RIICCM201D
Carry Out Measurements and Calculations

Reference Material
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1. Introduction

This training resource provides information on how to carry out measurements, perform calculations and estimate quantities. The resource outlines your roles and responsibilities and provides information that will assist you in planning and coordinating your work. The resource includes information on obtaining and applying work instructions and working as a team to prepare for work.

Before starting work, you must plan and prepare for the work task so that you can perform the job safely, efficiently and effectively. This involves organising your time and resources and coordinating with others in order to perform the work safely and in a logical sequence.

This resource contains information that will assist you to:

- obtain and interpret site safety and work procedures from the Site Safety Plan
- plan and prepare for work, using information from briefings and documentation
- identify the basic tools and equipment used for measurement
- understand and use the most common units of measurement
- obtain base measurements to be used in calculations
- estimate quantities of materials and resources.

**NOTE**

This training resource is a guide only. Always follow site standard operating procedures when performing work.
2. **General Obligations**

You are obliged to act responsibly and perform work safely. You are also expected to take reasonable care to protect the health and safety of yourself and others by:

- reporting to a supervisor or safety representative any unsafe conditions, activities, dangerous occurrences or injuries
- using correct Personal Protective Equipment (PPE)
- using your work site's lock and tag system (if applicable)
- reporting damaged or defective equipment for repair
- not attempting any task unless you are qualified, authorised, competent and confident to perform the task safely.

3. **Legislation and Site Policies**

You must access and understand government legislation and site guidelines to perform your work within the regulations. Compliance documentation may include:

- legislative acts and regulations
- employment and workplace health and safety procedures
- organisational and site requirements and procedures
- manufacturer guidelines and specifications
- national standards
- codes of practice.

3.1 **Comply with Legislation and Site Procedures**

During your general and site specific inductions you would have been familiarised with organisational and site policies and procedures. These have been developed in accordance with legislation and are designed to ensure that work is undertaken safely.

Gather and read all relevant documents and procedures for the task that you are doing. Ensure that you understand the documents and how they apply to your work.

The general hierarchy of statutory and organisational compliance documentation is shown in the following table.
3.2 Meet Quality Requirements

Quality assurance is a system for checking that a product or service meets the specified requirements. A high quality output can only be achieved if everyone meets the quality requirements. Quality requirements can include specified dimensions, tolerances, standard of material or process, compliance, project documentation and client satisfaction. To meet the quality requirements:

- use the right equipment, tools and materials to do the job
- ensure that equipment and tools are serviceable
- operate equipment according to manufacturer guidelines and site procedures
- follow planned work schedules
- maintain quality during production processes, even when increasing quantity
- undertake a process of inspections and checks.

3.3 Comply with Standards

Standards are published guidelines that set out specifications and procedures to ensure that products, services and systems are safe, reliable and consistently perform in the way they were intended.

Standards provide a benchmark for an operation, process or consumer product to a minimum level of safety, quality, capability and community benefit. The guidelines are practical, based on current industrial, scientific and consumer experience and expectations. You must perform your work in accordance with the relevant Standards.

**NOTE**

Ensure that you know how to access the appropriate Standards relevant for your task or work activity.

3.4 Tolerances

The nature of the work requires that measurements must be accurate. However when performing estimates and calculations, slight variations may be acceptable. These variations are called ‘tolerances’. Tolerances may be the result of rounding a number up or down to the nearest whole number, the ability of equipment to exactly measure materials, or fluctuating circumstances such as temperature or humidity.

Measurements and calculations must be kept within tolerance levels that are defined in the job specifications, drawings and other quality control documents. Use measuring instruments that conform to tolerance expectations. Do not estimate widths, lengths or other items that can be measured.

3.5 Confirmation

Check and confirm the required measurement to ensure an accurate reading and verify that you have recorded the number correctly before starting the next measurement task.
10. Measuring and Calculating Tools

There are some basic tools used for obtaining measurements and carrying out simple construction calculations.

- Tape Measures – spring loaded steel tape (up to 8 m), wind up cloth tape (up to 100 m).
- Rulers – folding box and fixed steel.
- Squares and triangles are usually used for measuring materials that will be scribed and cut in situ.
- A simple mathematical calculator with +, -, x, ÷ and % functions.

10.1 Steel Tape Measure

The convenience and versatility of steel tape measures make them the most widely used measuring tool on a construction site. Tapes are marked in either millimetres or fractions of a centimetre. Because they can be stretched, steel tapes must be checked regularly against a measuring block to verify their accuracy. Dirt and moisture can also damage the face of the tape making it difficult to read. The steel end-hook must also be checked regularly for wear, as movement or bending can occur.

