On the top edge of the rule below, the scales are 1:1 and 1:100, so the dimensions they show differ by a factor of 100.

![Figure 2.3: A scale rule with scales of 1:1 and 1:100.](image)

Another scale rule edge is shown below. In this case the dimensions differ by a factor of 10 (1:50 is 10 times larger than 1:500).

![Figure 2.4: A scale rule with scales of 1:50 and 1:500.](image)

To measure something to scale, put the zero mark on the left hand edge of what you’re measuring, and read the length at the right hand edge.
How to read scale

Reading scale is covered in CPCCCM2001A Read and interpret plans and specifications; however, we’ll look at the basics here. By using a scale rule, a measurement can be determined from the plan provided to its actual size. If a drawing or house plan is set at a scale of 1:100, that means that all items on the house plan are one hundred times larger in reality.

1:10 scale

The scale rule pictured below is marked at a scale of 1:10 and 1:100. To understand how to read a scale rule, let’s first look at a scale of 1:10, the top row of numbers on this rule.

- The 1:10 scale means that all items are ten times larger than shown on the drawing.
- Each increment on a scale of 1:10 represents 10 mm, then goes to 20 mm, 30 mm, 40 mm and so on until 100 mm is reached.
- From there, increments of 10 continue as 110, 120, 130, 140 and 150 all the way to 200 mm.
1:100 scale

- Each increment on a scale of 1:100 represents 100 mm, then goes to 200 mm, 300 mm, 400 mm and so on until 1000, or 1 m is reached.
- From there, increments of 100 continue as 1100 mm, 1200 mm, 1300 mm and so on all the way to 2000 or 2 m, as shown by the bottom row of numbers on this rule.

Activity 2.2 Reading a scale rule

Below is a section of a scale rule. Write the measurements indicated by each of the arrows. An example has been done for you.

- 70 mm
- 700 mm
- 10 mm
- 100 mm
- 200 mm
- 300 mm
- 400 mm
- 500 mm
- 600 mm
- 700 mm
- 800 mm
- 900 mm
- 1000 mm
- 1100 mm
- 2000 mm
- 3000 mm
- 4000 mm
- 5000 mm
- 6000 mm
- 7000 mm
- 8000 mm
- 9000 mm
- 10000 mm
- 11000 mm
- 12000 mm
## Activity 2.3 Scaled dimensions

Below is a series of lines drawn to various scales. Use your scale rule to carefully measure each line according to the scale shown. Write down the length of each line in mm at the end of that line. The first one has been done for you as an example.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Line</th>
<th>Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:50</td>
<td><img src="image" alt="Scale 1:50 Line" /></td>
<td>2300</td>
</tr>
<tr>
<td>1:10</td>
<td><img src="image" alt="Scale 1:10 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:100</td>
<td><img src="image" alt="Scale 1:100 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:200</td>
<td><img src="image" alt="Scale 1:200 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:5</td>
<td><img src="image" alt="Scale 1:5 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:2</td>
<td><img src="image" alt="Scale 1:2 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:100</td>
<td><img src="image" alt="Scale 1:100 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:50</td>
<td><img src="image" alt="Scale 1:50 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:10</td>
<td><img src="image" alt="Scale 1:10 Line" /></td>
<td></td>
</tr>
<tr>
<td>1:5</td>
<td><img src="image" alt="Scale 1:5 Line" /></td>
<td></td>
</tr>
</tbody>
</table>
Activity 2.4 Measuring shapes with a scale rule

Use the appropriate side of your scale rule to work out the dimensions indicated by arrows. Write each answer neatly next to the dimension arrows.

Scale 1:5

Scale 1:10
### Activity 2.5 Using measuring and calculating equipment

Answer the following questions about measuring equipment in the spaces provided.

1. **What would you use to measure the following lengths?**
   - a) 12 m
   - b) 13.2 mm
   - c) 2105 mm

2. **Explain the difference between a steel tape and a steel tape rule.**

3. **Add 950 mm, 67 mm and 48 mm together.**

4. **Add these measurements together without a calculator: 1.25 m, 2.36 m and 11.75 m. Write the answer in the space provided and show your working out.**

5. **Subtract 790 mm from 3.0 m, and give the answer in both millimetres and metres.**

6. **Multiple 600 m by 8, and give the answer in both millimetres and metres.**

7. **Divide three metres into eight equal parts.**
Carry out basic measurements and calculations for residential buildings

30011
Section 3 – Working safely

Introduction

Workplace health and safety is everyone’s responsibility. Working safely is covered thoroughly in the unit BSBOHS201A *Participate in OHS processes*, but a brief overview is included here.

Performance criterion

1.4 Work in accordance with safety policies

All employees must take reasonable care of the health and safety of themselves and others, and cooperate with employers in their efforts to comply with occupational health and safety (OHS) requirements.

As an employee, you must not:

- interfere with or misuse any item provided for the health, safety or welfare of people at work
- block or interfere with attempts to give aid or attempts to prevent a serious risk to the health and safety of a person at work
- refuse a reasonable request to help in giving aid or in preventing a risk to health and safety.
OHS induction training

It is a requirement under the relevant OHS Act of each state or territory that all workers carry out OHS induction training to familiarise themselves with:

- the reasons for OHS legislation
- rights and responsibilities of employers and employees in relation to OHS legislation
- identification of common workplace hazards
- inspection of a workplace to assess risks
- identification of quality control measures to control hazards
- purpose and use of work method statements
- identification of essential personal protective equipment (PPE)
- identification of barricades, hoardings and signs to highlight site hazards and to protect workers.

OHS induction cards are recognised from state to state. As long as the training that a worker has received meets existing standards and requirements, they will be permitted to carry out work on a construction site without having to undertake another OHS induction course in that state.

Site induction

Each OHS Act requires the principal contractor, employees and self-employed people to ensure that all construction workers have undertaken mandatory OHS induction. If they don’t, they can be fined.

Workers who are going to be working on site need to undertake a site induction before entering the site, but a contract administrator in an office does not need to do so, unless their employer requests it. As a contract administrator, scheduler, estimator or other paraprofessional, you might require a general site induction to cover safe practice for all sites, as you may conduct site visits as part of your work.

If you’re not working on site, you may not need to know how to use a safety harness, but you will still need to follow workplace safety procedures, which will include things like:

- manual handling (lifting and moving things safely)
- ergonomics (ensuring that workplace equipment, including furniture, is adjusted to suit you)
- following safe computer use practices (such as taking regular breaks to avoid eyestrain).
Codes of practice

Codes of practice are used in conjunction with the OHS Act, but they are not classified as law documents. However, you are still required to follow them.

The basic purpose of codes of practice is to provide workers in the building industry with practical, commonsense, industry-acceptable ways of following the OHS Act and working safely.

They are published by each state and territory’s OHS Regulating Authority, and cover areas such as electrical safety, roof tiling, formworking, personal protective equipment (PPE), use of safety harnesses, construction and use of hoardings.

Activity 3.1 Working safely

List ten OHS policies and/or procedures that you would need to consider when carrying out basic measurements and calculations. What precautions can you take, to keep yourself safe?
Carry out basic measurements and calculations for residential buildings
Section 4 – Obtaining measurements

Introduction

Everyone involved in the construction industry needs to be able to understand, obtain and use measurements accurately in a variety of situations, whether you need to read a plan to find out the height of a wall or check the width of a window frame before it’s loaded for delivery.

Being able to measure quickly, confidently and accurately is a valuable skill, as it will enable you to get the job done quickly and without mistakes, something all employers value.

Performance criteria

1.2 Interpret information regarding levels, heights, gradients and other measurements
2.1 Select and apply appropriate industry methods of measurement
2.2 Obtain measurements by physical measurement or from plans or other documentation to required degree of accuracy
2.3 Confirm measurements, including areas and volumes, and record correctly
Ways of obtaining measurements

There are several ways to obtain measurements. You can:

- Read them off a plan or drawing
- Measure them off a plan or drawing using a scale rule
- Reproduced or adapted with the permission of WA Country Builders.
- Calculate them using other known measurements
- Measure them physically using the appropriate tape measure
- Read them from the packaging
- Read them from the manufacturer’s instructions
Activity 4.1 Obtaining measurements from plans: Part 1

Study the Hopscotch Homes plan set provided at Annex E. Then circle the correct answer to each of the following questions.

