Technically Drawn

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Communicating Technical Information Through Drawings and Sketches

NEW BRUNSWICK COMMUNITY COLLEGE AND CAMOSUN COLLEGE

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Introduction and Objectives

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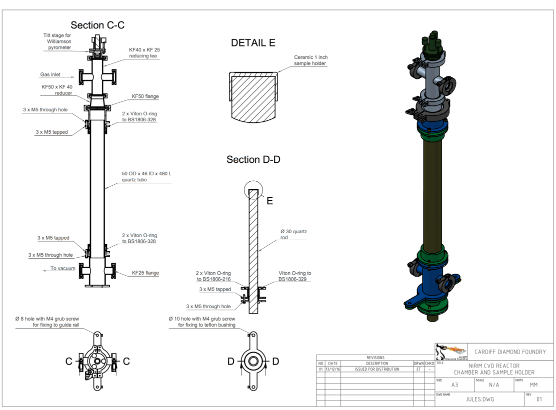
Introduction

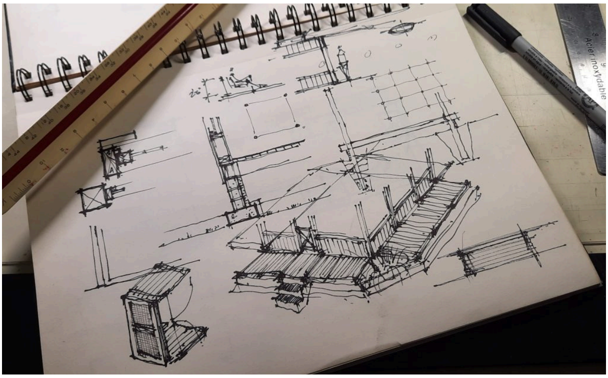
It would be almost impossible for an engineer, technologist, or architect to completely describe in words the shape, size, and features of a complex object. Technical drawings have become the universal language used by engineers, technologists, technicians, as well as craftsmen, to communicate the information necessary to build, assemble and service the products of industry.

The drawing show below is a formal CAD representation of a chemical reactor at an industrial diamond factory. A lot of information is conveyed in this drawing – there is an 3D rendering and a couple of sectional views. Annotations are added to show dimensions and descriptions of special features.



CAD *drawing*

Less formal technical drawings are sometimes sketched by hand and incorporated into notes as a means for recording observations taken at a field site, or to support a complicated mathematical analysis of lab results, such as show below. While different from formal CAD drawings these sketches share the same basic features such as symbols, line types, dimensioning, and annotation techniques, of their more formal equivalents.



Notebook sketch of deck construction

Some of the most important documents used in the workplace are technical drawings, sketches, and schematics and it is essential for anyone involved in a technology or trade be able to correctly interpret and create drawings. If you are in a construction or fabrication industry, you will need to be able to examine a drawing, take information from it, and visualize the finished product. If you are in a service or maintenance industry, you will need to interpret exploded drawings in order to properly repair or assemble equipment. If you are a technician or technologist you will need to be able to visit field sites and draw sketches to communicate what you observe to others on your team.

Objectives

- Read and interpret drawings and sketches
- Observe objects and situations with an eye to identifying important features
- Recognize and identify basic terms, components, symbols, and lines used in drawings
- Describe different types of drawing projections
- Produce annotated sketches of objects and situations
- Write legible notes

PART I

SKILLS AND TECHNIQUES

1. Observation and Measurements

CHRIS STANDEN

Learning Objectives

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

- employ key observation skills
- identify important features and measurements
- record observations with drawings and descriptive text
- compose photographs of objects and situations to convey feature details

The Cambridge dictionary defines "Observation as:

"to watch carefully the way something happens or the way someone does something, especially in order to learn more about it:"

A requirement for being able to produce technical drawings is to be able to learn everything we can about the object or situation that we need to draw. It is not difficult to observe accurately but neither is it instinctual. Learning a few key observation skills will make you better at interpreting and producing technical drawings.

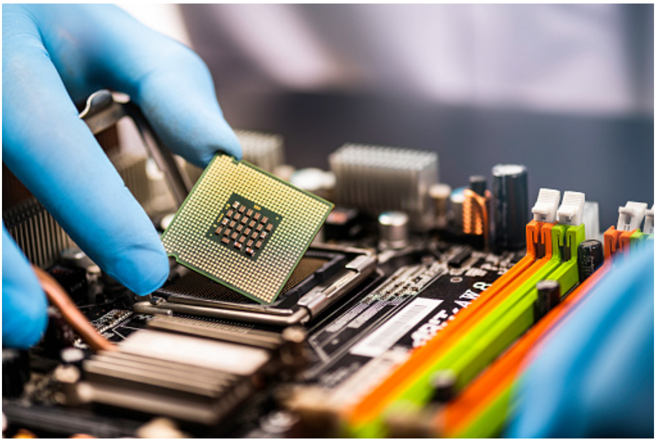
If you consider making an observation as a task, it will help focus your attention so you do not miss key details. We will consider four aspects of the observation task:

1. Recognize the context
2. Observing the features
3. Record the measurements
4. Photographing the situation

Context

The first step to observing is to **recognize the context of the task**. Do you have to produce a drawing for machining an object or are you inspecting for wear and damage during use? Maybe you are simply taking a few requested measurements at a construction site?

Once you know the context of your observation task you should identify features to look for. These could include obvious physical features but could also include things like orientation, weather, coatings, burn marks, identification tags, etc. Listing out ahead of time the details you need to fulfil the task will ensure you don't forget anything nor waste your time taking measurements you don't need.



Circuit board for inspection

Observing

We usually think of observing as a visual thing yet we can, and should observe with more than just our eyes. Remember that the goal of our observation is to learn specific things about the object or situation we are observing. That may require us to listen for abnormal noises, or smell for unusual fumes, or touch to detect changes in texture. Sometimes added tools or technology are required to properly observe the features you are looking for. Special cameras can extend your vision into small spaces or even into the infrared spectrum. Microphones can help you detect sounds too faint to hear, or too dangerous to approach.

Making observations:

- Use your senses and use tools to extend your senses
- Look for key physical features such as shape, holes, projections, lines
- Look for associated features such as colour, texture, temperature, coatings, vibrations, sound
- Pay attention to abnormalities such as smells, visible burn marks, cracks, bends, breaks, bearing sounds
- Record the environment including lighting, weather, moisture level, location, orientation, compass heading

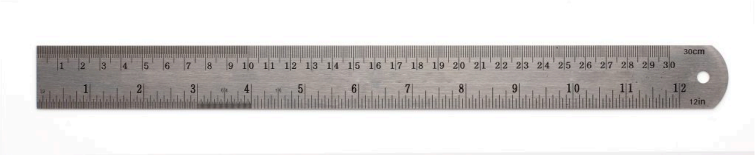
Measurements

Measurements offer key information points about the features of the object or situation being observed. For measurements to be useful they need to be accurate, and of the right precision. To be accurate, your measurement tool must be adequate for the job and the desired precision.

When taking multiple measurements, it's a good idea to try to select a limited number of reference points from which the measurements can all be taken. This simplifies the recording of the measurements and reduces the chance of errors. The reference point should be fixed and have a clear edge or point in the same plane as the measurement being taken.

Taking measurements:

- Determine which measurements are required
- Determine the appropriate precision and ensure your measurement tool is capable
- Select a reference point, or points to make measurements relative to
- Sketch the object or situation identifying the reference points
- Take and record the measurements along with identifying notes
- Transcribe the measurements on the sketch



Scale for measurement

Photography

Today's smartphones all have good quality cameras built in and its never been easier to take a quick photograph of a situation or object. Photos are a great tool to help record observations such as general shape and feature details that would be difficult to describe or sketch. Yet, photos cannot and should not replace physical observations and measurement taking.

When using your own camera phone to take photos for work you must remember to adhere to your company policies on privacy and use of personal equipment for company work. Having a work-related picture stored on your personal phone, or emailing that photo using your personal email account might result in a privacy breach and/or disciplinary action taken by your employer.

Taking photographs:

- Use company provided camera and/or verify your company policies on intellectual property and use of personal equipment
- Ensure the background of the photo is appropriate and clear of distracting features
- Set the camera to blur the background if possible
- Compose the photo carefully to ensure it captures the required features
- Adjust lighting as required
- Be careful when the background is bright as the object may appear silhouetted
- Do not include people in your photos
- Include a known object, or ruler, for scale
- Always check the photo after to ensure it is clear and correct
- Write down the filename of any photographs you take in your notebook.
- Consider the image file as company intellectual property and handle it appropriately

Photographing construction site through digital tablet

Field Inspection

When you are tasked to inspect something there might be hundreds of details that present themselves, but not all of them are important to the task at hand. In this activity, you will follow along with an experienced technologist as they make an inspection, and record the important observations and details.

Click on the hot spots from left to right and ask yourself whether *you* think the detail is important.

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Self Test

Now complete the Learning Task Self-Test.

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Key Takeaways

- **Understand your observation's context** and evaluate what important features and measurements are.

- **Record your observations** in a notebook with a sketch and descriptive text. Include the measurements you have taken.
- **Follow your company policies** when photographing a situation. You may not be allowed to use personal devices, such as cell phones, for work purposes. Write down the filename of any photographs you take in your notebook.

Self Test - Observations

CHRIS STANDEN

Self Test – Observations

Imagine you are part of a team that have been tasked to make a 3D model of kitchen appliances for use in architectural models of a kitchen. You have to go check out a fridge and come back with enough information to create the model.

1. What is the context of your observation task?
2. What specifically should you look for?
3. What senses are you going to need to make your observations?
4. What features did you observe?
5. What features can you ignore?
6. Will you be on the lookout for abnormalities or environment?
7. What measurements will you take?
8. Will you take a photo?
9. What value will the photo have?

2. Lines, lettering, and Dimensions

CAMOSUN COLLEGE

Learning Objectives

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

- identify line types used in technical drawings
- interpret dimensioning on technical drawings
- use professional lettering techniques

The purpose of technical drawings is to convey objective facts, whereas artistic drawings convey an emotion or artistic sensitivity in some way.

Technical drawings and sketches need to display simplicity and uniformity, and they must be executed with speed. Technical drawing has evolved into a language that uses an extensive set of conventions to convey information very precisely, with very little ambiguity.

Standardization is also very important, as it aids internationalization; that is, people from different countries who speak different languages can read the same engineering drawing and interpret it the same way. To that end, drawings should be as free of notes and abbreviations as possible so that the meaning is conveyed graphically.

Line styles and types

Standard lines have been developed so that every drawing or sketch conveys the same meaning to everyone. In order to convey that meaning, the lines used in technical drawings have both a definite pattern and a definite thickness. Some lines are complete and others are broken. Some lines are thick and others are thin. A visible line, for example, is used to show the edges (or "outline") of an object and to make it stand out for easy reading. This line is made thick and dark. On the other hand, a centre line, which locates the precise centre of a hole or shaft, is drawn thin and made with long and short dashes. This makes it easily distinguishable from the visible line.

When you draw, use a fairly sharp pencil of the correct grade and try to maintain an even, consistent pressure to make it easier for you to produce acceptable lines (Figure 1).

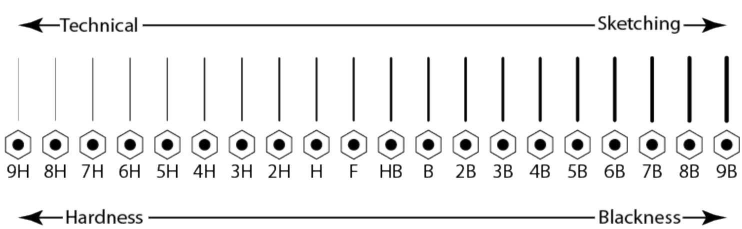


Figure 1 – Lead grade and usage

To properly read and interpret drawings, you must know the meaning of each line and understand how each is used to construct a drawing. The ten most common are often referred to as the "alphabet of lines." Let's look at an explanation and example of each type. Figure 2 shows these ten line types and how to draw them.

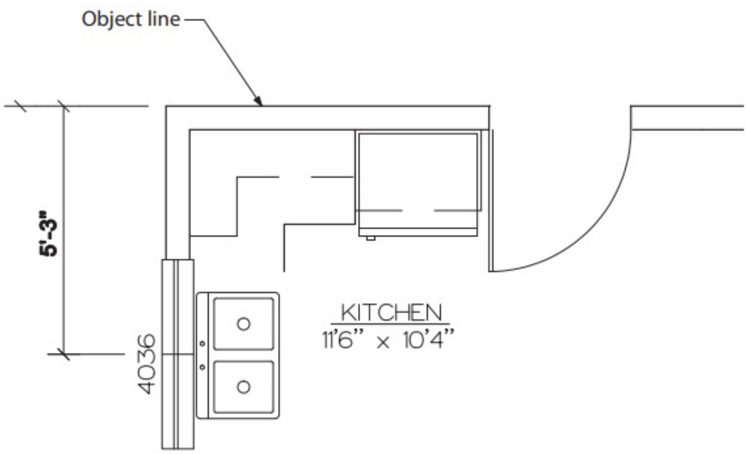
Type	Weight	Line	Description
Object line Margin line	Heavy		Solid line to show visible shape, edges, and outlines.
Hidden body line	Medium		Broken line of long and short dashes to show hidden object lines not visible to the eye.
Phantom line	Light		Broken line of short dashes to show alternate positions or movement of a part.
Section line	Light	Steel Copper/Brass Lead Cast iron/ General purpose	Unbroken lines arranged in a pattern, usually straight and at a 45º diagonal.
Projection line	Light		Unbroken lines that extend away from the object or feature for emphasis.
Centre line	Light		Broken line of long and short dashes to show the centre of an object.
Extension line/ Dimension line	Light	25 mm 25	Extension lines are small lines that extend outward from an object or feature. Dimension lines span between the extension lines and a given dimension.
Leader line	Light	Label	Unbroken line usually drawn at an angle often with a "dogleg" and an arrowhead. A dot is used in place of an arrowhead where a surface is referenced. Usually accompanied by a label.
Cutting plane line	Heavy	A A	Broken line of one long and two short dashes to show an imaginary cross-section. The arrowheads show the direction from where the cross-section is viewed. The arrowhead shape will vary
Break lines for wood and metal	Heavy		Unbroken freehand or straight zig-zag lines to abbreviate longer spans of wood or metal.
Break lines for piping	Heavy		Curled lines to abbreviate a longer span of pipe.