Steel tapes can be locked in position. This makes them particularly useful for measuring the depth of trenches while standing at ground level or for completing short measurements above head height.

The tape can be used for both internal and external measurements. When making an internal measurement ensure that the hook is butted against the internal corner. Take care that the hook does not become dislodged and that the tape is kept tight. You may need a work colleague to hold the end of the tape in position while you take the readings.

10.2 Cloth Tape Measure

Cloth tape measures are used for measuring large distances beyond the reach of a steel tape or where the measurement must be made in a single operation, as opposed to stepping-out the distance with a steel tape.

Check that the tape is clean and free of moisture. Keep the tape as tight as possible as bowing of the tape over large distances can significantly reduce the accuracy of the measurement.
10.3 Folding Box Ruler

Folding box rulers have been largely replaced by steel tapes on construction sites but still have a place in making accurate measurements over small distances. The most common type folds out to a length of 1 m in 250 mm segments. Each 250 mm section is graduated in millimetres. When using these rulers, make sure that you hold them at 90º to the surface, with the end of the ruler level with the edge of the material being measured. Sight along the opposite edge of the material to read the measurement.

Box rulers are not recommended for measuring lengths of greater than 1 metre.

10.4 Fixed Steel Rulers

Fixed steel rulers are mostly used in fabrication and engineering workshops where tolerances are critical and most measurements are of less than 200 mm. They are particularly useful for measuring the thickness of sheeting as well as the wall thickness of steel products. They can also be used for making scale measurements off plans and maps.
10.5 Calculators

Hand held calculators are a common feature on building and other industrial sites. They must be kept in a clean, dry condition. Read-out screens should be checked regularly for signs of damage or battery failure. Many small calculators are now solar powered and need to be exposed to sunlight for them to operate properly.

Press the required function button to perform basic addition, subtraction, multiplication and division operations.

Calculate percentages using a calculator. For example, to calculate 25% of 250, use the following procedure.

1. Select the number you wish to apply the % to (e.g. 250).
2. Press the x button.
3. Select the % value (e.g. 25).
4. Press the % button.

The answer (62.5) will appear in the LCD screen.

11. Obtaining Measurements

Ensure your personal safety when taking measurements on a construction site.

- Wear the appropriate PPE.
- Check the site for potential hazards before starting work.
- Be aware of moving vehicles, cranes and other construction activities going on around you.
- Do not over-reach when attempting to obtain a measurement at height.
- Check the stability of ladders, work platforms and any trenches you are working in.

11.1 Measurement Method

Select the the appropriate method of obtaining a measurement. This will depend on whether you are measuring length, perimeter, weight, area or volume. While the same basic tools may be required, the methods of calculation will vary depending on the result that you are required to determine.

Always check if the dimensions are an inside or outside measurement. This is particularly important when measuring the fit between two objects, as allowances must be made for the thickness of the material being used.

Check the accuracy of your measurements. If in doubt take a second recording. Remember the saying: “Measure twice – cut once”. For critically important measurements, check with a second person to confirm the result.
13. Calculations

Performing a calculation involves the application of a formula to a set of measurements or data. As a matter of good practice you should always record your calculations in a sequential and logical manner that will allow you, or another person, to check their validity and accuracy. Keep all base measurements and resultant calculations in a work file that clearly identifies their origin and purpose.

You must select the appropriate calculation method depending on the task. Calculations include the basic mathematical processes of addition, subtraction, multiplication and division. In addition, you may need to apply percentages or express the result as a ratio.

13.1 Perimeter

The perimeter is the total length or distance around the outside of a plane or two-dimensional object.

Examples of the use of a perimeter calculation include estimating the amount of fencing required to secure a site, or how many metres of trenching may be required for drainage.

13.1.1 Rectangular Shapes

To calculate the perimeter of a building consisting of rectangles, such as the one below, add the length of all sides. Perimeters of triangles, trapeziums and parallelograms are calculated in the same way. All dimensions are in metres.

\[
\text{(A+B+C+D+E+F) = Perimeter} \\
\text{(16 + 3 + 10 + 3 + 6 + 6) = 44 m}
\]

Calculating a Building Perimeter

\[
\text{(A+B+C) = Perimeter} \\
\text{(9.5 + 12 + 6) = 27.5 mm}
\]

Calculating the Perimeter of a Triangle

**NOTE**

In calculations you may see / used instead of +
For example: \((AxB) / 2\) is the same as \((AxB) ÷ 2\).
Also the x symbol may be left out when brackets ( ) are used.
For example: S(A-B) is the same as S x (A-B).
13.1.2 Circles

The perimeter of a circle, known as its circumference, is calculated as follows.

\[
\text{Circumference} = \pi d \text{ or } 2\pi r \\
\text{Circumference} = 15 \times 3.1416 \\
\text{Circumference} = 47.124 \text{ cm}
\]

Diameter
\(d\) of the circle is a line joining one side of the circle to the other that always travels through the circle’s centre.