1. The size of the home theatre is:
   a) 5880 × 3790
   b) 4100 × 2800
   c) 4200 × 3790
   d) 5880 × 2110.

2. The size of Bed 4 is 3880 wide by:
   a) 2320
   b) 4770
   c) 3820
   d) not shown.

3. The length of the kitchen bench to the right of the sink is:
   a) 14 – 8
   b) 2410
   c) 1810
   d) not shown.

4. The number of light fixtures in the house is:
   a) 28
   b) 27
   c) 7
   d) not shown.

5. The height of the bathroom window is:
   a) 5 course
   b) 12 course
   c) 16 course
   d) 20 course.

6. The size of the linen cupboard is:
   a) 1010 × 510
   b) 1290 × 720
   c) Lot 92 Bitter Way Beechboro
   d) not shown.

7. The roof overhangs the walls by:
   a) 600 mm
   b) 300 mm
   c) 500 mm
   d) unable to determine.

8. The number of 720-wide doors in the house is:
   a) 2
   b) 3
   c) 4
   d) 1.

9. The width of the garage-attached piers is:
   a) 250
   b) 290
   c) 350
   d) not shown.

10. The thickness of the concrete floor slab is:
    a) 100 mm
    b) 172 mm
    c) 6 courses
    d) 85 mm.
Activity 4.2 Obtaining measurements from plans: Part 2

Pictured below is a detail drawing for a bathroom. Use your scale rule to measure the missing dimensions and write them in.

Confirming measurements

Always check any measurements you’ve taken before using them. That way if you’ve made a mistake it can be corrected before it’s too late.

Activity 4.3 Confirming measurements

With a partner or in a small group, think of five ways you could check calculations, measurements from other documentation, measurements from plans or physical measurements. Write your answers in the space below.

1. 

2. 

3. 

4. 

5. 
Recording measurements

How you record a measurement will depend on how it is going to be used. Different tasks and different workplaces will have different requirements.

The most important thing is that all measurements, calculations or totals need to be recorded clearly and accurately, including using the correct units. It is important that anyone reading the information can understand it and rely on it.

Activity 4.4 Obtaining and recording physical measurements

Measure the following items around the building you’re currently in. Use the appropriate piece of measuring equipment from the selection provided, and write your answers in the spaces below.

Remember to check that all equipment is in good working order before you begin.

**Safety note:** Remember to wear a hat, long-sleeved shirt, sunglasses and sunscreen. Follow all other safety instructions given by your lecturer.

<table>
<thead>
<tr>
<th>Item</th>
<th>Equipment</th>
<th>Length</th>
<th>Width or height</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door frame</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light switch from FFL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of south wall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of footpath</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height of handrail</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car parking bay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front fence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Carry out basic measurements and calculations for residential buildings
Section 5 – Using measurements in calculations

Introduction

We looked at linear measurements earlier in this guide. Linear measurements can be used as they are, or they can be used to calculate area and volume, the next two most frequently used measurements in the construction industry.

Performance criteria

2.1 Select and apply appropriate industry methods of measurement
2.2 Obtain measurements by physical measurement or from plans or other documentation to required degree of accuracy
2.3 Confirm measurements, including areas and volumes, and record correctly
3.1 Select appropriate calculation factors and use correct methods for achieving required result
3.4 Check, confirm and record results

Uses of different measurements

Now is a good time to check what you know already about different types of measurements.

Activity 5.1 Checking your knowledge of linear, square and cubic metres

Briefly explain the following measurement terms. The first one has been done for you as an example.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Used to measure</th>
<th>Example</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear metres</td>
<td>Length, height, width, depth</td>
<td>Length of a boundary, height of a window</td>
<td>mm or m</td>
</tr>
<tr>
<td>Square metres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cubic metres</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Some specific linear measurements are shown in Table 5.1.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
<th>Graphic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter</td>
<td>The distance around the outside edge of a shape</td>
<td>![Perimeter Graphic]</td>
</tr>
<tr>
<td>Circumference</td>
<td>The perimeter of a circle</td>
<td>![Circumference Graphic]</td>
</tr>
<tr>
<td>Diameter</td>
<td>The distance across the middle of a circle</td>
<td>![Diameter Graphic]</td>
</tr>
<tr>
<td>Radius</td>
<td>The distance from the midpoint of a circle to the outer edge</td>
<td>![Radius Graphic]</td>
</tr>
</tbody>
</table>

Table 5.1: Specific linear measurements.

Some of these measurements can either be physically measured with a tape or ruler, or they can be calculated using measurements and a mathematical formula.
### Activity 5.2 Linear, square or cubic?

Fill in the spaces to show whether each of the following is a linear, square or cubic measurement, and which unit is used for each one. Some examples have been provided for you.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Linear, square or cubic?</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter of a rectangle or square ( P = (\text{length} + \text{width}) \times 2 )</td>
<td>Linear, square or cubic?</td>
<td>mm or m</td>
</tr>
<tr>
<td>Circumference of a circle ( C = \pi d )</td>
<td>Circumference of a circle</td>
<td>mm or m</td>
</tr>
<tr>
<td>Area of a rectangle or square ( A = L \times W )</td>
<td>Linear, square or cubic?</td>
<td>mm(^2) or m(^2)</td>
</tr>
<tr>
<td>Area of a circle ( A = \pi r^2 )</td>
<td>Linear, square or cubic?</td>
<td>square</td>
</tr>
<tr>
<td>Area of a triangle ( A = \frac{1}{2} \text{base} \times \text{perpendicular height} )</td>
<td>Linear, square or cubic?</td>
<td></td>
</tr>
</tbody>
</table>

### Activity 5.3 How measurements are used

Discuss with a partner an example of where you might see each of the following measurements used in the construction industry.

- Perimeter of a rectangle
- Circumference of a circle
- Area of a circle
- Area of a square
- Area of a triangle
Perimeter

*Perimeter* means the total distance, or length, around the outside edge of a figure. This measurement is used a lot in the building industry, for things like fencing, gutters and external wall lengths.

Calculating the perimeter of a rectangle

A rectangle is any four sided figure in which all angles are 90°, and opposite sides are of equal length and parallel, as shown here.

For establishing formulas, we label the longer side L (for length) and the shorter side W (for width). If \( P \) stands for the perimeter, we can write:

\[
P (\text{rectangle}) = L + W + L + W
\]

\[
= 2L + 2W
\]

\[
= 2(L + W)
\]

Therefore, the formula for calculating the perimeter of a rectangle is:

\[
P (\text{rectangle}) = 2(L + W)
\]

**Example 1**

Find the perimeter of the following rectangle.

Solution:

\[
P (\text{rectangle}) = 2(L + W)
\]

\[
= 2(140 + 60) \text{ mm}
\]

\[
= 2(200) \text{ mm}
\]

\[
= 400 \text{ mm}
\]
Example 2
Find the perimeter of a rectangle whose length is 8 m and whose width is 4 m.

Solution:

Step 1
Draw a diagram.

Step 2
Write down the appropriate formula.

\[ P \text{ (rectangle)} = 2(L + W) \]

Step 3
Substitute numbers into the formula and calculate the answer.

\[ P \text{ (rectangle)} = 2(8 + 4) \text{ m} \]
\[ = 2(12) \text{ m} \]
\[ = 24 \text{ m} \]

Activity 5.4 Finding perimeters

Calculate the following two perimeters, showing your working out in the space provided. Draw a simple diagram if it helps you.

1. Find the perimeter of a rectangle with a base length of 4.5 m and a width of 3.5 m.

2. A table measuring 820 mm by 1240 mm has a thin jarrah beading around its edge. What length does the beading need to be?
Calculating more complex perimeters

Most houses aren’t just a simple rectangle, but you can use the same method as you just learned to work out their perimeters too.

Example 1

Have a look at this example of a house drawing.

Solution:

Perimeter of rectangle = 2(L + W)
= 2(6 + 4) m
= 20 m

Have a look at the shape to see why this method works even though the shape is not just a basic rectangle.
Activity 5.5 Finding more complex perimeters

Calculate the perimeter of the shape below. Show your working out in the space provided.