Technical Drawings Line Types

Figure 2 – Line Types and Techniques

Object lines

Object lines (Figure 3) are the most common lines used in drawings. These thick, solid lines show the visible edges, corners, and surfaces of a part. Object lines stand out on the drawing and clearly define the outline and features of the object.

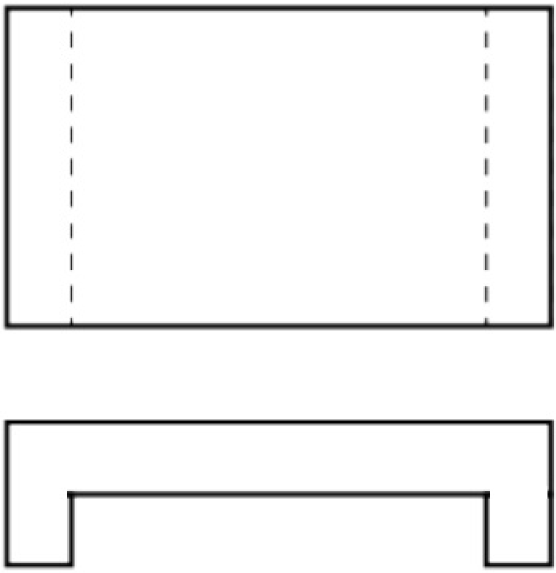


Object Lines

Figure 3 – Object lines

Hidden lines

Hidden lines (Figure 4) are used to show edges and surfaces that are not visible in a view. These lines are drawn as thin, evenly spaced dashes. A surface or edge that is shown in one view with an object line will be shown in another view with a hidden line.



Hidden Lines

Figure 4 – Hidden lines

Centre lines

Centre lines (Figure 5) are used in drawings for several different applications. The meaning of a centre line is normally determined by how it is used. Centre lines are thin, alternating long and short dashes that are generally used to show hole centres and centre positions of rounded features, such as arcs and radii. Arcs are sections of a circle, and radii are rounded corners or edges of a part. Centre lines can also show the symmetry of an object.

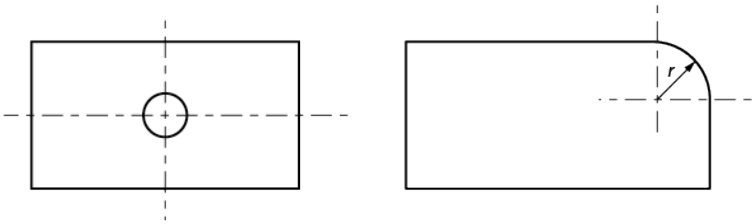


Figure 5 – Centre lines

Dimension and extension lines

Dimension and extension lines (Figure 6) are thin, solid lines that show the direction, length, and limits of the dimensions of a part. Dimension lines are drawn with an arrowhead at both ends.

Extension lines are drawn close to, but never touching, the edges or surface they limit. They should be perpendicular, or at right angles, to the dimension line. The length of extension lines is generally suited to the number of dimensions they limit.

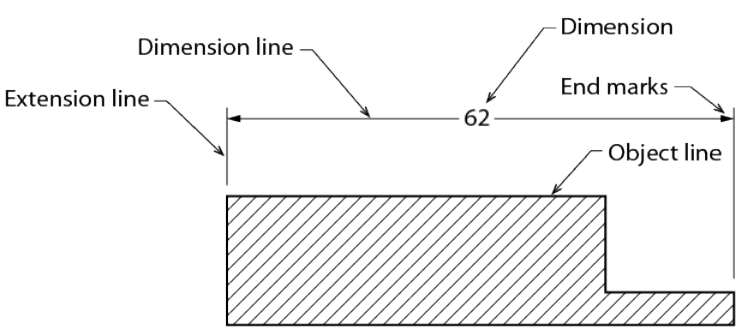


Figure 6 – Dimension and extension lines

Leader lines

Leader lines (Figure 7) show information such as dimensional notes, material specifications, and process notes. These lines are normally drawn as thin, solid lines with an arrowhead at one end. They are bent or angled at the start, but should always end horizontal at the notation. When leader lines reference a surface, a dot is used instead of an arrowhead.

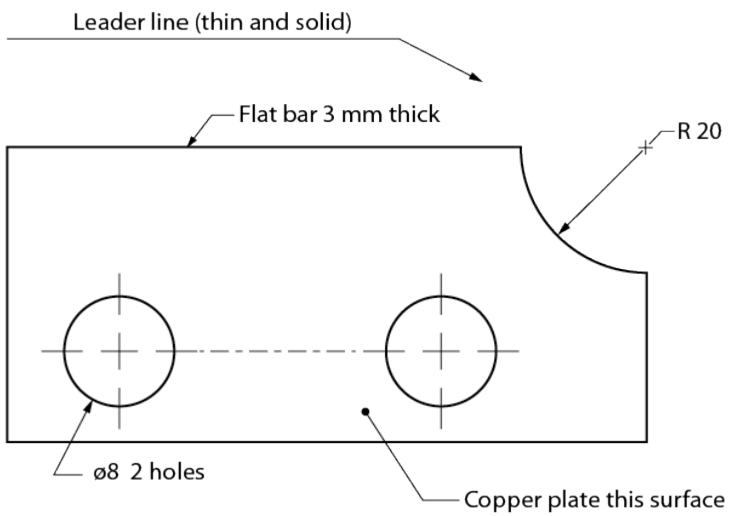


Figure 7 – Leader lines

Note that the symbol ø is used to indicate a diameter rather than the abbreviation "DIA." The number that immediately follows this symbol is the diameter of the hole, followed by the number of holes that must be drilled to that dimension.

Phantom lines

Like centre lines, phantom lines (Figure 8) are used for several purposes in blueprints. Phantom lines are used to show alternate positions for moving parts and the positions of related or adjacent parts, and to eliminate repeated details. Phantom lines are drawn as thin, alternating long dashes separated by two short dashes.

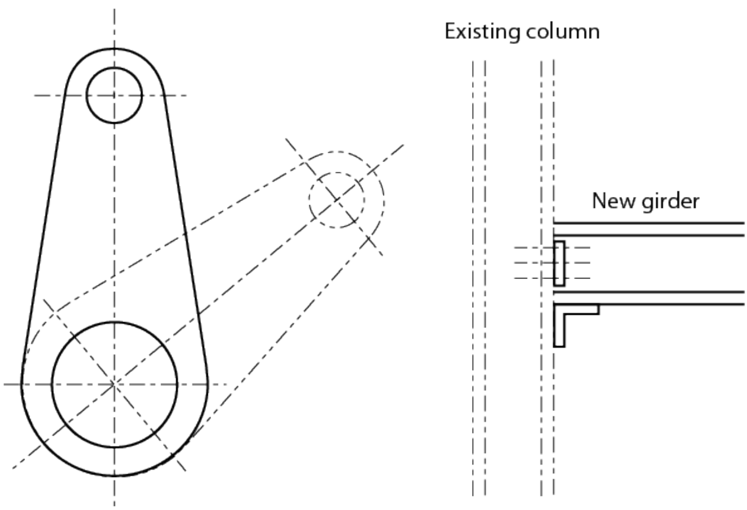
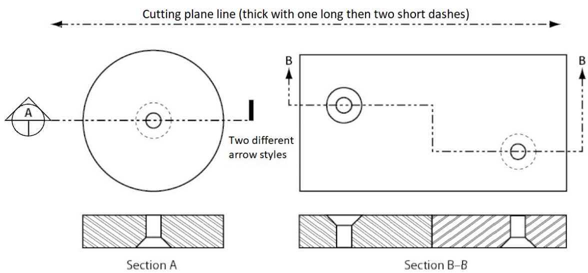


Figure 8 – Phantom lines

Cutting plane lines

Cutting plane lines (Figure 9) show the location and path of imaginary cuts made through parts to show internal details. In most cases, sectional views (or views that show complicated internal details of a part) are indicated by using a cutting plane line. These lines are thick, alternating long lines separated by two short dashes. The arrowheads at each end show the viewing direction of the related sectional view. The two main types of cutting plane lines are the straight and the offset.



Cutting plane lines with two arrow styles

Figure 9 – Cutting plane lines

Section lines or hatch patterns

Section lines, also known as hatch patterns, (Figure 10) indicate the surfaces in a sectional view as they would appear if the part were actually cut along the cutting plane line. These are solid lines that are normally drawn at 45-degree angles. Different symbols are used to represent different types of materials.

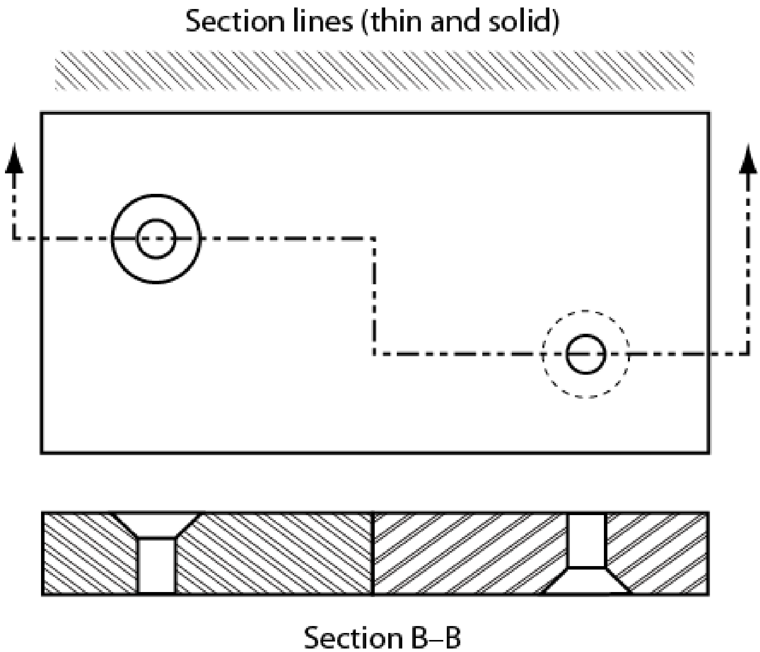


Figure 10 – Section lines combined with cutting plane lines

Break lines

Break lines are drawn to show that a part has been shortened to reduce its size on the drawing. The two variations of break lines common to blueprints are the long break line and the short break line (Figure 11). Long break lines are thin solid lines that have zigzags to indicate a break. Short break lines are thick, wavy solid lines that are drawn freehand. When either of these break lines is used to shorten an object, you can assume that the section removed from the part is identical to the portions shown on either side of the break.

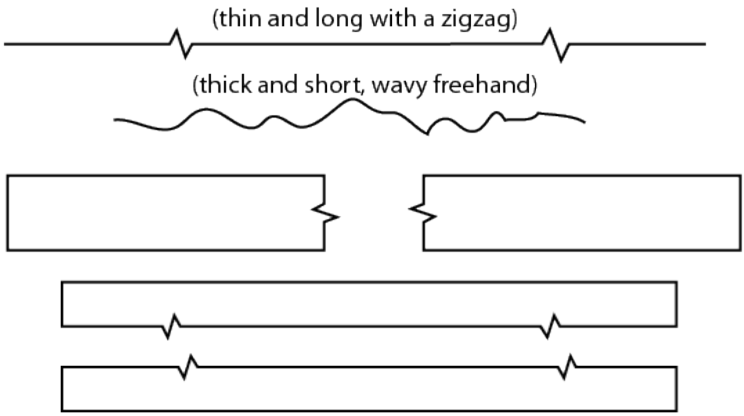


Figure 11 – Break line

Self Test

Now complete this mid-chapter self-test.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://caul-cbua.pressbooks.pub/lined/?p=78#h5p-4

Standard lettering

The letters and numbers on a drawing or sketch are as important as the lines. Scribbled, smudged, or badly written letters and numbers can become impossible to read. This may lead to time-consuming and costly errors. Lettering is necessary to describe:

- the name or title of a drawing
- when it was made
- the scale
- who sketched it
- the dimensions
- the special notations that describe the size
- the materials to be used
- the construction methods

The American Standard Vertical letters (Figure 12) have become the most accepted style of lettering used in the production of manual drafting. This lettering is a Gothic sans serif script, formed by a series of short strokes.

Font styles and sizes may vary in computer drafting. Note that all letters are written as capital (upper case) letters. Practise these characters, concentrating on forming the correct shape. Remember that letters and numbers must be black so that they will stand out and be easy to read. Lettering and figures should have the same weight and darkness as hidden lines.

Title and drawing sizes = 6 mm (¼")

A B C D E F G H I J K L
M N O P Q R S T U V W
X Y Z 0 1 2 3 4 5 6 7 8 9

Dimension and notation sizes = 3 mm (⅛")

A B C D E F G H I J K L
M N O P Q R S T U V W
X Y Z 0 1 2 3 4 5 6 7 8 9

Figure 12 – Standard lettering

Abbreviations

Abbreviations are commonly used to help simplify a drawing and conserve space. Although many fields share common abbreviation conventions, there are also field- or trades-specific conventions that you will see as you become more specialized. Here is a common list of abbreviations that are used on drawings. Each trade will have specific abbreviations from this list, and therefore a set of drawings will usually include an abbreviation key.