Radius
The radius of a circle is a line from the centre of the circle to its edge.

Circumference
The perimeter of the circle.

Pi (\(\pi\))
\(\pi\) is a symbol used in mathematics to indicate the value of 3.1416 (approximately)

13.2 Area

An area is the amount of surface or ground covered by a structure and is measured in square metres (m\(^2\)). Area calculations are often used when estimating quantities of material such as paint or cladding.

13.2.1 Rectangular Shapes

The area of simple rectangular shapes is calculated by multiplying the length by the width dimension. The dimensions are in metres. In the case of an L-shaped building, it is necessary to divide it into two simple rectangles.

\[
\text{Total Area} = 30 + 36 = 66 \text{ m}^2
\]

Formula is \(L \times W = \text{Area}\)

<table>
<thead>
<tr>
<th>Area 1</th>
<th>Area 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A \times B)</td>
<td>(C \times D)</td>
</tr>
<tr>
<td>= 10 \times 3</td>
<td>= 6 \times 6</td>
</tr>
<tr>
<td>= 30 \text{ m}^2</td>
<td>= 36 \text{ m}^2</td>
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</tbody>
</table>

Total Area = 30 + 36 = 66 \text{ m}^2

Calculating a Building Area
## Terms and Acronyms

The following are terms commonly used on some sites. Space is provided over the page for you to add terms and acronyms common to your site.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
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<tbody>
<tr>
<td><strong>Job Safety Analysis (JSA)</strong></td>
<td>A risk management process that focuses on job tasks to identify potential hazards, assess risks and determine suitable controls to manage risks.</td>
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<tr>
<td></td>
<td>A JSA:</td>
</tr>
<tr>
<td></td>
<td>• must be completed before a high risk task commences</td>
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<td></td>
<td>• is a written record that could be used in a court of law if a serious incident occurs in the workplace</td>
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<td></td>
<td>• must be signed off by all parties who have responsibility for the work to be performed under the JSA.</td>
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<tr>
<td></td>
<td>Also called a Job Step Analysis (JSA), Job Safety and Environment Analysis (JSEA) or Job Hazard Analysis (JHA).</td>
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<tr>
<td><strong>Permits</strong></td>
<td>Permits are required for certain jobs that have high risk potential. Some permits used on work sites include Hot Work Permit, Permit to Dig/Penetrate, Confined Space and Work at Heights Permits.</td>
</tr>
<tr>
<td><strong>Site Procedures</strong></td>
<td>Site procedures are documented ways of working to achieve an acceptable level of risk. A procedure can be a Standard Work Procedure (SWP), Safe Work Instruction (SWI) or Standard Operating Procedure (SOP). Procedures are a legal requirement and outline the workplace method and processes for carrying out tasks safely and in an environmentally sustainable way. Procedures are developed after consultation with workers and are monitored and amended as required. Procedures contain detailed information such as:</td>
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<tr>
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<td>• a description of the task</td>
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<td>• a list of tools and equipment required</td>
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<td>• information on identified hazards associated with the task</td>
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<td>• risk controls, including training requirements</td>
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<tr>
<td></td>
<td>• sequential steps to perform the task safely and efficiently</td>
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<tr>
<td></td>
<td>• references to applicable workplace health and safety acts, regulations and policies.</td>
</tr>
<tr>
<td><strong>Safe Work Method Statement (SWMS)</strong></td>
<td>A SWMS documents a process for identifying and controlling health and safety hazards and risks. A SWMS must be prepared for all high-risk activities and contains detailed information such as:</td>
</tr>
<tr>
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<td>• the type of high risk work to be performed</td>
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<td>• associated hazards and risks</td>
</tr>
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<td>• risk management controls to be put in place</td>
</tr>
<tr>
<td></td>
<td>• how the risk controls will be implemented, monitored and reviewed.</td>
</tr>
</tbody>
</table>
Supporting Document Register

Use this register to note the location of important supporting documentation such as your site operating and safety procedures, work instructions, relevant standards, equipment manuals and safety alerts/bulletins.

<table>
<thead>
<tr>
<th>Document Name</th>
<th>Document Description</th>
<th>Location/How to Access Document</th>
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