[Diagram of a shape consisting of a rectangle with dimensions 5 m x 6 m and a smaller rectangle attached to one side with dimensions 2 m x 3 m, and another smaller rectangle attached to the corner with dimensions 4 m x 3 m. The perimeters of these rectangles are marked with measurement labels such as 2 m, 3 m, 4 m, 5 m, 6 m.]
Circumference, radius and diameter

The perimeter of a circle is called its circumference. The distance from the centre of a circle to any point on the circumference is called the radius. The distance across the circle through the centre is called the diameter (and equals twice the radius).

Calculating the circumference of a circle

So, if the radius (r) in the circle shown here is 30 mm, then the diameter (d) would be 60 mm (ie 2 × 30 mm).

Whenever a circle is drawn, no matter what the size, it is always the case that the circumference is approximately 3.1416 times the diameter. We refer to this figure as ‘pi’, the Greek letter π. So the formula for finding the circumference of a circle is:

\[
C = \pi \times d
\]

where:  
\[
\begin{align*}
C &= \text{circumference} \\
d &= \text{diameter} \\
\pi &= 3.1416
\end{align*}
\]
Example 1

Find the circumference of a grinding disc of diameter 50 mm.

Solution:

Step 1

Draw a diagram.

Step 2

Write down the appropriate formula.

\[ C = \pi \times d \]

Step 3

Substitute numbers into the formula and calculate the answer.

\[ C = 3.1416 \times 50 \text{ mm} \]

\[ = 157.08 \text{ mm} \]
**Example 2**

Find the circumference of a circle of radius 35 mm.

Solution:

The radius = 35 mm

∴ the diameter = 2 × 35 mm

= 70 mm

Now \( C = \pi \times d \)

= \(3.1416 \times 70 \) mm

= 219.9 mm
Activity 5.6 Finding circumferences

Calculate the following two circumferences. Show your working out in the space provided. Draw a simple diagram if it helps you.

1. Find the circumference of a circle with a diameter of 100 mm.

2. Find the circumference of a circular pool with a radius of 12 m.

Area

Area is the amount of surface something has. Square units are used for area measurements, such as mm$^2$ and m$^2$.

Area is used in the construction industry to determine things like the:

- floor area of a building, as a way of describing the size of the building
- floor area of individual rooms, to determine the quantities of flooring or floor coverings required
- wall and ceiling area, for quantities of sheeting required to cover the walls and ceilings
- roof area, to determine the number of roof tiles or amount of sheet roofing required
- area of a building block, to determine the minimum and/or maximum coverage to meet building regulations.

Area measurements are also used for the calculation of the number of bricks required to construct a wall, or for the number of pavers required for a path or driveway.

Let's look at how to calculate the area of the shapes most often found in construction.
Calculating the area of a rectangle

This is a 10 millimetre square. It covers one hundred square millimetres (100 mm$^2$) of the surface of this page.

![10 mm square]

This rectangle is 100 mm by 70 mm. It covers 7000 square millimetres (7000 mm$^2$) of the surface of this page.

![100 mm by 70 mm rectangle]

The formula for finding the area of a rectangle is:

\[ A (\text{rectangle}) = B \times H \]

where:
- $A$ = number of square units in the area
- $B$ = number of units in the base
- $H$ = number of units in the height

**Note:** Base and height might also be called length and width, or length and breadth, depending what the rectangle represents.

The base and the height must be measured in the same units.
Find the area of a wall which is 2.5 m long and 0.5 m high.

**Example 1**

Find the area of a rectangle which is 50 mm along the base and has a height of 30 mm.

Solution:

\[ A(\text{rectangle}) = B \times H \]
\[ = (50 \times 30) \text{ mm}^2 \]
\[ = 1500 \text{ mm}^2 \]

**Example 2**

Find the area of a rectangle which is 2.5 m long and 0.5 m high.

Solution:

\[ A(\text{rectangle}) = B \times H \]
\[ = (2.5 \times 0.5) \text{ m}^2 \]
\[ = 1.25 \text{ m}^2 \]
Activity 5.7 Finding the area of a rectangle

Calculate the area of a rectangle 3.5 m high with a base of 6.2 m, showing your working out in the space provided. Draw a simple diagram if it helps you.

Calculating the area of a circle

The formula for calculating the area of a circle is:

\[
A \text{ (circle)} = \pi r^2 = 3.1416 \times r \times r \\
\text{or } \frac{\pi}{4} d^2
\]
Example 1
Find the area of a circle with a radius of 100 mm.
Solution:

\[ A \text{(circle)} = \pi r^2 \]
\[ = (3.1416 \times 100 \times 100) \text{ mm}^2 \]
\[ = 31416 \text{ mm}^2 \]

Example 2
Find the area of a circle with a radius of 7 m.
Solution:

Since the diameter = 7
then the radius = \( \frac{7}{2} = 3.5 \)

\[ A \text{(circle)} = \pi r^2 \]
\[ = (3.1416 \times 3.5 \times 3.5) \text{ m}^2 \]
\[ = 38.485 \text{ m}^2 \]
Activity 5.8 Calculating areas of circles

Calculate the following two areas, showing your working out in the space provided. Draw a simple diagram if it helps you.

1. Find the area of a circle with a radius of 600 mm.

2. Find the area of a circle with a diameter of 6.4 m.

Calculating the area of a triangle

The formula for calculating the area of a triangle is:

\[ A = \frac{1}{2} (B \times H) \]
Example 1
Find the area of a triangle with a base of 16 m and a height of 5 m.
Solution:

\[ A \text{ (triangle)} = \frac{1}{2} (B \times H) \]

\[ = \frac{1}{2} (16 \times 5) \text{ m}^2 \]

\[ = \frac{1}{2} (80) \text{ m}^2 \]

\[ = 40 \text{ m}^2 \]

Example 2
Find the area of a triangle with a base of 43 mm and a height of 12 mm.
Solution:

\[ A \text{ (triangle)} = \frac{1}{2} (B \times H) \]

\[ = \frac{1}{2} (43 \times 12) \text{ mm}^2 \]

\[ = \frac{1}{2} (516) \text{ mm}^2 \]

\[ = 258 \text{ mm}^2 \]
Example 3

Find the area of the triangle below.

Solution:

\[
\text{A (triangle)} = \frac{1}{2} (B \times H) \\
= \frac{1}{2} (4.2 \times 1.5) \text{ m}^2 \\
= \frac{1}{2} (6.3) \text{ m}^2 \\
= 3.15 \text{ m}^2
\]

Example 4

Find the area of the triangle below.

Solution:

Because this is a right angled triangle, the side marked 5 mm also represents the height.

\[
\text{A (triangle)} = \frac{1}{2} (B \times H) \\
= \frac{1}{2} (12 \times 5) \text{ mm}^2 \\
= \frac{1}{2} (60) \text{ mm}^2 \\
= 30 \text{ mm}^2
\]
Activity 5.9 Finding area of triangles

Calculate the following two areas, showing your working out in the space provided. Draw a simple diagram if it helps you.

1. Find the area of a triangle with a base of 520 mm and a height of 360 mm.

2. Calculate the area of this triangle.
Calculating the area of compound shapes

In the building industry, it is often necessary to calculate the area of more complex shapes. In order to do this, we can divide them into figures whose areas can be calculated more easily, such as rectangles, circles and triangles.

Example 1

Find the area of this figure.

By dividing the figure into two separate rectangles as shown, we simply need to find each rectangle's area and combine them.

Area of rectangle A = breadth × height

= (3 × 2.5) m²

= 7.5 m²

Area of rectangle B = breadth × height

= (6 × 1.5) m² (since the breadth = 2 + 3 + 1 m)

= 9 m²

Total area of rectangles = A + B

= (7.5 + 9) m²

= 16.5 m²
Example 2

Find the area of the shaded region in this figure.

Solution:

Since the circle has a radius of 30 mm, its diameter must be 60 mm.

Furthermore, since the diameter of the circle extends to the sides of the square, then the sides of the square must also be 60 mm long.