AB anchor bolt
ABT about
AUX auxiliary
BC bolt circle
BBE bevel both ends
BCD bolt circle diameter
BOE bevel one end
BE both ends
BL baseline
BM bench mark
Btm bottom
BP base plate
B/P blueprint
BLD blind
C/C centre to centre
COL column
CPLG coupling
CS carbon steel
C/W complete with
CYL cylinder
DIA diameter
DIAG diagonal
DIM dimension
DWG drawing
EA each
EL elevation
EXT external
F/F face to face
FF flat face
FLG flange
FW fillet weld
Ga gauge
Galv galvanized
HVY heavy
HH hex head
HR hot rolled
HT heat treatment
HLS holes
HSS hollow structural steel
ID inside diameter
IN inches
INT internal
ISO International Standards Org.
KP kick plate
LH left hand
LAT lateral
LR long radius
LG long
MB machine bolt
MS mild steel
MIN minimum
MAX maximum
MAT'L material
MISC miscellaneous
NC national course
NF national fine
NO number
MOM nominal
NTS not to scale
NPS nominal pipe size
NPT national pipe thread
O/C on centre
OA overall
OD outside diameter
OR outside radius
OPP opposite
PAT pattern
PBE plain both ends
POE plain one end
PSI pounds per square inch
PROJ project
RD running dimension
R or Rad radius
RND round
REF reference
REQ'D required
REV revision
RF raised face
RH right hand
SCH schedule
SI International System of Units
SPECS specifications
SQ square
SM seam
SMLS seamless
S/S seam to seam
SO slip on
SEC section
STD standard
SS stainless steel
SYM symmetrical
T top
T&B top and bottom
T&C threaded and coupled
THD threaded
TBE threaded both ends
TOE threaded one end
THK thick
TOL tolerance
TOC top of concrete
TOS top of steel
TYP typical
U/N unless noted
VERT vertical
WD working drawing
WP working point
WT weight
W/O without
XH extra heavy
XS extra strong

Figure 13 shows a simple drawing. Notice that the dimensions are given between arrows that point to extension lines. By using this method, the dimensions do not get in the way of the drawing. One extension line can be used for several dimensions. Notice also that the titles require larger letter sizes than those used for dimensions and notations. It is important that the title and sketch number stand out, as shown in Figure 13. When you begin lettering, you may wish to use very light lettering guide lines to ensure uniformity in lettering size and alignment.

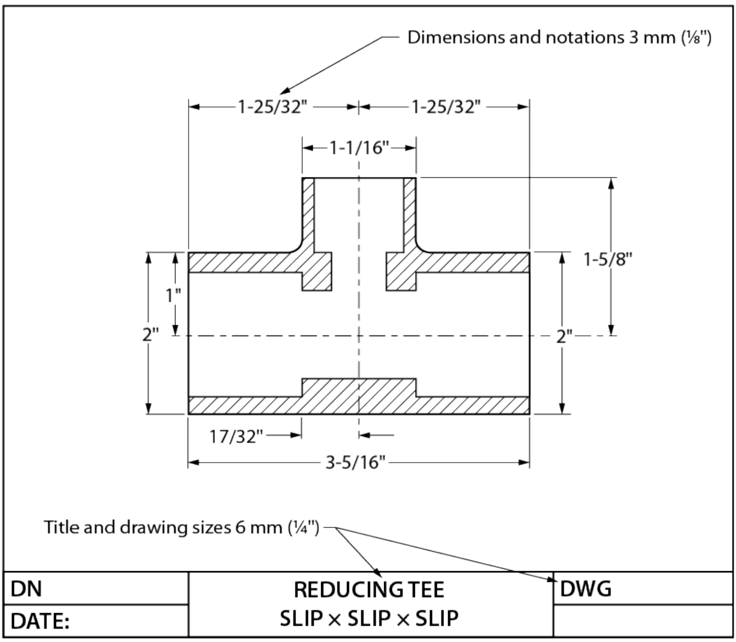


Figure 13 – Standard lettering sizes

Principles of dimensioning

A good sketch of an object is one that you can use as a blueprint to manufacture the object. Your sketch must show all the necessary dimensions of the part, locate any features it may have (such as holes and slots), give information on the material it is to be made from, and if necessary, stipulate the processes to be used in the manufacture of the object.

Three principles of dimensioning must be followed:

1. Do not leave any size, shape, or material in doubt.
2. To avoid confusion and the possibility of error, no dimension should be repeated twice on any sketch or drawing.
3. Dimensions and notations must be placed on the sketch where they can be clearly and easily read.

Consider Figure 14 and note whether these three dimensioning principles have been followed.

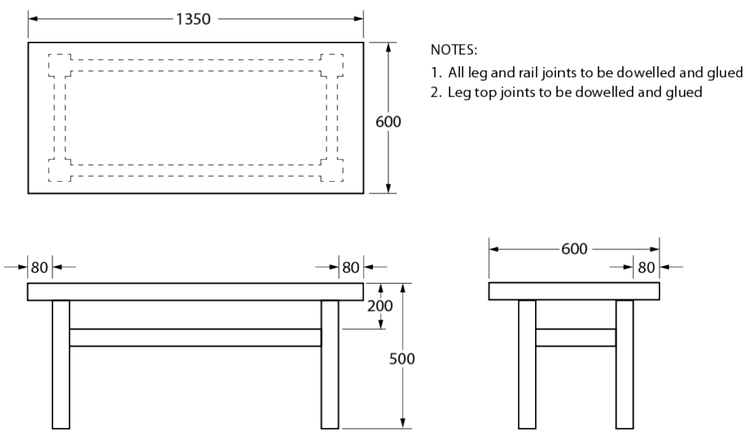


Figure 14 – Shop table

Although the dimensions and notations are clear and easy to read in Figure 14, the following points should be made:

- Leg and rail sizes have not been shown.
- The thickness of the top has not been given.
- The material has not been given as a notation.
- The 600 dimension has been repeated.

- The type of finish to be used has not been given.
- Note 2 is redundant.

The sketch of the shop table is far from complete, and the table could not be made without a lot of guesswork. Figure 15, on the other hand, shows a completed sketch that, along with the necessary notes and dimension information, can be readily used for construction purposes.

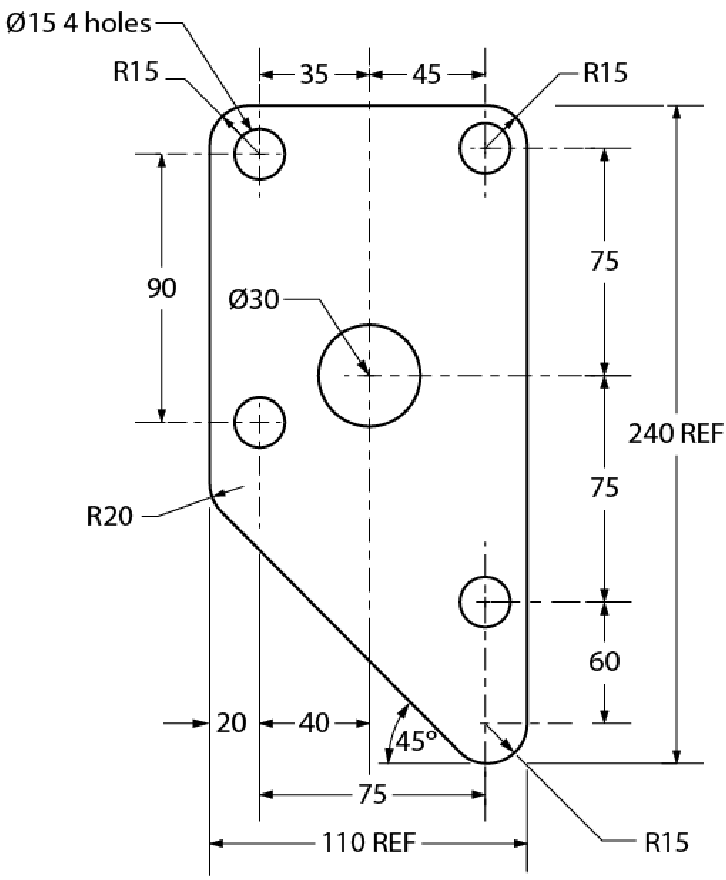


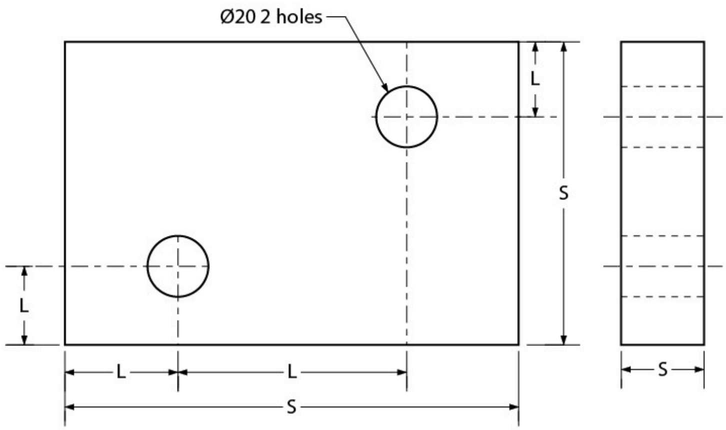
Figure 15 – Dimensioning

Rules of dimensioning

For most objects, there are three types of dimensions:

- size dimensions
- location dimensions
- notation dimensions

Figure 16 illustrates the difference between size and location dimensions. (S = size dimension and L = location dimension).



Location and size dimensions

Figure 16 – Shim plate

Size dimensions are necessary so that the material size of the object can be determined. Location dimensions are necessary so that parts, holes, or other features can be positioned in or on the object. Notation dimensions describe the part, hole, or other feature with a short note such as the “ø20 2 holes” notation (see Figure 16). Keep these points in mind:

- Keep all dimension lines at least 10 mm (3/8“) clear of object lines wherever possible.
- Try to group related dimensions rather than scattering them.
- Try to keep dimensions off the views themselves.
- Separate one line of dimensions from another line of dimensions or from a notation by a space of at least 10 mm (3/8“).
- Leave a space of approximately 3 mm (1/8“) between the object outline and the beginning of any extension line.
- Keep arrowheads slim and neat.
- Never dimension to a hidden line.
- Draw leader lines at an angle when intersecting object lines to avoid confusing them with extension lines.

Figure 17 illustrates good placement of dimensions and notations. Note the placement of extension lines and the use of centre lines to locate features such as holes. Also, note the shape and size of arrowheads.

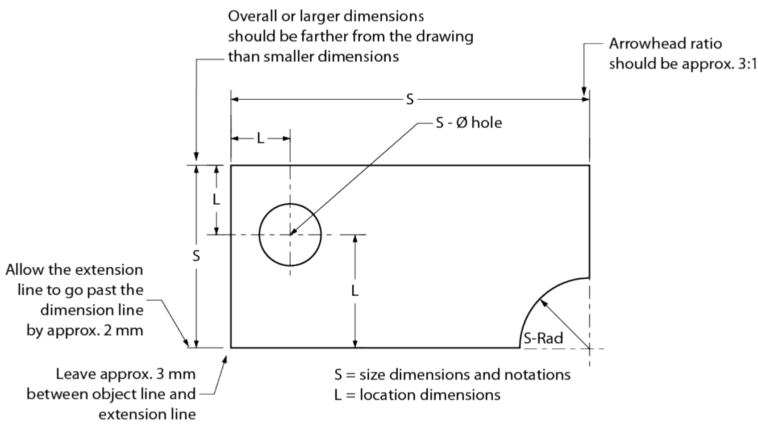


Figure 17 – Extension line usage

Dimensioning systems

Two systems are used for dimensioning drawings. They are the aligned and the unidirectional systems. Figure 18 shows examples of both systems. As you can see, the aligned system requires that you turn the drawing on its side, whereas the unidirectional system may be read from the normal reading position. For most drawings, the unidirectional system is preferred, as it is easier to read; however, architectural drawings still use the aligned system.

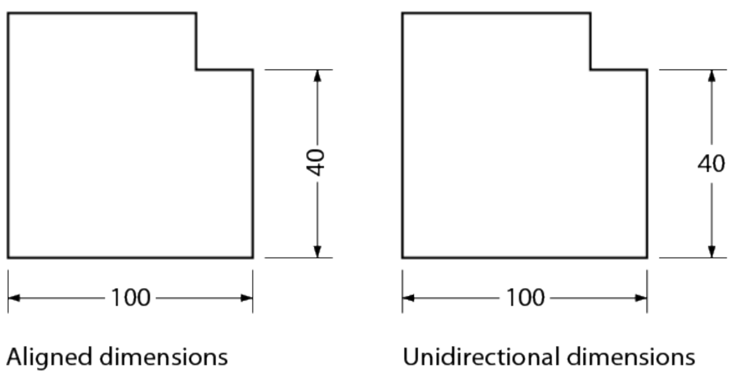


Figure 18 – Dimensioning systems

Systems of measurement

You may be required to sketch or read drawings constructed with either metric (SI) or imperial dimensions. You may also encounter drawings that are dual-dimensioned and contain both systems of measurement on the same drawing.

SI system of measurement

The SI system of measurement has become the official standard in Canada. It is common practice on shop drawings to express all metric dimensions in millimetres. Figure 19 shows a detailed drawing for a connector arm using metric measurements. All metric drawings should contain a note specifying that all dimensions are in millimetres.

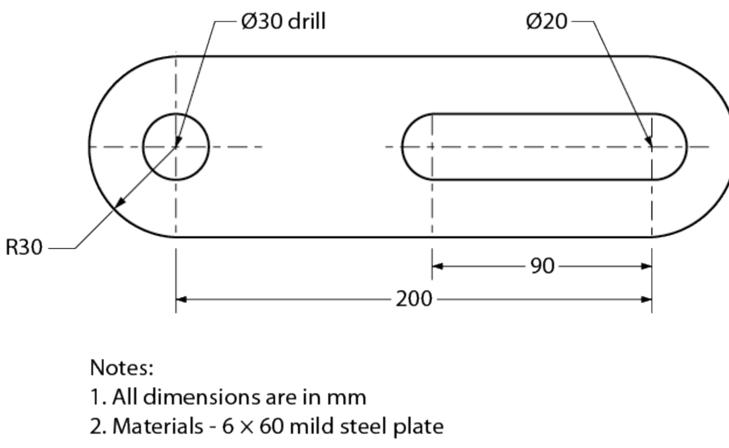


Figure 19 – Connector arm – metric measurement

Imperial system of measurement

An imperial drawing may use the decimal-inch system, the fractional-inch system, or feet and inches.