Area of square

\[ \text{Area of square} = B \times H \]

\[ = (60 \times 60) \text{ mm} \]

\[ = 3600 \text{ mm}^2 \]

Area of circle

\[ \text{Area of circle} = \pi r^2 \]

\[ = 3.1416 \times 30 \times 30 \text{ mm} \]

\[ = 2827.44 \text{ mm}^2 \]

Area of shaded region = area of square – area of circle

\[ = (3600 - 2827.44) \text{ mm}^2 \]

\[ = 772.56 \text{ mm}^2 \]

When the area of part of a region or shape is subtracted from the area of the overall region or shape, the answer is known as the net surface area. This is used for things like calculating the number of bricks required for a wall minus the area of the openings (windows and doors), or the paving required for a courtyard minus the area of garden beds.
Activity 5.10 Finding areas of compound shapes

Calculate the following two areas. Show your working out in the space provided.

1. Find the area of this shape.

2. Find the area of the shaded part of this shape.
3. Calculate the net area (shaded part) of the wall in the sketch below. The wall height is 2450. The door is 2040 × 820 and the window is 940 × 1200.

Formula

Answer
Volume

The volume of an object is the amount of space it takes up in three dimensions. To measure volume, we have to use three dimensional units, or cubic units, such as mm$^3$ and m$^3$.

Calculations of volume in the construction industry are used to determine things like the:

- volume of soil to be excavated from the foundation for footings
- volume of soil to be removed from a sloping site to provide a level area to build on
- amount of material required as fill, eg under floor slabs
- quantity of materials required for a particular job, eg cubic metres of sand for use in bricklayer’s mortar
- volume of concrete needed for strip footings and slabs.

Calculating the volume of a rectangular solid

The volume of a prism (a solid shape whose ends are the same shape and size, and whose sides are parallel) = area of base × height

For a rectangular solid, since the base is a rectangle:

\[ A \text{ (rectangle)} = L \times B \]
\[ \text{So } V \text{ (rectangular solid)} = L \times B \times H \]
Example 1

Calculate the volume of the rectangular box shown here.

![Diagram of a rectangular box with dimensions 11 m x 3 m x 7 m]

Solution:

\[ V(\text{rectangular solid}) = L \times B \times H \]
\[ = 3 \times 7 \times 11 \text{ m}^3 \]
\[ = 231 \text{ m}^3 \]

Example 2

Calculate the volume of sand needed to fill this trench.

![Diagram of a rectangular trench with dimensions 0.5 m x 1.5 m x 5 m]

Solution:

\[ V(\text{rectangular solid}) = L \times B \times H \]
\[ = (0.5 \times 1.5 \times 5) \text{ m}^3 \]
\[ = 3.75 \text{ m}^3 \]
Activity 5.11 Finding volume

Calculate the following two volumes, showing your working out in the space provided. Draw a simple diagram if it helps you.

1. Calculate the volume of the rectangular box shown here.

![Rectangular box diagram](image)

2. Calculate the volume of cement needed for a driveway which is 10 m long, 3 m wide and 100 mm deep.
Mass

Mass is what we often call weight, or how heavy something is. It is measured in units such as grams (g) and kilograms (kg).

Different objects or substances have different masses, even if they have the same volume. For example, if you had to push a wheelbarrow of something up a ramp, which would you rather push – a wheelbarrow full of bricks or a wheelbarrow full of feathers?

Calculating mass

You may be required to calculate the mass of objects for the purpose of organising lifting equipment. To do this, you would use the formula:

\[ V \times (\text{mass of materials per cubic metre}) \]

or

\[ L \times B \times H \times (\text{mass of material per cubic metre}) \]

Example

Consider the rectangular box we looked at in Activity 5.11. Let’s work out the mass of this box if it were filled with aluminium. For this calculation, remember that aluminium has a mass of 2700 kg per cubic metre.

\[ V (\text{rectangular solid}) = L \times B \times H \]

\[ = 4 \times 3 \times 2 \, \text{m}^3 \]

\[ = 24 \, \text{m}^3 \]

Mass of box filled with aluminium = volume × (mass of material per cubic metre)

\[ = 24 \times 2700 \, \text{kg} \]

\[ = 64800 \, \text{kg} \]
Activity 5.12 Calculating mass

Calculate the following two masses for the same box, showing your working out in the space provided. Draw a simple diagram if it helps you.

1. Find the mass of the box when it is filled with solid concrete. Concrete has a mass of 2400 kg per cubic metre.

2. Find the mass of the box when it is filled with solid mild steel. Mild steel has a mass of 7850 kg per cubic metre.
Ratio

A *ratio* is a comparison or relationship between two numbers or amounts. It can be expressed as:

- the ratio of A to B
- A:B.

A ratio of 1:5 says that the second number is five times as large as the first. The numbers being compared in a ratio might be measurements such as speed or length, or amounts of substances or numbers of objects.

For example, the weight ratio of water to cement used in concrete is commonly stated as 1:4. This means that the weight of cement used is four times the weight of water used. It doesn’t tell us how much cement or water is used, or how much concrete is being made, just the relationship of the amount of cement to water.

Ratios are used in building for things like:

- mixing mortar
- expressing slope
- drawing to scale
- thinning paint.

Other units of measurement

Some materials and products aren’t measured using metric units. Sometimes in the construction industry, a term more specific to the industry and/or the type of material or product will be used to express quantity.
### Activity 5.13 Other quantities and units

Read through these examples of quantities and units of measurement. Then try to think of another example of something measured the same way and write it into the last column. If you’re not sure of some, check with your lecturer.

<table>
<thead>
<tr>
<th>Material or product</th>
<th>Quantity/ container</th>
<th>Measure/unit</th>
<th>Another example material or product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber – general</td>
<td>Lengths and packs</td>
<td>mm in 300 mm increments, eg 1800 mm, 2100 mm, 2400 mm</td>
<td></td>
</tr>
<tr>
<td>Timber – sheets (eg ply, veneer)</td>
<td>Sheets and packs</td>
<td></td>
<td>Polycarbonate sheeting</td>
</tr>
<tr>
<td>Timber – cross-sectional sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bricks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td></td>
<td>Cubic metre, m³</td>
<td></td>
</tr>
</tbody>
</table>
Section 6 – Calculating quantities

Introduction

*Quantity* is a term used in the building industry for the number or amount of materials required for a particular task. For instance, before constructing the roof frame for a house, a carpenter must be able to calculate the sizes, lengths and amount of timber needed so that the correct quantities can be ordered from the supplier.

Performance criteria

3.1 Select appropriate *calculation factors* and use correct methods for achieving required result
3.2 Apply calculations to *basic estimating activities* related to residential building
3.3 Calculate *material quantities* for the project correctly using appropriate factors
3.4 Check, confirm and record results

Now that you know how to take measurements and what types of materials you might need to calculate quantities for, it’s time to put it all together.

Bricks and mortar

Calculating how many bricks are needed to build a wall is a multi-step process. We’re going to work through how to do that now. Then we’ll have a look at the materials needed.
Bricks

The wall we’re going to work out is the west wall on the drawing below, and just the external leaf (the outside wall). We’re going to assume an external wall height of 2400, and that standard bricks will be used.

Step 1: Identify the wall

Use the north point to determine that the west wall is on the left-hand side of the plan.

Step 2: Find the length of the wall

The wall hasn’t been dimensioned, so we’ll have to measure it using a scale rule. We can see that the floor plan has been drawn at a scale of 1:100 (100 times smaller than real life) so we need to use the side of the scale rule showing 1:100.
Section 6 – Calculating quantities

Figure 6.1: Finding the length of the west wall of the plan.

So the scale rule says that the length of the wall is 6950. Can we just go ahead and use that?

What do we need to check before using a measurement scaled from a plan?

We need to make sure that the drawing has been printed at the right size. We can do this by finding something on the drawing that has been dimensioned, and checking if the measurement on the scale rule matches the dimension. In this case we can see that the north wall dimension is 11 030. Put your scale rule against that wall and see if it’s correct.

It is, so we can trust that the length of the west wall is 6950.
Step 3: Calculate the area

Draw a diagram of the wall to help.

![Diagram of a wall with dimensions 6950 mm x 2400 mm]

Step 4: Check the units

We usually measure area in square metres (m$^2$), so let's convert those dimensions from millimetres to metres first, so we can calculate the area more easily. To do that we move the decimal point three places to the left, so 6950 mm becomes 6.95 m, and 2400 mm becomes 2.40 m.

Step 5: Apply the formula

Area (rectangle) = B × H

= 6.95 × 2.40

= 16.68 m$^2$

Step 6: Determine bricks per square metre (m$^2$)

Now we have the area of the wall to be built, it’s time to work out how many bricks we’ll need. The first part of doing that is to find out how many bricks are needed to build 1 m$^2$ of wall. To do that, we need to know what kind of bricks are being used and then check the manufacturer’s information on those bricks.

Table 6.1 shows the kind of information you would find on the brick manufacturer’s website – it shows how many bricks of each size are needed for 1 m$^2$ of wall. The one that’s in bold (76 × 230) is a standard brick, which is the size we’re using. The table tells us that for every square metre of wall we want to build, we need 48.5 bricks.
Table 6.1: Brick quantities per square metre.

<table>
<thead>
<tr>
<th>Face size</th>
<th>Bricks per m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 × 230</td>
<td>48.5</td>
</tr>
<tr>
<td>119 × 230</td>
<td>32.3</td>
</tr>
<tr>
<td>162 × 230</td>
<td>24.3</td>
</tr>
<tr>
<td>162 × 390</td>
<td>14.6</td>
</tr>
</tbody>
</table>

**Step 7: Calculate brick quantity**

To work this out, we simply multiply the number of square metres of wall by the number of bricks required per square metre.

Square metres of wall = 16.68
Bricks required per square metre = 48.5
Multiply 16.68 × 48.5 = 808.98

We can’t order 0.98 of a brick, so we’ll need to round that number up to 809 bricks.

**Solution:** 809 bricks are needed to build the west wall.

**Note:** When ordering bricks for a job, an allowance also needs be made for wastage – bricks that will be wasted during construction – so the quantity ordered for this job would actually be more than 809 bricks. You’ll learn more about this in the estimating unit.

Brick suppliers provide their bricks in different ways – for example, on pallets, or just wrapped for a forklift to pick up. This may require bricks to be ordered in specific quantities, such as hundreds or thousands.
Activity 6.1 Calculating brick quantity

Follow the steps in the example we just completed to work out how many bricks will be needed to build the west wall of this house. Show your working out in the space below.
Mortar

Cement, lime and sand are used to make mortar. The manufacturer’s mortar table tells us the ratio of cement to lime to sand required.

<table>
<thead>
<tr>
<th>Mortar</th>
<th>Cement</th>
<th>Lime</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3 mortar – GP cement + Hy Lime</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 6.2: The ratio required for a particular mortar mix.

The ratio of cement to lime to sand shown in Table 6.2 is 1:1:6. This means that for every one bucket (or barrow load or shovel full) of cement in the mortar mix, we need to add the same amount of lime and six times that amount of sand, which is a calculation involving ratio for quantities.

Concrete

Concrete quantities are calculated as a volume, and measured in cubic metres (m$^3$). Working out how much concrete is needed for the slab to a building is a multi step process.

FLOOR PLAN
SCALE 1:100
Step 1: Choose the formula

Volume = L × B × H

When we’re talking about a slab, the ‘height’ refers to the thickness of the concrete. The engineer determines how thick the slab needs to be – in this case it’s 100 mm – so we just need to get the other two dimensions from the floor plan – the length and the breadth.

Step 2: Convert the units

Volume is calculated in cubic metres, so we need the three measurements to all be in metres. We have the length and breadth in metres already, but we’ll have to convert the slab height from millimetres to metres. To convert millimetres to metres, we move the decimal point three places to the left to make the number 1000 times smaller.

For example:

Start with 100 mm.

Move the decimal point three times to the left.

It becomes 0.10 m.

Step 3: Apply the formula

Volume = L × B × H

= 11.03 × 6.95 × 0.10

= 7.66585 m³

Step 4: Wastage

Even the most careful and well-calculated jobs will have some wastage. When calculating the volume of concrete required, a percentage is added to the total to allow for irregular forms, varying thickness and losses caused by spilling when transporting and depositing the concrete. The typical wastage allowance for concrete poured on the ground is 10%. This means we need to calculate and add an amount of 10% more concrete to the volume required.

Volume calculated (see above) = 7.66585 m³

7.66585 × 10% = 0.766585 m³

7.66585 + 0.766585 = 8.432435 m³

Step 5: Round the number to give the answer

Obviously no one can measure concrete completely accurately to six decimal places as calculated above, so our answer needs to be given to two decimal places, and we need to round up. That means that in our example, the amount of concrete required for the slab is 8.44 m³.
Activity 6.2 Calculating volume of concrete

Follow the steps in the example we just completed to work out the volume of concrete required to pour a 100 mm slab for this house. Show your working out in the space below.
Timber

In Figure 6.2, you can see the site plan for a new home currently under construction. The owners of the house want a fence around the back garden to keep their small children safe.

We need to calculate how many fence posts, at maximum 1800 centres, are required to fence the garden. Like the previous calculations we have done, this one also requires several steps.
Step 1: Work out the length of each section to be fenced

We know the length of the rear boundary is 17.03 m, but the rest of the area to be fenced hasn’t been dimensioned on the site plan – only the actual boundaries have. So we’ll have to measure the plan using a scale rule to work out those lengths. We can see that the site plan has been drawn at a scale of 1:200 (200 times smaller than real life) so we need to use the side of the scale rule showing 1:200.

Figure 6.3: A site plan showing the measurement of the east side.
So the scale rule says that the length of fence needed for the east side is 15 m. Can we just go ahead and use that?

What do we need to check before using a measurement scaled from a plan?

We always need to make sure the drawing has been printed at the right size. We can do this by finding something on the drawing that has been dimensioned and checking whether the measurement on the scale rule matches the dimension. In this case, we can see that the north boundary dimension is 17.03 m. Put your scale rule against that line and see if it's correct.

It is, so we can trust our scaled measurement of the east fence line, and find the other measurements we need using our scale rule.

We don't need to measure the length to be fenced on the west side, as this block is rectangular, so it's the same as the east – 15 m. We also don't need to measure the two short sections between the front corners of the house and the side boundaries, because those distances are the same as the side setback dimensions – 1500 and 4500.
Step 2: Calculate the total length to be fenced

Adding up all those measurements will give us the total length that needs to be fenced.

17.03 m + 15.00 m + 15.00 m + 1500 mm + 4500 mm

It will be easier to add this up if all the measurements are in the same unit, so let’s convert the 1500 and 4500 to metres. To do that, we just need to move the decimal point three places to the left.

17.03 + 15.00 + 15.00 + 1.50 + 4.50 = 53.03 m
Step 3: Work out the number of posts required

To work out how many posts are needed, we can just divide the total length by the required distance between centres. So 53.03 m divided by 1800 mm, or 1.8 m if we convert that distance to metres, right?

Not quite. If this were just one straight piece of fence that was 53.03 m long, that method would work, but it isn’t. Have a look at this sketch of where the fence is going and see if you can figure out why.
What is needed at the corners and where the fence meets the house?

**Step 4: Corner posts**

Wherever the fence ends or changes direction, a corner post is required. So this fence will need six corner posts. Have a look at the sketch to see where they go.

![Figure 6.5: A sketch of the position of the corner posts for the fenceline, showing a post at each corner and one at each point where the fence meets the house.](image-url)
Step 5: East side fence posts

Next we need to work out how many posts are needed for each section of fence. Let's start with the east boundary. Remember that the maximum spacing for the posts is 1800 centres. So we need to space the posts out along the boundary with no more than 1800 mm from the centre of one post to the centre of the next. So let's divide the length to be fenced by the spacing.

\[ \frac{15000}{1800} = 8.33 \]

That means we'll have eight spaces of 1800 mm each, and one of about 600 mm. The owner might want the posts spaced evenly instead, or having two close together might work for them to fix something to, like a seat. The installer will check that before digging.

This sketch shows how it could be done.

Figure 6.6: A sketch of the position of the fence posts along the east boundary, showing 10 posts and the dimensions of the spaces between them.
**Step 6: Remaining posts**

We can use the same method to work out the number of posts and spacings for the remaining four lengths of fence. Alternatively, if the sketch we drew was to scale, we could measure and draw in all the posts, which would look something like this.