- In the decimal-inch system, very accurate dimensions for items such as machine parts are expressed as decimals of an inch, such as 0.005“. In words, this reads as five one-thousandths of an inch.
- In the fraction-inch system, dimensions for things such as steel and lumber sizes are expressed as inches and fractions of an inch from as small as 1/64“ (Figure 20). Most drawings that are dimensioned in the imperial system will use the fraction-inch system.

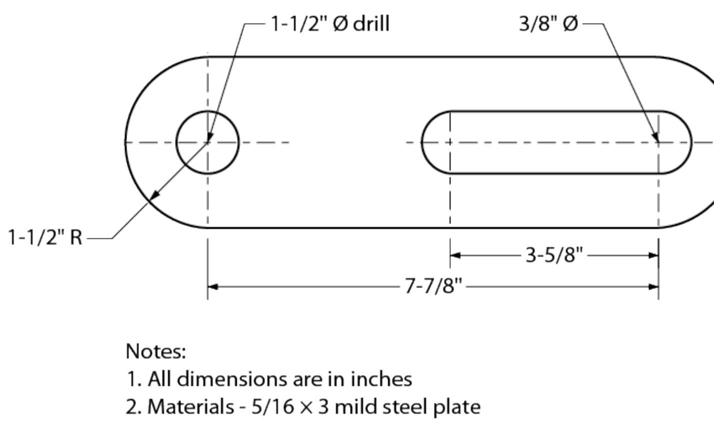


Figure 20 – Connector arm – imperial measurement

In the feet-inch system (Figure 21), the dimensions of large structures such as machine frames and buildings are expressed in feet and inches, such as 2‘-6“ (two feet, six inches).

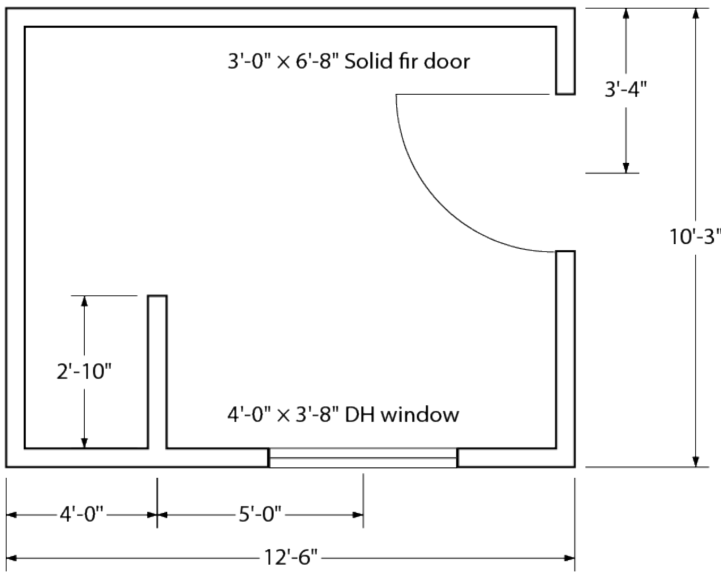


Figure 21 – Fuel storage shed

Dimensioning orthographic sketches

The following are rules and procedures for dimensioning single- and multi-view sketches:

- Place dimensions on views that show parts of features as solid outlines. Avoid dimensioning hidden lines wherever possible.
- Try to keep dimensions between views. Leave adequate room between views when you begin your sketch.
- Keep the smallest dimensions nearest to the object outline.
- Diameters in metric measurement should be denoted on a sketch using the symbol ø (e.g., ø20 – 2 holes). A radius should

be denoted using the letter R (e.g., R 25).

- Diameters in imperial measurements may be denoted on a sketch by the symbol ø or the abbreviation DIA (e.g., 3“ ø DRILL or 4½“ DIA). A radius may be denoted using the letter R or the abbreviation RAD (e.g., 3“ R or 6½“ RAD).
- Arrows carrying notations should always point toward the centre of circular objects.
- Arrows should always point toward a circle centre when dimensioning a diameter and away from the centre when dimensioning a radius.

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://caul-cbua.pressbooks.pub/lined/?p=78#h5p-19

Key Takeaways

- **Technical drawings convey objective facts**, and those facts are represented by the lines and text on the drawing.
- **Different styles and thicknesses of lines** are used to convey different aspects of the object being drawn.
- **Text must be printed and legible.** Dimensions must be clearly located with extension lines and arrows.

Self Test - Lines, Lettering, and Dimensions

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Self Test – Lines, Lettering, and Dimensions

1. Which line in a drawing should be the darkest and thickest?
   a. Centre line
   b. Hidden line
   c. Object line
   d. Dimension line

2. Which type of line in a drawing is a broken line of alternating short and long dashes.
   a. Centre line
   b. Hidden line
   c. Phantom line
   d. Compression line

3. What is the name of a line in a drawing that shows a hidden feature?
   a. Buried line
   b. Missing line
   c. Hidden line
   d. Concealed line

4. A break line shows where part of an object in a drawing has been removed.
   a. True
   b. False

5. A drawing should have all dimensions shown in every view.

a. True

b. False

6. Which line is used to shows notes or specifications in a drawing?

a. Leader line

b. Object line

c. Extension line

d. Phantom line

7. How are alternate positions of moving parts shown in a drawing?

a. With a break line

b. With a hidden line

c. With an object line

d. With a phantom line

8. What does a sectional view in a drawing normally show?

a. Outside of a part

b. Inside dimensions

c. Internal features of a part

d. Internal holes and slots

9. What do the arrows that locate a sectional view in a drawing indicate?

a. Side the part is cut on

b. Internal holes and slots

c. Direction of the standard view

d. Direction of observation when the section is drawn

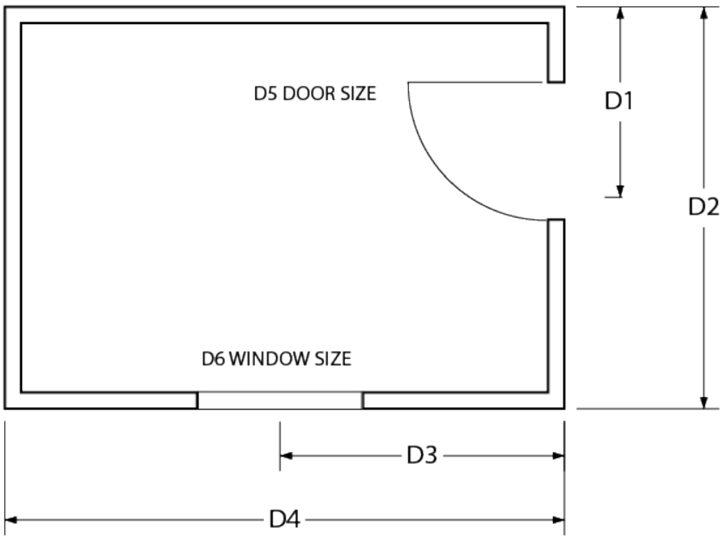
10. In the drawing, indicate what type of dimensions are shown by D2 and D4

a. Size dimensions

b. No dimensions

c. Notation dimensions

d. Location dimensions



3. Views and Projections

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Learning Objectives

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

- identify views used in technical drawings including perspective, isometric, oblique, orthographic, plans, elevations, and sections

Architectural drawings are made according to a set of conventions, which include particular views (floor plan, section, etc.), sheet sizes, units of measurement and scales, annotation, and cross-referencing.

Types of views used in drawings

The two main types of views (or “projections”) used in drawings are:

- pictorial
- orthographic

Pictorial views

Pictorial views show a 3-D view of how something should look when completed. There are three types of pictorial views:

- perspective
- isometric
- oblique

Perspective view

A perspective view presents a building or an object just as it would look to you. A perspective view has a vanishing point; that is, lines that move away from you come together in the distance. For example, in Figure 1, we see a road and line of telephone poles. Even though the poles get smaller in their actual measurement, we recognize them as being the same size but more distant.

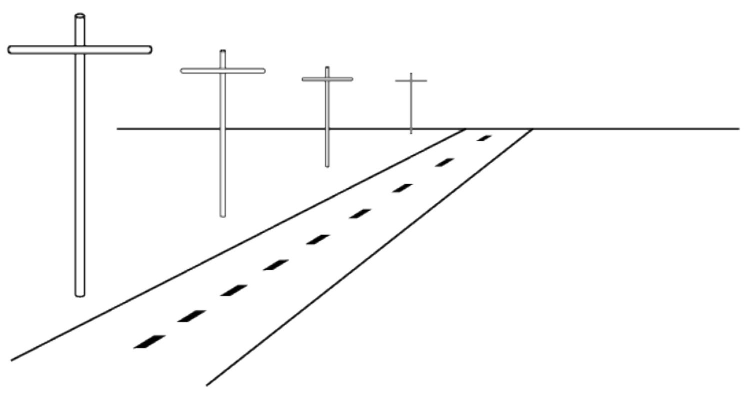

Figure 1 – Perspective view

Isometric view

An isometric view is a three-dimensional view. The plumb lines are vertical. The horizontal lines are set at 30 degree angles from a line parallel to the bottom of the page. Isometric views have no vanishing point, so the objects do not appear as they would in a perspective view. Lengths are exact on isometric drawings only when the item is parallel to one of the axes of the drawing. Figure 2 shows an isometric view of a simple object, as well as the lines that represent the three dimensions.

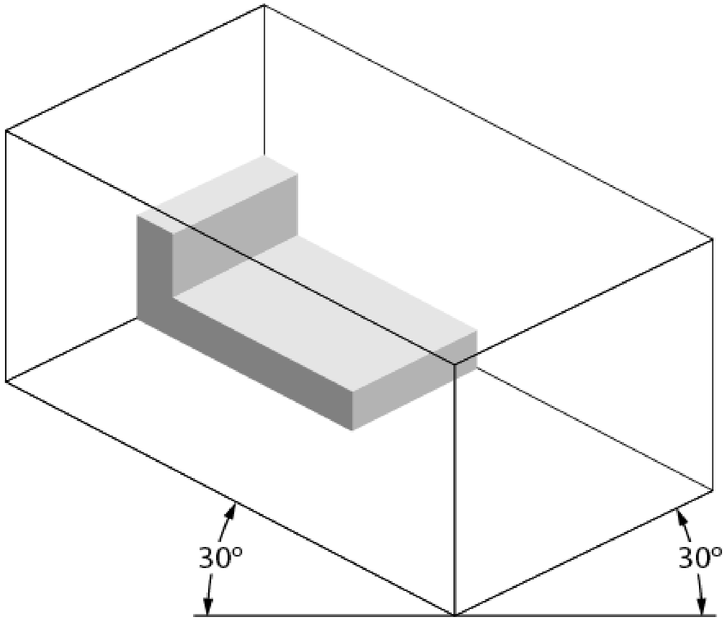

Figure 2 – An isometric view

Oblique view

An oblique view is similar to an isometric view, except that the face or front view is drawn to exact scale and the oblique lines are extended at a 30 degree to 45 degree angle to create a three-dimensional representation (Figure 3).

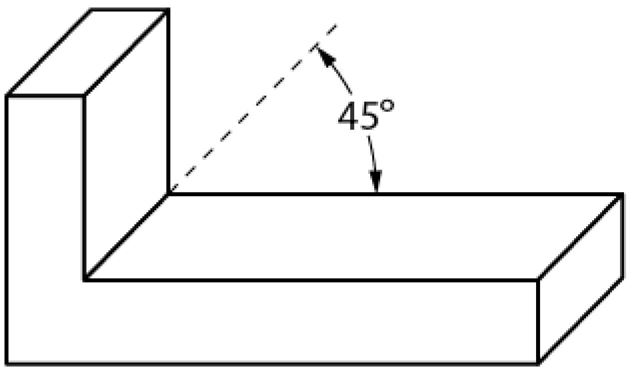

Figure 3 – Oblique view of the object in Figure 2

Multi-view (orthographic) drawings

Pictorial drawings are excellent for presenting easy-to-visualize pictures to the viewer, but there are some problems. The main problem is that these drawings cannot be accurately drawn to scale. Also, they cannot accurately duplicate exact shapes and angles. As this information can be essential, another form of drawing is used, one that has several names, including orthographic projection, third angle projection, multi-view projection, and working drawing. Each projection is a view that shows only one face of an object, such as the front, side, top, or back. These views are not pictorial.

To interpret or read these drawings you must first understand how the views in a multi-view drawing are developed and how each view relates to the other views. The best way to understand the principle of orthographic views is to suspend the object you wish to draw inside an imaginary glass box. If you were to look at the object through each side of the box and draw onto the glass the view of the object you see through the glass, you would end up with a sketch similar to that shown in Figure 4.

The view through each side of the glass box shows only the end view of one side of the object. All lines are straight and parallel because the original object has sides that are straight and parallel. Each view represents what you see when you look directly at the object.