![Figure 6.7: A sketch of the position of the fence posts along the entire fenceline, showing all the posts and the spaces between them.](image-url)
Step 7: Add them up

The last thing we need to do is add up the total number of post required, as follows:

East side = 10 posts
North side = 10
West side = 9
South side (left) = 1
South side (right) = 3

Total = 33

So we need 33 posts in total.

Sometimes it’s a good idea to use both methods – calculating and sketching – as a way of double-checking and avoiding errors.
Activity 6.3 Calculating the number of fence posts needed

Follow the steps in the example we just completed to work out how many fence posts are needed to fence the rear garden of this house in Sanderson Street in the same way. Show your working out in the space below.
Carry out basic measurements and calculations for residential buildings
Section 7 – Unit summary and evaluation

Performance criteria
All

Introduction
In this unit, we have looked at how to carry out basic measurements and calculations for residential buildings.

Evaluation
This is the last activity for this unit and is a reflection on what you’ve learned. Take a few minutes to complete the questions in the table and the answers will be discussed as a class group.
### Activity 7.1

<table>
<thead>
<tr>
<th>Element 1</th>
<th>Determine work requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element 2</td>
<td>Obtain measurements</td>
</tr>
<tr>
<td>Element 3</td>
<td>Perform calculations</td>
</tr>
</tbody>
</table>

In your opinion, have the stated outcomes for this unit been met?

Has this unit given you the confidence to consider a career in the residential building industry?

Are there any improvements that you can suggest for this unit for the benefit of future classes?

----------------------------------------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------------------------------------

Thank you for participating in this unit. We wish you well for your future career path. Please talk to your lecturer if you need any more information on pathways and study options.
Annex A – Unit details

<table>
<thead>
<tr>
<th>Unit title</th>
<th>Carry out basic measurements and calculations for residential buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor</td>
<td>This unit of competency specifies the outcomes required to carry out basic measurements and perform common calculations to determine task and material requirements for a typical job in residential building without a need to go onto a work site.</td>
</tr>
<tr>
<td>Employability skills</td>
<td>The following employability skills are an integral part of the delivery of this unit. They include: communication; teamwork; problem solving; initiative and enterprise; planning and organising; self-management; learning; and technology.</td>
</tr>
</tbody>
</table>
| Pre/co-requisite units | BSBOHS201A Participate in OHS processes  
CPCCCM2001A Read and interpret plans and specifications |
| Application | This unit of competency supports achievement of skills to take measurements and use these to calculate material qualities and perform calculations for tasks commonly used and applied in residential building construction work. It includes taking measurements from plans as well as making physical measurements. |

Element 1 Determine work requirements

1.1 Read and understand appropriate drawings or plans

1.2 Interpret information regarding levels, heights, gradients and other measurements

1.3 Check that measuring and calculating equipment selected to carry out tasks is consistent with job requirements, is serviceable, and any faults are rectified or reported

1.4 Work in accordance with safety policies

Element 2 Obtain measurements

2.1 Select and apply appropriate industry methods of measurement

2.2 Obtain measurements by physical measurement or from plans or other documentation to required degree of accuracy

2.3 Confirm measurements, including areas and volumes, and record correctly
Element 3 Perform calculations

3.1 Select appropriate calculation factors and use correct methods for achieving required result

3.2 Apply calculations to basic estimating activities related to residential building

3.3 Calculate material quantities for the project correctly using appropriate factors

3.4 Check, confirm and record results

Required skills and knowledge

Essential knowledge

Understanding of:

• basic calculators
• scale rulers
• basic arithmetic rules and geometric principles
• company procedures
• residential building terminology
• measuring, calculating, geometry and determination of quantities
• processes for use and care of measuring equipment.

Essential skills

Ability to:

• communicate and determine requirements
• provide clear and direct communication, using questioning to identify and confirm requirements, share information, listen and understand
• follow instructions
• read and interpret drawings and specifications
• write measurements, calculations and quantities
• demonstrate numeracy skills to apply measurements, calculations and geometry
• work with others to action tasks
• relate to people.
Range statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

**Information may include:**
- verbal or written and graphical instructions
- diagrams or sketches
- plans and specifications for simple projects
- instructions issued by authorised organisational or external personnel
- manufacturer specifications and instructions
- organisation’s work specifications and requirements
- safe work procedures or equivalent
- work schedule.

**Safety (OHS) is to be in accordance with state or territory legislation and regulations, organisational safety policy, and may include:**
- clothing and equipment
- handling of materials
- hazard control
- hazardous materials and substances
- use of tools and equipment
- concepts associated with workplace environment and safety.

**Equipment may include:**
- rulers, scale rulers, measuring tapes
- calculators, computers.

**Measurements are to:**
- be in metric scale
- cover all necessary calculations and include units.

**Areas and volumes may include:**
- calculating regular and irregular shapes, such as rectangles, squares, circles, triangles, trapeziums, rectangular solids, cubes and cylinders that represent calculations taken in a residential building environment.

**Calculation factors may include:**
- addition, subtraction, multiplication, division
- length, area, weight, height, width, depth, volume, mass, scales, ratios, perimeters, quantities, numbers
- calculation performed manually and with the aid of a calculator or other devices.

**Material quantities are to be:**
- calculated in either packed, bulk, loose or compacted stages
- converted to volumes in the other states.
Basic estimating activities may include:

- building perimeter
- floor and wall area (i.e. vertical or horizontal surfaces)
- footing and slab volume
- count of numbers of bricks/blocks, sheets or tiles on vertical or horizontal surfaces.

### Evidence guide

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, Range Statement and the Assessment Guidelines for this course.

<table>
<thead>
<tr>
<th>Critical aspects for assessment and evidence required to demonstrate competency in this unit</th>
<th>A person who demonstrates competency in this unit must be able to provide evidence of the ability to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• locate, interpret and apply relevant information</td>
<td></td>
</tr>
<tr>
<td>• comply with organisational policies and procedures, including quality requirements</td>
<td></td>
</tr>
<tr>
<td>• safely and effectively use tools and equipment relevant to measurement and calculation</td>
<td></td>
</tr>
<tr>
<td>• communicate and work effectively and safely with others in a setting similar to a builder’s or estimator’s office</td>
<td></td>
</tr>
<tr>
<td>• complete measurements, calculations and determination of quantities for different projects of basic complexity</td>
<td></td>
</tr>
<tr>
<td>• measure at least five separate tasks using a scale rule</td>
<td></td>
</tr>
<tr>
<td>• complete measurements, calculations and determinations of quantities for at least three areas of construction such as:</td>
<td></td>
</tr>
<tr>
<td>- concrete</td>
<td></td>
</tr>
<tr>
<td>- brickwork</td>
<td></td>
</tr>
<tr>
<td>- plaster</td>
<td></td>
</tr>
<tr>
<td>- wall and ceiling lining</td>
<td></td>
</tr>
<tr>
<td>- joinery</td>
<td></td>
</tr>
<tr>
<td>- timber.</td>
<td></td>
</tr>
<tr>
<td>Access and equity considerations</td>
<td>Reasonable adjustment may be made to meet individual learner needs.</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Context of and specific resources for assessment** | This competency is to be assessed using standard and authorised work practices, safety requirements and environmental constraints. Assessment of essential underpinning knowledge will usually be conducted in an off-site context. Assessment is to comply with relevant regulatory or Australian Standards’ requirements. Resource implications for assessment include: realistic tasks or simulated tasks covering the mandatory task requirements
• relevant specifications and work instructions
• tools and equipment relevant to measurement and calculation
• support materials appropriate to activity
• research resources, including industry related systems information.

Reasonable adjustments for people with disabilities must be made to assessment processes where required. This could include access to modified equipment and other physical resources, and the provision of appropriate assessment support. |
<table>
<thead>
<tr>
<th><strong>Method of assessment</strong></th>
<th>Assessment methods must:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• satisfy the endorsed Assessment Guidelines of the Construction, Plumbing and Services Integrated Framework Training Package</td>
</tr>
<tr>
<td></td>
<td>• include direct observation of tasks in real or simulated work conditions, with questioning to confirm the ability to consistently identify and correctly interpret the essential underpinning knowledge required for practical application</td>
</tr>
<tr>
<td></td>
<td>• reinforce the integration of employability skills with work place tasks and job roles</td>
</tr>
<tr>
<td></td>
<td>• confirm that competency is verified and able to be transferred to other circumstances and environments.</td>
</tr>
</tbody>
</table>

Validity and sufficiency of evidence require that:

• competency will need to be demonstrated over a period of time, reflecting the scope of the role and the practical requirements of the workplace

• where the assessment is part of a structured learning experience the evidence collected must relate to a number of performances assessed at different points in time and separated by further learning and practice. A decision on competency should only be taken at the point when the assessor has complete confidence in the person’s demonstrated ability and applied knowledge

• all assessment that is part of a structured learning experience must include a combination of direct, indirect and supplementary evidence.

Assessment processes and techniques should as far as is practical take into account the language, literacy and numeracy capacity of the candidate in relation to the competency being assessed.

Supplementary evidence of competency may be obtained from relevant authenticated documentation from third parties, such as existing supervisors, team leaders or specialist training staff.
# Annex B – Learning plan

<table>
<thead>
<tr>
<th>Session</th>
<th>Performance criteria</th>
<th>Guide</th>
<th>Resources</th>
</tr>
</thead>
</table>
| 1       | 1.1, 1.2             | Introduction
Types of plans and drawings
Users and uses
Finding information | Learner’s guide |
| 2       | 1.1, 1.2             | Measurements on plans
Linear measurements
Converting metres and millimetres | Learner’s guide
Calculator |
| 3       | 1.1, 1.2, 1.3        | Review
Activity 1.4 Interpreting a site plan
Equipment for measuring and calculating
Scaling | Learner’s guide
Calculator
Scale rule |
| 4       | 1.3, 1.4             | Review
Activity 2.4 Using measuring and calculating equipment
Working safely | Learner’s guide
Calculator |
| 5       | 1.2, 2.1
2.2, 2.3 | Obtaining measurements
Confirming and recording measurements | Learner’s guide
Scale rule |
| 6       | 2.1, 2.3             | Using measurements in calculations
Formulas
Linear, square or cubic? | Learner’s guide
Calculator |
| 7       | 2.3
3.1 | Assessment 1 due | Learner’s guide
Calculator |
| 8       | 2.3
3.1, 3.4 | Calculating perimeter
Calculating circumference | Learner’s guide
Calculator |
<table>
<thead>
<tr>
<th>Session</th>
<th>Performance criteria</th>
<th>Guide</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>2.3</td>
<td>Calculating area</td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td>3.1, 3.4</td>
<td></td>
<td>Calculator</td>
</tr>
<tr>
<td>10</td>
<td>2.3</td>
<td>Calculating volume</td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td>3.1, 3.4</td>
<td>Calculating mass</td>
<td>Calculator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other units of measurement</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>2.3</td>
<td><strong>Assessment 2 due</strong></td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td>3.1, 3.4</td>
<td></td>
<td>Calculator</td>
</tr>
<tr>
<td>12</td>
<td>1.1, 1.2</td>
<td>Calculating quantities – bricks</td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td>3.1, 3.2, 3.3, 3.4</td>
<td></td>
<td>Calculator</td>
</tr>
<tr>
<td>13</td>
<td>1.1, 1.2</td>
<td>Calculating quantities – concrete</td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td>3.1, 3.2, 3.3, 3.4</td>
<td>Calculating quantities – timber</td>
<td>Calculator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Review</td>
<td>Scale rule</td>
</tr>
<tr>
<td>14</td>
<td>1.1, 1.2</td>
<td><strong>Assessment 3 due</strong></td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td>3.1, 3.2, 3.3, 3.4</td>
<td></td>
<td>Calculator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scale rule</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Review</td>
<td>Learner’s guide</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calculator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scale rule</td>
</tr>
</tbody>
</table>
Annex C – Assessment plan

The three assessments in this unit are designed to assess your competency in the elements of 30011 Carry out basic measurements and calculations for residential buildings as listed in the unit details at Annex A to this guide.

<table>
<thead>
<tr>
<th>Due</th>
<th>Assessment</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 7</td>
<td>Assessment 1 – Calculations and units</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>This is an open-book assessment. You may seek guidance from your lecturer, and you may refer to your learner’s guide if you wish. You may use a calculator.</td>
<td></td>
</tr>
<tr>
<td>Session 11</td>
<td>Assessment 2 – Calculating perimeter, area and volume</td>
<td>2, 3</td>
</tr>
<tr>
<td></td>
<td>This is an open-book assessment. You may seek guidance from your lecturer, and you may refer to your learner’s guide if you wish. You may use a calculator.</td>
<td></td>
</tr>
<tr>
<td>Session 14</td>
<td>Assessment 3 – Calculating material quantities</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td></td>
<td>This is an open-book assessment. You may seek guidance from your lecturer, and you may refer to your learner’s guide if you wish. You may use a calculator.</td>
<td></td>
</tr>
</tbody>
</table>

Individual learning and assessment needs

Everyone has different learning styles and needs. Please let your lecturer know if there is anything that may have an effect on your learning.

Results and appeals

There is a process to be followed should you wish to appeal the result of your assessment. Please ask your lecturer for more information about this.
Carry out basic measurements and calculations for residential buildings
Annex D – Assessments
Carry out basic measurements and calculations for residential buildings
Assessment 1 – Calculations and units

This is an open-book assessment. You may seek guidance from your lecturer, and you may refer to your learner’s guide if you wish. You may use a calculator.

Read each question carefully.

Materials and equipment

To complete this assessment, you will need:

• the assessment paper
• your learner's guide
• a calculator
• a pen or pencil and an eraser.
Carry out basic measurements and calculations for residential buildings
30011

Carry out basic measurements and calculations for residential buildings

Assessment 1 – Calculations and units

Name ________________________________ Date __________

I have received feedback on this assessment.

Signature ____________________________ Date __________

Assessor’s initials
Carry out basic measurements and calculations for residential buildings
Assessment 1 – Calculations and units

Use a calculator to find the answers to questions 1–4. Show your working out if you wish.

1. Carry out the following additions.
   a) $20 + 316 + 4300 = $
   b) $5.592 + 12.476 + 0.500 = $
   c) $0.750 + 8.7744 + 2.345 = $

2. Carry out the following subtractions.
   a) $653 – 179 = $
   b) $6.76 – 1.610 = $
   c) $2969.445 – 845.708 = $

3. Carry out the following multiplications.
   a) $27.76 \times 35 = $
   b) $18.017 \times 3.58 = $
   c) $0.976 \times 0.675 = $

4. Carry out the following divisions.
   a) $1565 \div 25 = $
   b) $85.325 \div 27.5 = $
   c) $750 \div 0.75 = $

Write the answers to the following questions in the spaces provided.

5. a) The two metric units of length used in the building industry are: __________ and __________.
   b) The metric unit of area used in the building industry is __________.
   c) The metric unit of volume used in the building industry is __________.

6. Convert the following from metres to millimetres.
   \[
   \begin{array}{ccc}
   \text{Metres} & \text{Millimetres} \\
   \hline
   a) 15.662 & = \\
   b) 0.195 & = \\
   \end{array}
   \]
7. Convert the following from millimetres to metres

<table>
<thead>
<tr>
<th>Millimetres</th>
<th>Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 830</td>
<td></td>
</tr>
<tr>
<td>b) 5150</td>
<td></td>
</tr>
</tbody>
</table>

8. When dimensions in millimetres are to be used for either area or volume calculations, what should be done to the dimensions before making the calculation?

9. Write the formula for each of the following.

- Perimeter of a rectangle \( P = \)
- Area of a rectangle \( A = \)
- Area of a circle \( A = \)
- Volume of a rectangular prism \( V = \)
- Area of a triangle \( A = \)

End of Assessment 1
Assessment 2 – Calculating perimeter, area and volume

This is an open-book assessment. You may seek guidance from your lecturer, and you may refer to your learner’s guide if you wish. You may use a calculator.

Read each question carefully.

Materials and equipment

To complete this assessment, you will need:

• the assessment paper
• your learner’s guide
• a calculator
• a pen or pencil and an eraser.
Carry out basic measurements and calculations for residential buildings
30011

Carry out basic measurements and calculations for residential buildings

Assessment 2 – Calculating perimeter, area and volume

Name ___________________________ Date ____________

I have received feedback on this assessment.