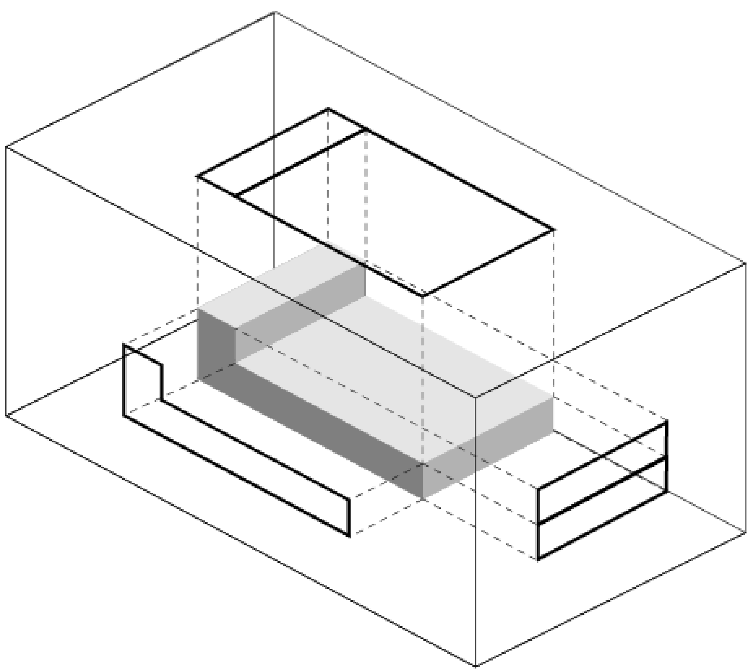

Figure 4 – Multi-view through a glass box

If you were to open up the glass box, as shown in Figure 5, each view would be in the correct position for a true orthographic drawing. Each view is given a name that reflects its position in relation to the other views.

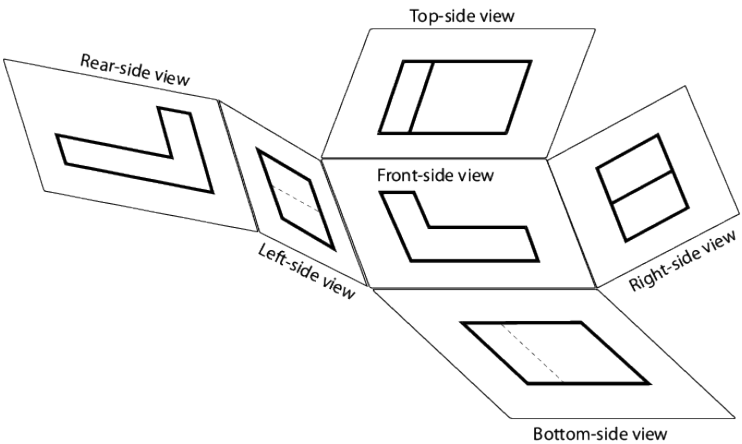

Figure 5 – Box opened to produce orthographic views

When the imaginary glass box is flattened as shown in Figure 6, you can see that each view is in line with the adjacent view. Then the edges of the box are removed and you have a six-view orthographic drawing of the original object (Figure 7). These six views are called the six principal orthographic views. This view alignment is important and is always consistent in orthographic projection. You will seldom need to show views of all six sides of an object; usually it is sufficient to show just two or three. You should remember the names of these six views and understand how they are obtained in case you ever need to show an object that cannot be truly represented in two or three views.

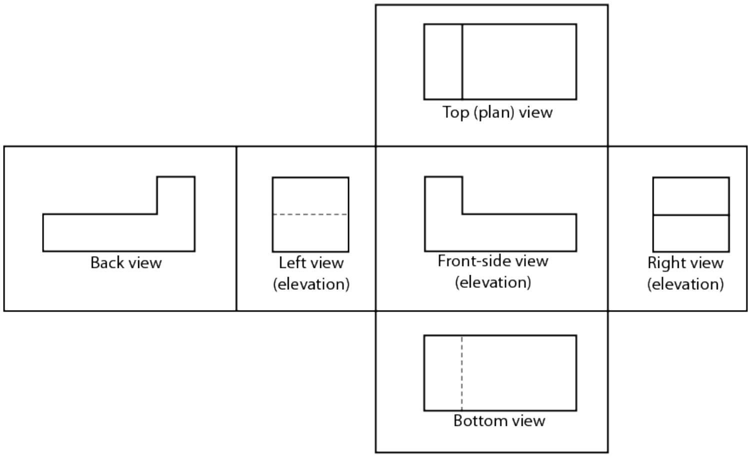

Figure 6 – Drawing with the glass box flattened out

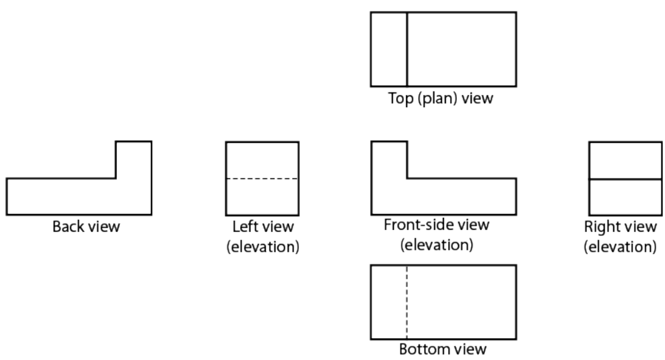

Figure 7 – Orthographic views of the object in Figure 2

Unless the object is very complex, only the front, top, and right-side views are necessary. If the object has a uniform thickness, only one or two views are necessary. You should not show more views than are necessary. The front, left, back, and right views are also referred to as elevations.

Floor plan

A floor plan (or floor drawing) is an orthographic plan view (or top view) looking down on the various floor levels. Floor plans are one of the most important drawings for construction, as they provide the most information about the building. Floor plans identify rooms by name or number. They give the:

- room dimensions
- overall dimensions
- doorways
- windows
- plumbing fixtures
- equipment
- location of structural members and walls

Figure 8 shows the floor plan for the main floor of a house.

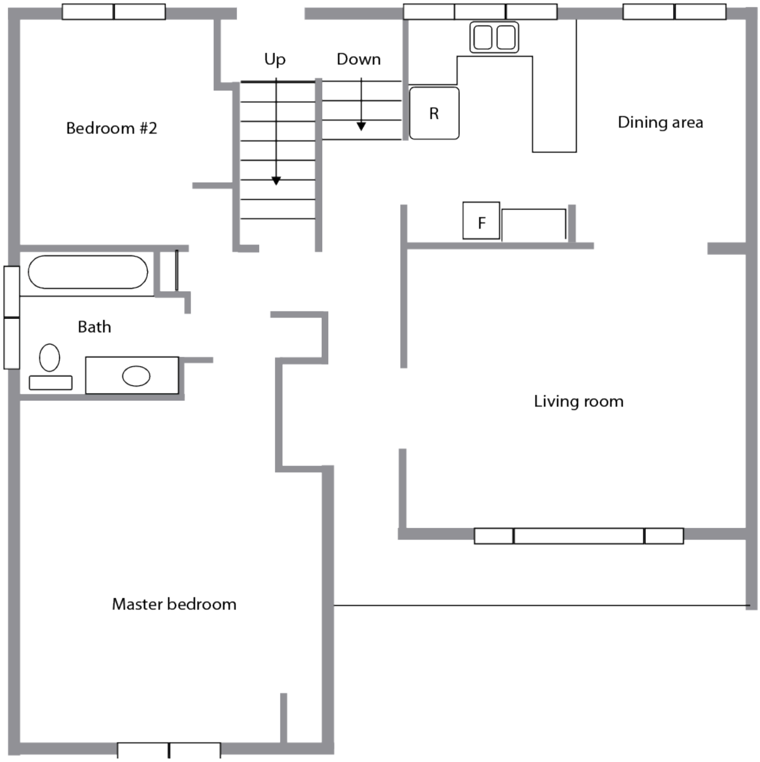

Figure 8 – Main floor plan of a house

Elevation drawings

An elevation drawing (called an elevation) is a view of any vertical surface and is taken from the floor plans (Figure 9). Normally, elevation drawings include the front, back, and side orthographic projections of the buildings. The elevation drawings show what the exterior of the building will look like when it is finished. The drawings show the finished grade line, the finish materials, and the door and the window locations. Elevation drawings may also show interior walls that have special features, such as fireplaces or kitchen cabinets.

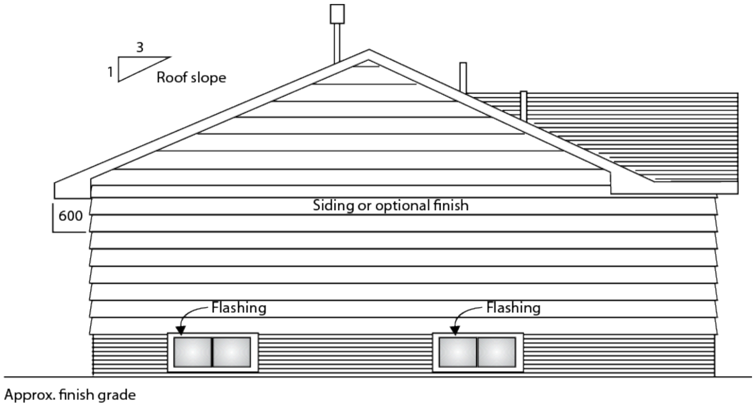

Figure 9 – Left elevation of house in Figure 8

Section drawing

Section drawings (called sections) provide detailed drawings of the cross-section of a building or wall unit (Figure 10). The scale of these drawings is large (about 1:20), which allows different structural members to be drawn so that the construction details are seen clearly.

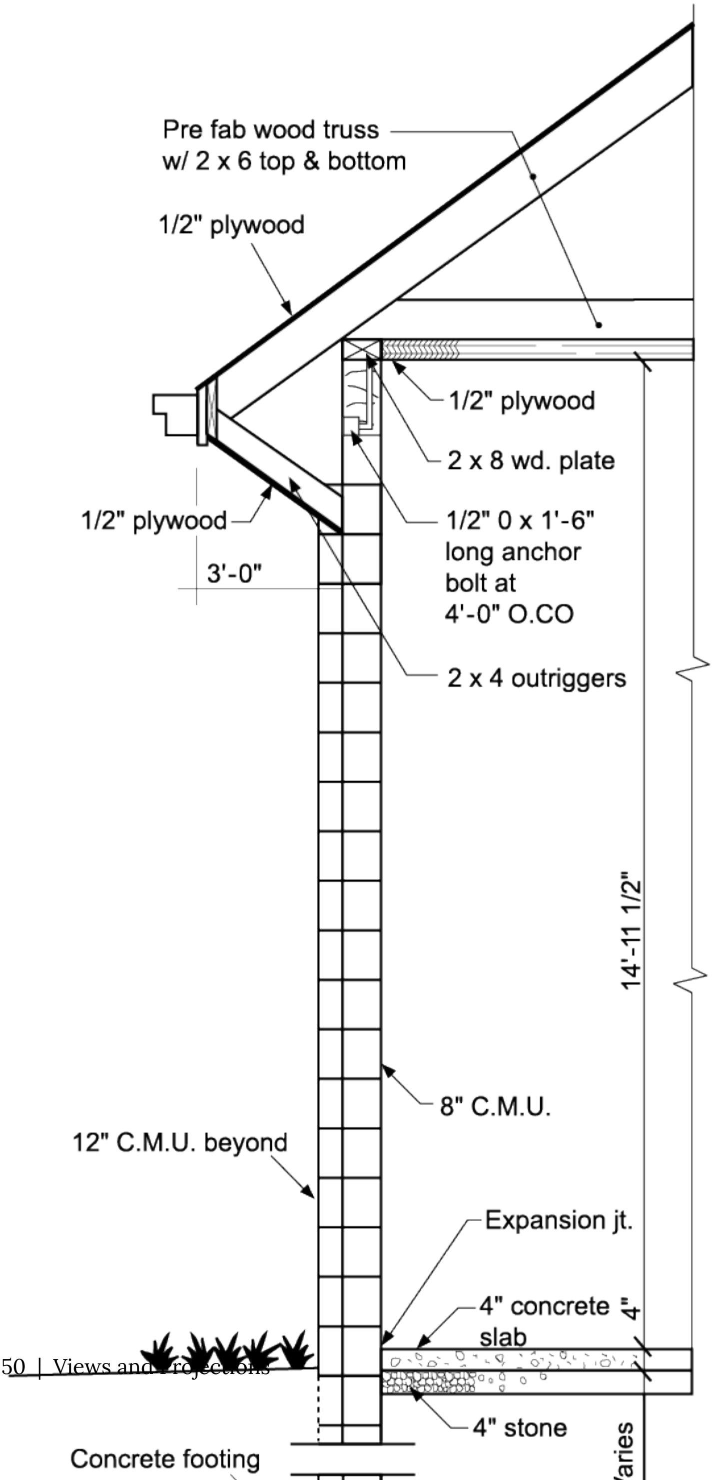
Pre fab wood truss
w/ 2 x 6 top & bottom
1/2" plywood
1/2" plywood
2 x 8 wd. plate
1/2" plywood
1/2" 0 x 1'-6"
long anchor
bolt at
4'-0" O.CO
3'-0"
2 x 4 outriggers
14'-11 1/2"
8" C.M.U.
12" C.M.U. beyond
Expansion jt.
4" concrete
slab
4"
4" stone
Concrete footing
Varies

Figure 10 – Section A-A

Sectional views give information about wall construction and exterior and interior wall finish. To avoid any confusion, the precise location or cut of a sectional view is given in another drawing, such as detail drawing or a floor plan. For example, the reference in the lower left-hand corner of Figure 11 shows the location of the section in Figure 10. The line drawn through the wall indicates the point and span of the cut and the arrows indicate the direction of view.

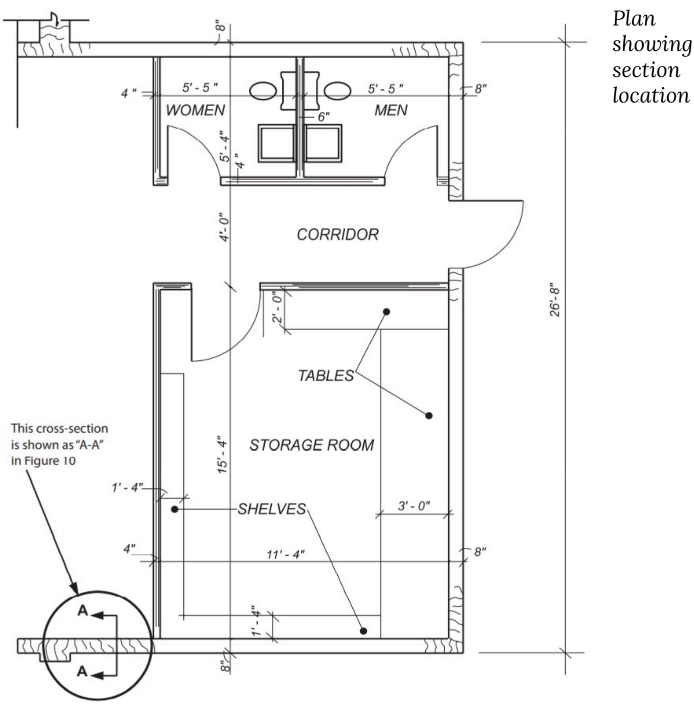

Figure 11 – Plan showing section A-A

Measurements on orthographic drawings

To get all of the measurements required, you will need to refer to more than one view. For example, you cannot take elevation measurements from a plan view.

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://caul-cbua.pressbooks.pub/lined/?p=116#h5p-20

Key Takeaways

- **Pictorial views show a 3-D view** of the object of the drawing and are the best views for visualizing an object's shape.
- **Orthographic views show a 2-D view** of the object

from multiple directions and are the best view for showing detail and measurements.

Self Test - Views and Projections

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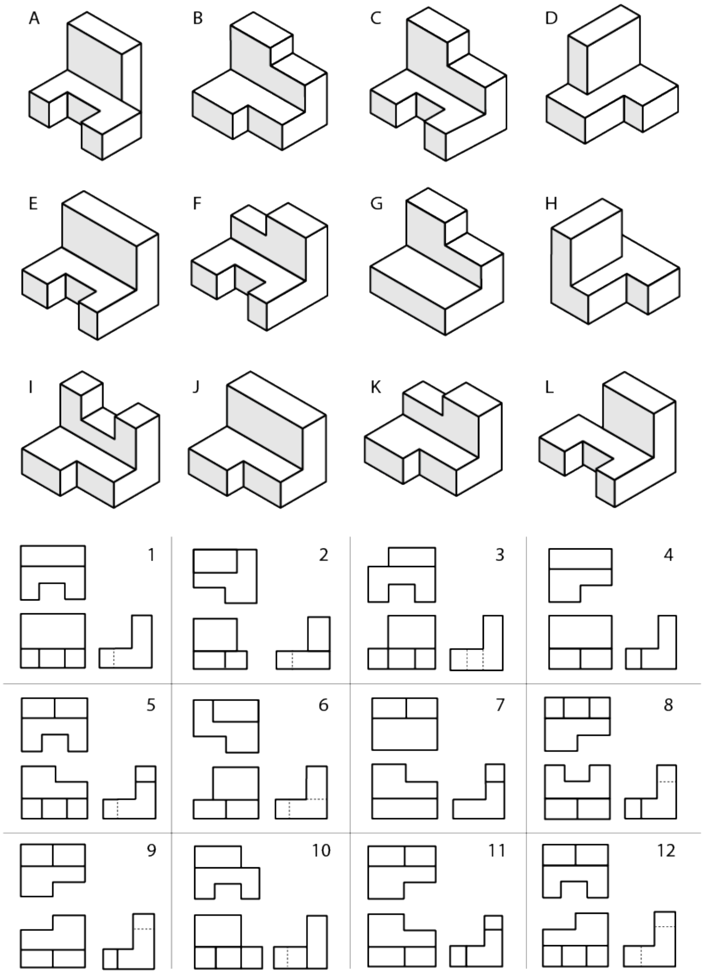
Self Test – Views and Projections

1. A perspective drawing is one form of which type of view?
    1. Oblique
    2. Pictorial
    3. Isometric
    4. Orthographic
2. At what angle should isometric drawings have horizontal lines drawn?
    1. 15°
    2. 30°
    3. 45°
    4. 60°
3. What do perspective drawings always have?
    1. Scale
    2. Dimensions
    3. Hidden lines
    4. Vanishing points
4. At what angles should oblique drawings have lines drawn?
    1. 0°–15°
    2. 15°–30°
    3. 30°–45°
    4. 45°–60°
5. Orthographic projection drawings are three-dimensional drawings.

    1. True
    2. False
6. What is a common name for a top view in an orthographic drawing?
    1. Plan view
    2. Down view
    3. Ceiling view
    4. Elevation view
7. In orthographic projection, how many views are most commonly shown?
    1. 1
    2. 2
    3. 3
    4. 4
8. In the diagrams below, match letters A to L with numbers 1 to 12.



9. What is a top view called in a construction drawing?
    1. Plan view
    2. Floor plan
    3. Floor detail
    4. Building plan
10. What are drawings called that show door and window locations, and other exterior finishes of a building?
    1. Wall drawings

2. Front drawings
3. Exterior drawings
4. Elevation drawings

4. Sketching and Drawing Techniques

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Learning Objectives

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

- use sketching skills to draw straight lines and round circles
- apply views to sketch 3d representations of objects

Freehand sketching is a very useful skill that can be mastered with practice and by following a few guidelines. The ability to interpret drawings is complemented by the ability to sketch information from a drawing to take to your work location. Sketching is also a valuable tool when no drawing is available and you need to communicate job information to someone else.

For freehand sketching, you require a pad of graph paper (8 ½" × 11″ sheets with a 5 mm or ¼" grid), a sharp HB pencil, and an eraser. Do not begin any sketch with a dull pencil.

Sketching technique

Sketching provides a quick and simple way to express ideas and to communicate the shape and general size of an object.

Sketching parallel lines

Start by drawing lines that are parallel to the edges of the paper, such as a border line and title block. Use your finger as a guide when you draw along the grid line on the sketch pad (Figure 1). If you let the end of your little finger run down the edge of the paper pad as you draw, this will steady your hand and make it easier to get a straight line.

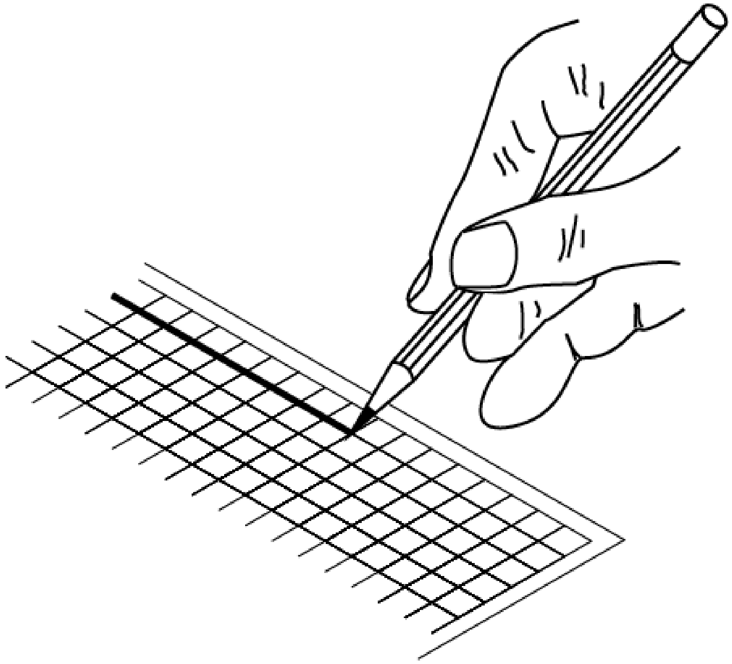


Figure 1 – Sketching a parallel vertical line

Sketching non-parallel lines

When you are sketching lines that are not parallel to the sides of the paper, turn the paper around so that the line you wish to draw is either straight up and down in front of you or straight across the sheet of paper.

It is much easier to draw lines this way, rather than at an angle across the sheet. Let the side of your little finger rest on the paper as you draw. This will help you steady your hand (Figure 2).

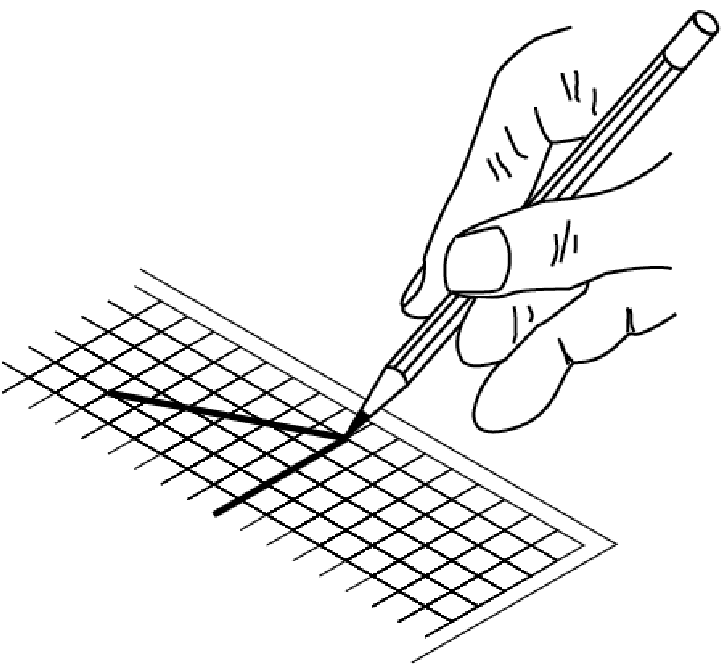


Figure 2 – Sketching a horizontal line

Sketching a rectangle

Locate the corners of the rectangle first. Then place your paper in a comfortable position for sketching and sketch downward for vertical lines and left to right for horizontal lines. Use the grid lines as a guide to maintain lines parallel and at 90 degrees to each other (Figure 3).

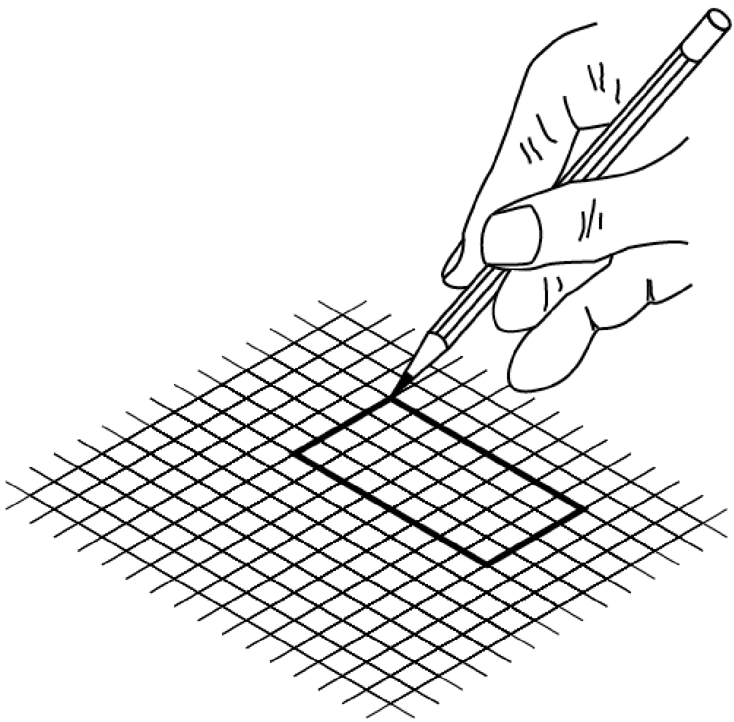


Figure 3 – Sketching a rectangle

Sketching a circle

First, locate the centre of the circle (Figure 4), and then very lightly box in the size of the circle (using the diameter as a guide), as in the top right. Sketch in the circle, one quarter at a time, as shown in the bottom row, left to right. You may find it necessary at first to add light points along the projected circumference to help guide you through each quarter. Remember to move your sketch pad so that you can maintain a comfortable sketching position.

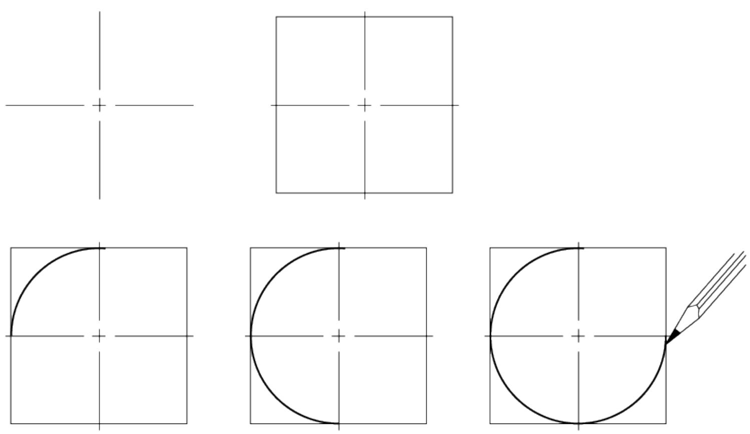


Figure 4 – Sketching a circle

Sketching to approximate scale

In Figure 5, the full-size square is on the left. The centre square is half size, and the right square is quarter size. Note that centre and right squares are the same shape as the left square, only smaller.

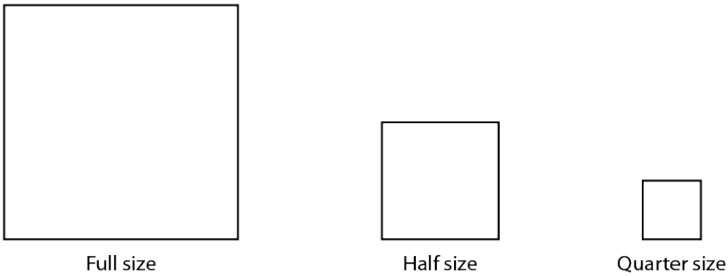


Figure 5 – Sketching to scale

When you are sketching freehand, your sketches should reflect the true shapes of objects as much as possible. If you use grid paper, it is not difficult to sketch to an approximate scale. Assume that the object in Figure 6 is shown full size. As it is necessary to show all orthographic views on the same sheet of paper, the views must be scaled. Figure 7 shows the views at approximately one-half the original size.