Signature ________________________ Date ____________

Assessor’s initials
Carry out basic measurements and calculations for residential buildings
Assessment 2 – Calculating perimeter, area and volume

1. Calculate the perimeters of the following two shapes.
   a) 
   ![Diagram of a shape with sides 4.950, 2.470, 9.450, and 8.150]
   Formula = ______________________
   ______________________
   ______________________
   ______________________
   Answer = ______________________

   b) 
   ![Diagram of a circle with diameter 7.800]
   Formula = ______________________
   ______________________
   ______________________
   ______________________
   Answer = ______________________
2. Calculate the area of this shape.

   Formula = ________________

   Answer = ________________

3. Calculate the area of this triangle.

   Formula = ________________

   Answer = ________________
4. The measurements of this concrete cube are 2.4 H × 2.4 W × 2.4 L. Calculate the volume in cubic metres.

\[ \text{Volume} = l \times w \times h \]

Answer =

5. Calculate the net area of brick paving (the shaded area) in this sketch of a courtyard.

\[ \text{Net Area} = \text{Total Area} - \text{Areas of Excluded Regions} \]

Answer =
Carry out basic measurements and calculations for residential buildings
Assessment 3 – Calculating material quantities

This is an open-book assessment. You may seek guidance from your lecturer, and you may refer to your learner’s guide if you wish. You may use a calculator.

Read each question carefully.

Materials and equipment

To complete this assessment, you will need:

• the assessment paper
• your learner's guide
• the Hopscotch Homes plans (provided at Annex E to this guide)
• a calculator
• a pen or pencil and an eraser
• a scale rule.
Carry out basic measurements and calculations for residential buildings
30011

Carry out basic measurements and calculations for residential buildings

Assessment 3 – Calculating material quantities

Name _________________________________ Date ______________

I have received feedback on this assessment.

Signature ______________________________ Date ______________

Assessor’s initials

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Carry out basic measurements and calculations for residential buildings
Assessment 3 – Calculating material quantities

1. Calculate the net surface area of the walls of Bed 2 in this part plan.
   The ceiling height is 2450, the door is 2060 high and the window is 1810 high.

Formula = 

Answer =
2. Calculate the volume of concrete required for the porch slab in this part plan.

**Formula =**

**Answer =**
3. This sketch shows part of a block of land. A fence is to be erected on the two sides shown.

Calculate how many fence posts will be required for the job if they are to be placed at a maximum of 2.4 m centres.

Formula = 

Answer = 
4. View the Hopscotch Homes floor plan. Use your scale rule to measure the following. Give your answers in metres (m).

   a) Internal perimeter of Bed 2, excluding the walk-in-robe (WIR).

   b) External perimeter of the building including the garage.

   c) Length of the kitchen benchtops.

   d) Perimeter of the alfresco cover.

   e) Length of the steel beam (200 UB) that spans the family and meal rooms.
5. Point A has a height of 3 m above natural ground level, and point B has a height of 1 m above ground level. These two points are 10 m distance apart.
   a) What is the height difference between the two points?

   b) With the aid of a sketch, describe how the ground slopes upwards or downwards from point A to point B.

   c) What is the gradient from A to B, stated as a ratio?
6. Consider the safety policies for an estimator working in an office environment. List four safety requirements in an office environment.

- 
- 
- 
- 

7. Consider the safety policies for workers on a building site. List four safety requirements on a typical building site.

- 
- 
- 
- 

End of Assessment 3
Annex E – Plans
Carry out basic measurements and calculations for residential buildings
**Notes:**
- Sub-contractors to verify all dimensions on site.
- Downpipes to roof plumbers.
- Discreetion to assign requirements.
- Refer to detail sheet for.
- Ceiling ventilation in accordance with.
- Relevant health & gas plumbing codes.
- Cold plumbing only to gey recess.
- Joint to bends to bends to.
- Bends to bendings.
- Discreetion.
- Insulation to house & garage.
- Flashing & D.P.
- Batts insulation to house & garage.
- Flickmixer tap to kitchen sink.
- Gas/electric.
- High wall on boundary with.
- Nib.
- Cold plumbing only to dw recess.
- joints to bends to bends to.
- Bendings.
- Discretion.
- 1:100.

**Floor Plan**
- *HIA plans have been reproduced with the permission of Housing Industry Association Ltd.*
Carry out basic measurements and calculations for residential buildings
**Floor Areas**

<table>
<thead>
<tr>
<th>GARAGE</th>
<th>HOUSE</th>
<th>PORCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (m²)</td>
<td>23.88</td>
<td>150.04</td>
</tr>
<tr>
<td>Perimeter (m)</td>
<td>23.92</td>
<td>59.10</td>
</tr>
</tbody>
</table>

**Roof Area**

- HIA drawn 22.2.12
- Total 3,600 m²

**Details:**
- Tiled roof @ 21°30' pitch
- Timber battens fixed to Hardiflex lining
- Ceiling @ 28c + plate

**Conventional Roof Construction in accordance with Timber Framing Code AS1684**

- Standard roof construction as per specifications.
- Zero lot garage wall
- Barge & scribe
- Ceiling @ 28c + plate
- 10mm packer
- Lintel @ 25c
- Termite barrier (refer to detail)
- 100 x 100 post

**Elevation 1**
- Remote sectional door w/ pelmet over
- Grano @ -1c
- Tiled roof @ 21°30' pitch
- Flashing as required

**Elevation 2**
- High wall on boundary with flashing and square line gutter on top and physical termite barrier (refer to detail)
- Barge & scribe

**Elevation 3**
- Remote sectional door w/ pelmet over
- Tiled roof @ 21°30' pitch

**Elevation 4**
- Grano @ -1c
- Tiled roof @ 21°30' pitch

**Section X-X**
- Standard roof construction as per specifications.
- Zero lot garage wall

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Carry out basic measurements and calculations for residential buildings
### Floor Areas

<table>
<thead>
<tr>
<th>Area</th>
<th>GARAGE</th>
<th>HOUSE</th>
<th>PORCH</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (m²)</td>
<td>23.88</td>
<td>150.04</td>
<td>4.50</td>
<td>178.42</td>
</tr>
<tr>
<td>Perimeter (m)</td>
<td>23.92</td>
<td>59.10</td>
<td>8.60</td>
<td>91.62</td>
</tr>
</tbody>
</table>

### ROOF AREA

- HIA DRAWN 22.2.12
- Total Roof Area: 213.59 m²

### Tennant Areas

#### E1
- MIRROR
- SHELF

#### E2
- SHELF
- C-ROD & SHR SCREEN

#### L1
- TAPS
- SHELF

#### ENSUITE
- SCALE: 1:50
- MIRROR
- C-ROD & SHR SCREEN

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Carry out basic measurements and calculations for residential buildings

Annex E
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Carry out basic measurements and calculations for residential buildings
Carry out basic measurements and calculations for residential buildings
Carry out basic measurements and calculations for residential buildings
CARRY OUT BASIC MEASUREMENTS AND CALCULATIONS FOR RESIDENTIAL BUILDINGS
CERTIFICATE II IN BUILDING AND CONSTRUCTION (PATHWAY – PARAPROFESSIONAL)
30011

LEARNER’S GUIDE

DESCRIPTION
This learner’s guide will help you to carry out measurements and perform simple calculations to determine task and material requirements for a job in a construction work environment. It contains a mix of content and hands-on activities that support the unit 30011 Carry out basic measurements and calculations for residential buildings from Certificate II in Building and Construction (Pathway – Paraprofessional). The course, and this guide, focus on the skills and knowledge required to get your career started as a paraprofessional in the residential building industry.

The topics covered in this guide include:
- measuring equipment and tools, and how they’re used
- measurement methods used in the construction industry
- calculating areas and volumes
- calculating quantities of materials for construction jobs.

You will also learn about how to find the information you need to take measurements and perform calculations from drawings and plans. Assessment activities are also included.

EDITION
Edition 1, 2012
Unit and course codes updated 2014

COURSE/QUALIFICATION
Certificate II in Building and Construction (Pathway – Paraprofessional)

UNIT
30011 Carry out basic measurements and calculations for residential buildings

RELATED PRODUCTS
This resource is one of a series that covers all 12 units of the Certificate II in Building and Construction (Pathway – Paraprofessional) qualification. Please refer to our product catalogue for more information.