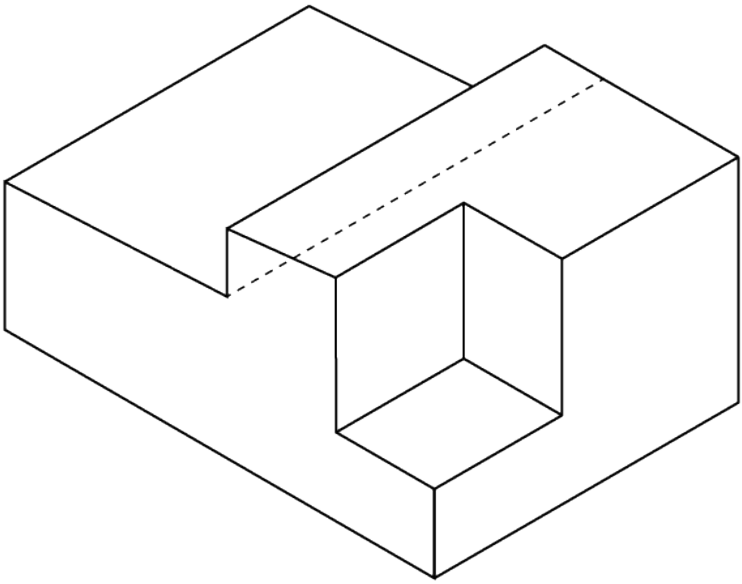


Figure 6 – Full-size isometric object

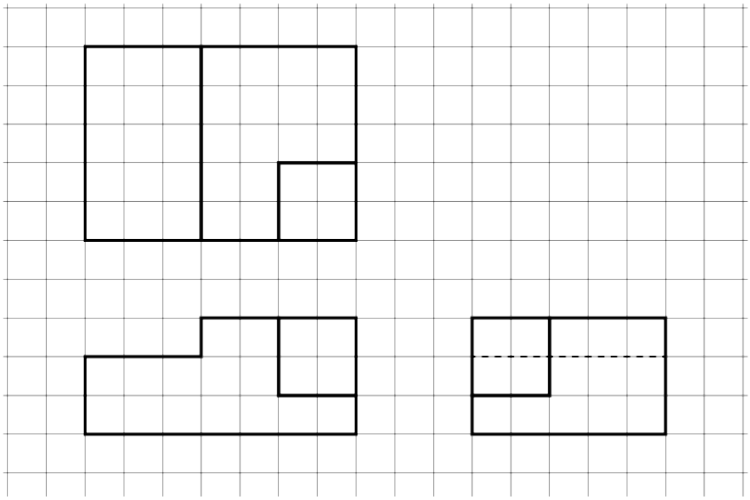


Figure 7 – Scale orthographic projections

Make isometric sketches of simple rectangular objects

Isometric sketches are useful because they are easy to draw and clearly represent an object or system. This clarity comes from using directional lines to represent the three dimensions of length, width, and height, much like a picture.

Construction methods

The following steps explain how to draw an isometric cube. The three dimensions of length, width, and height are drawn along the isometric axes shown in Figure 8. The lengths of objects running parallel to these axes can be drawn to scale. Lines at other angles will not be to scale.

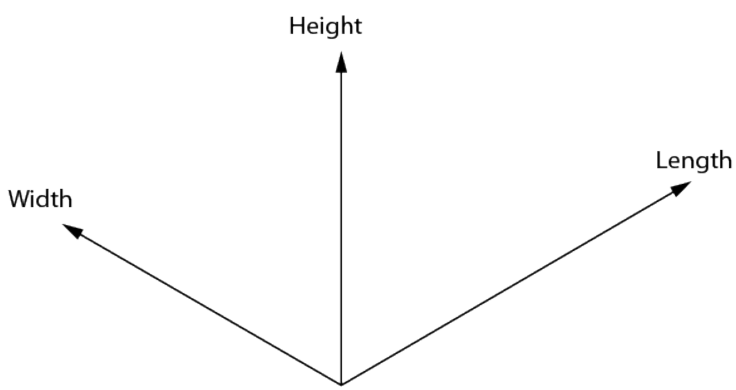


Figure 8 – Isometric axes

Draw a small star-shaped axis on the bottom corner of your grid paper. The sloping axes should be drawn at a 30° degree angle from the horizontal grid line. The vertical axis of the star indicates height (H) or depth (D), and the two sloping axes indicate the length (L) and the width (W) of the rectangle. The vertical axis can be used as a guide when making lines on your drawing. Notice we have labelled the points on the star in Figure 9. These labels can change depending on the view that you may want when drawing a stationary object. The bottom two horizontal points indicate the view that is being drawn. In this case, we would be creating a front-right view.

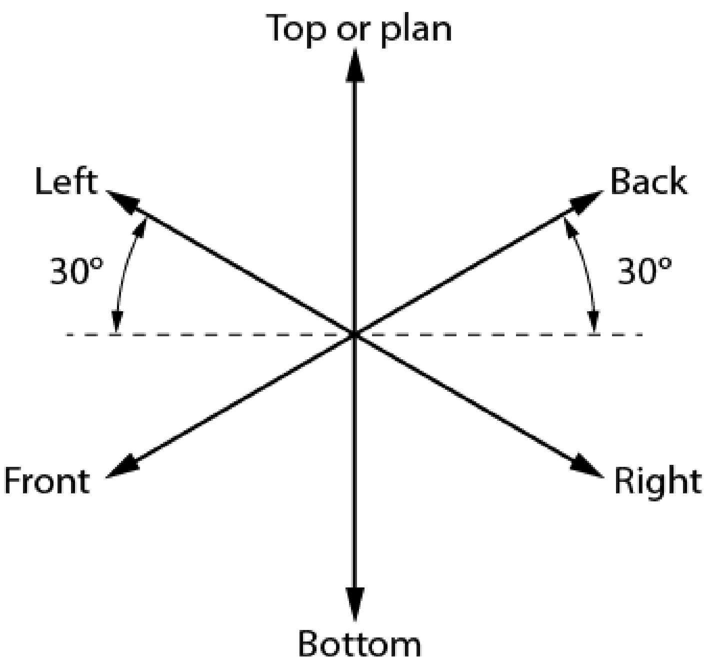


Figure 9 – Step 1: Isometric guide for a front-right view

Sketch the top of the block by drawing two lines, one parallel to L and one parallel to W (Figure 10).

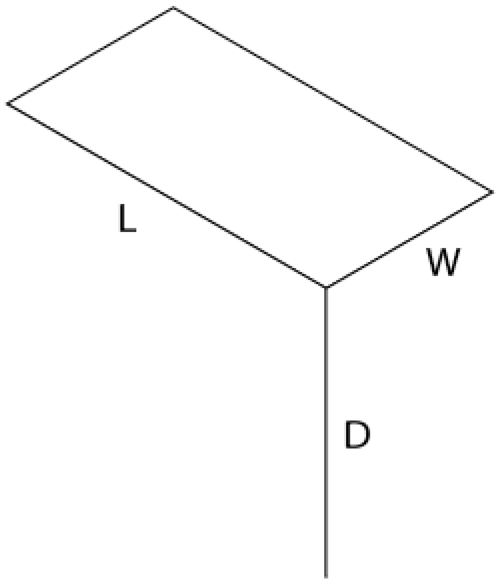


Figure 10 – Step 2: Isometric view of the top surface of a rectangular block

Sketch two lines, one parallel to L and one parallel to D as shown in Figure 11.

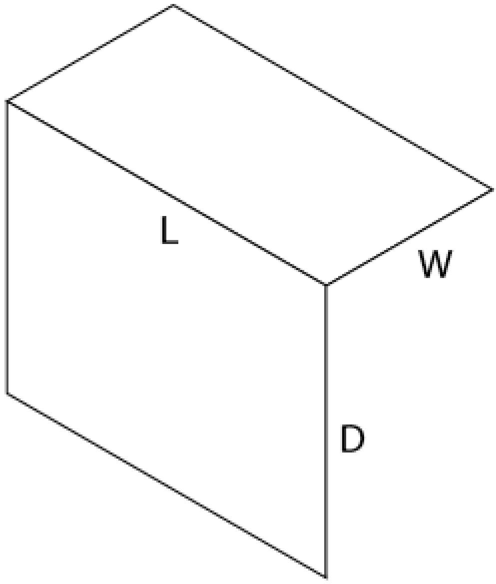


Figure 11 – Step 3: Lines parallel to L and D

Sketch two lines, one parallel to W and one parallel to D, to complete the outline of the rectangular block as shown in Figure 12. Begin with light construction lines so that you can make any necessary adjustments before darkening them. The finished isometric sketch is shown in Figure 13.

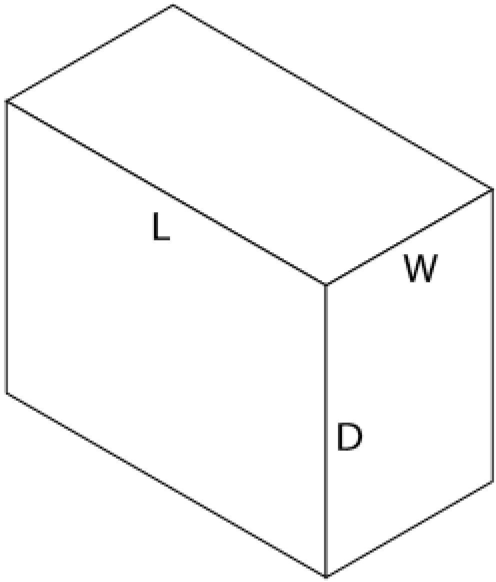


Figure 12 – Step 4: Completed outline of the rectangular block

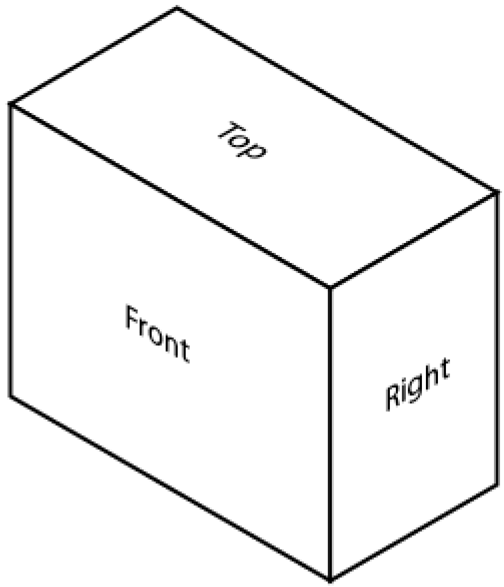


Figure 13 – Completed isometric sketch

Sketching irregular shapes with isometric lines

Not all rectangular objects are as simple as the block you have just sketched. Sometimes the shapes are irregular and have cut-out sections or some sides longer than others. All rectangular objects can be fitted into a box having the maximum length (L), width (W), and depth (D). Begin by sketching a light outline of a basic box that is the size of the object to be drawn.

As an example, consider the object shown in the three-view orthographic sketch in Figure 14. To produce an isometric sketch of this object, you need to find the maximum L, W, and D for the containing box (Figure 14). In this case:

L = 5 grid spaces
W = 3 grid spaces
D = 3 grid spaces

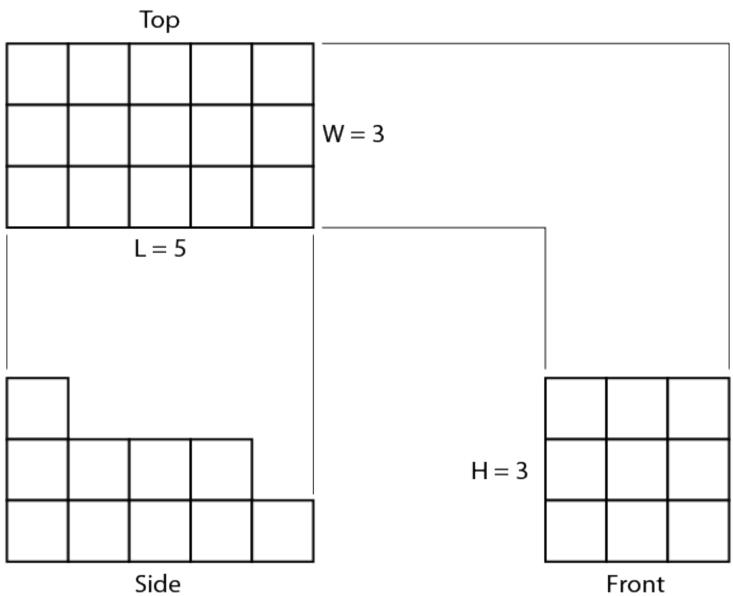


Figure 14 – Orthographic views

Sketch a light outline of the basic rectangular box to the required size, as shown in Figure 15.

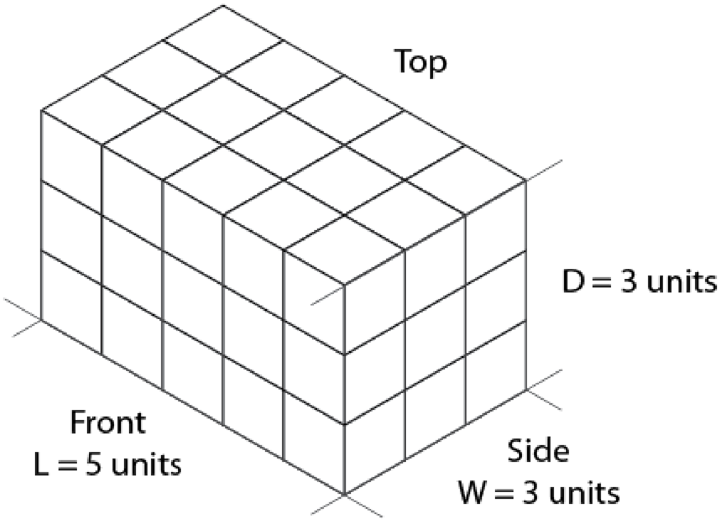


Figure 15 – Basic outline

The front view shows the outline most clearly. Place this view on the front surface of the isometric box. Use the dimension given in the front view of Figure 14 and mark the number of units indicated along the axes L and D (Figure 16).

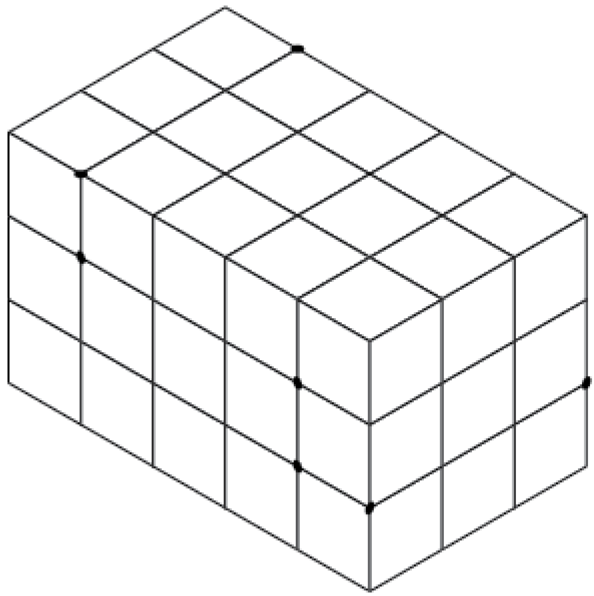


Figure 16 – Location of marks on axes

Lightly sketch lines parallel to the L and D axes from the marked points on the front surface (Figure 17). The step outline is drawn more heavily to emphasize the profile of the object, once you are sure your sketch is correct.

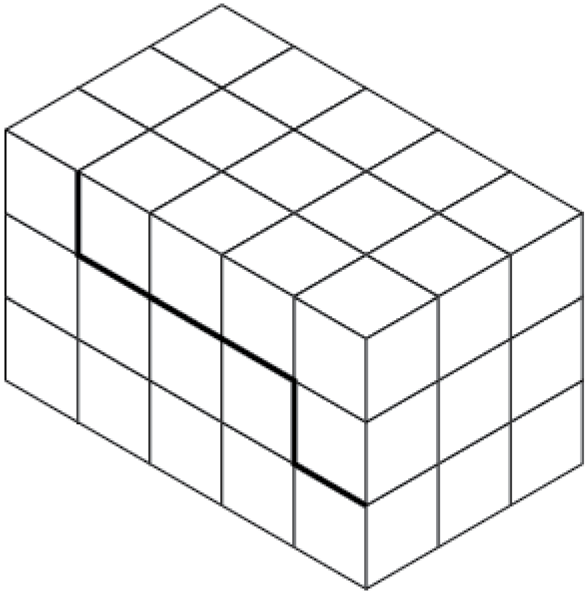


Figure 17 – Location of main features

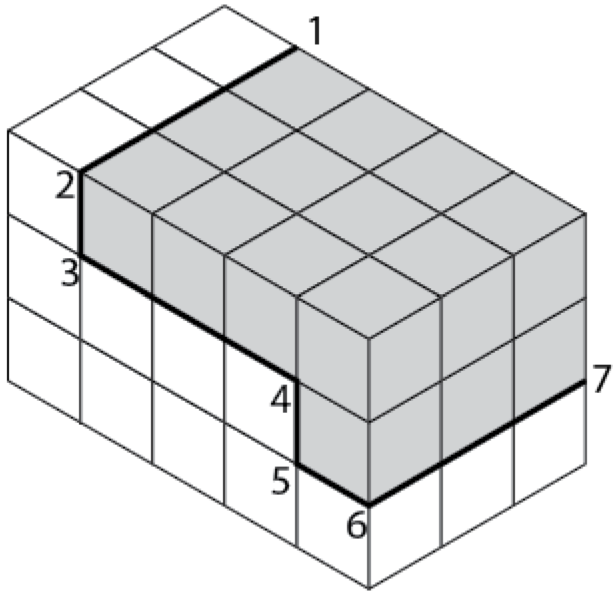


Figure 18 – Location of outer surfaces

Sketch in a series of lines parallel to the axes (L, W, and D) from the corners numbered 1 to 7 (Figure 18). These lines establish the stepped outline as shown in Figure 19.

When you are sure your isometric sketch is correct, erase all unnecessary construction lines and darken the object lines. Your completed sketch of the rectangular object should be similar to that in Figure 20.

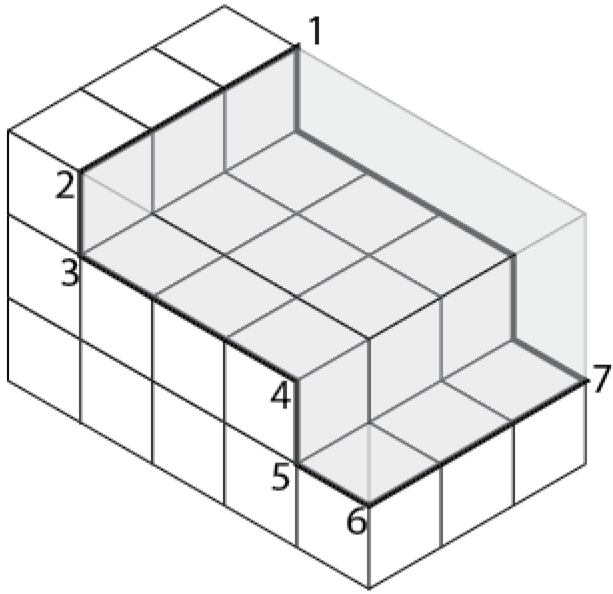


Figure 19 – Internal features

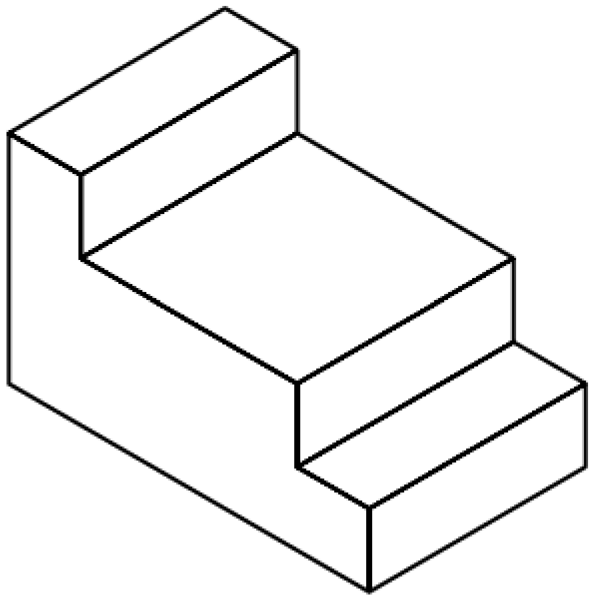


Figure 20 – Completed sketch

Sketching figures with non-isometric lines

Figure 21 shows an object that is basically rectangular but has one face machined at an angle. You can easily construct an isometric sketch of the basic rectangular block. To show the machined face, it is necessary to plot the appropriate points of intersection and join those points to produce the correct angle.

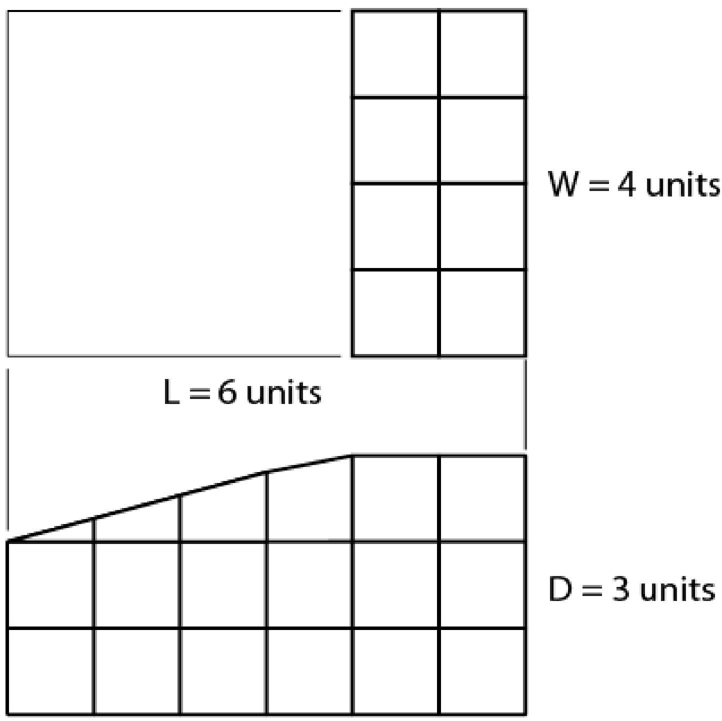


Figure 21 – Rectangle with face machined at an angle

Sketch a light outline of the basic rectangular block, using the size measurements given in Figure 21. Mark the number of units indicated along the length (L) and the depth (D), as shown in Figure 22.

Lightly sketch lines parallel to the original block outlines from the marked points on the front and side surfaces, as shown in Figure 23.

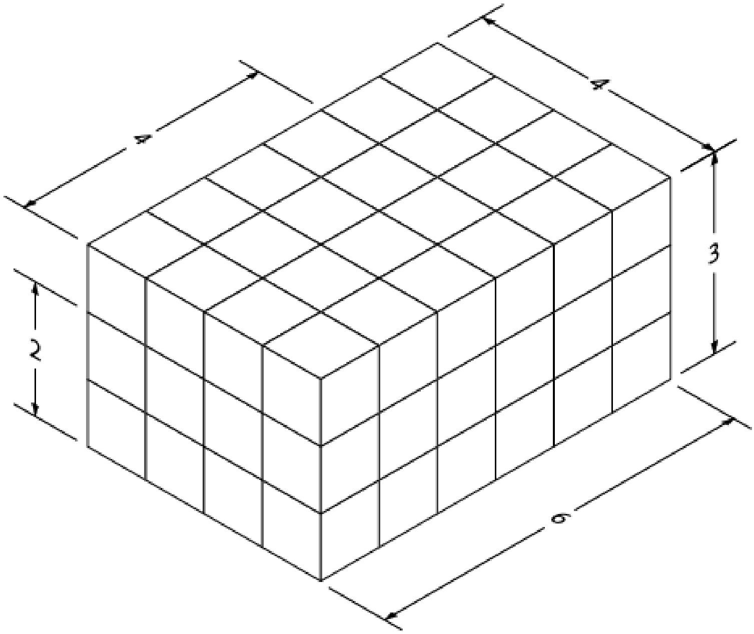


Figure 22 – Rectangle with units marked along L and D

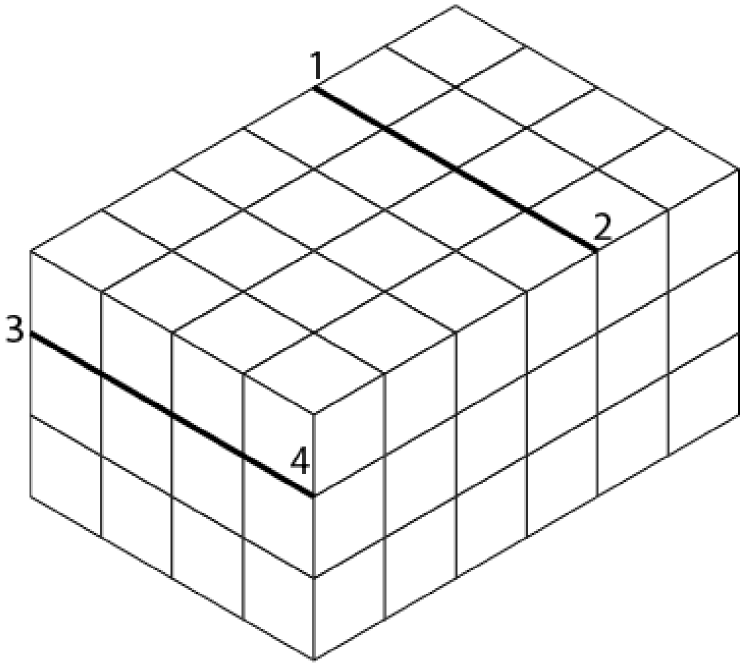


Figure 23 – Lines sketched parallel to original block outline

Join the two points on the front face and the two ends of the lines you have just sketched across the object (Figure 24). Once you are sure your sketch is correct, erase the light lines that originally outlined the block and darken the outline of the completed block as shown in Figure 25.

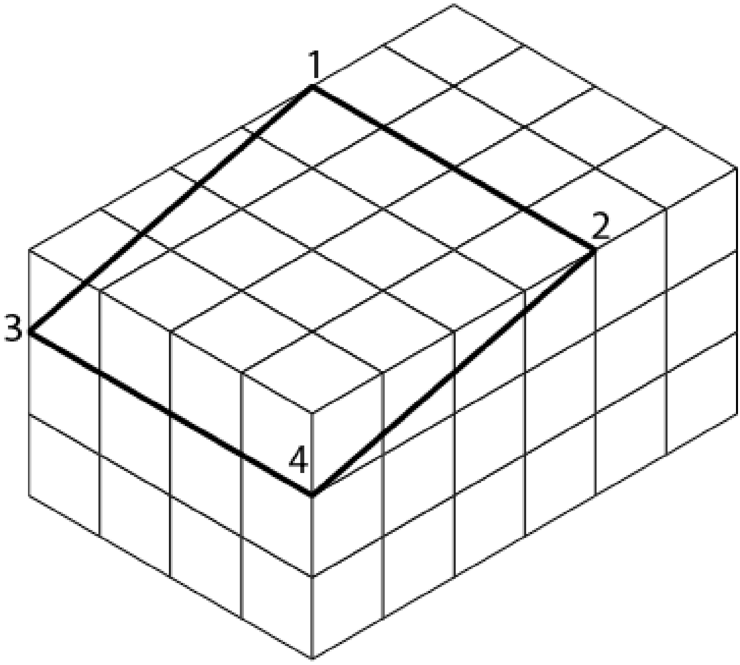


Figure 24 – Front face

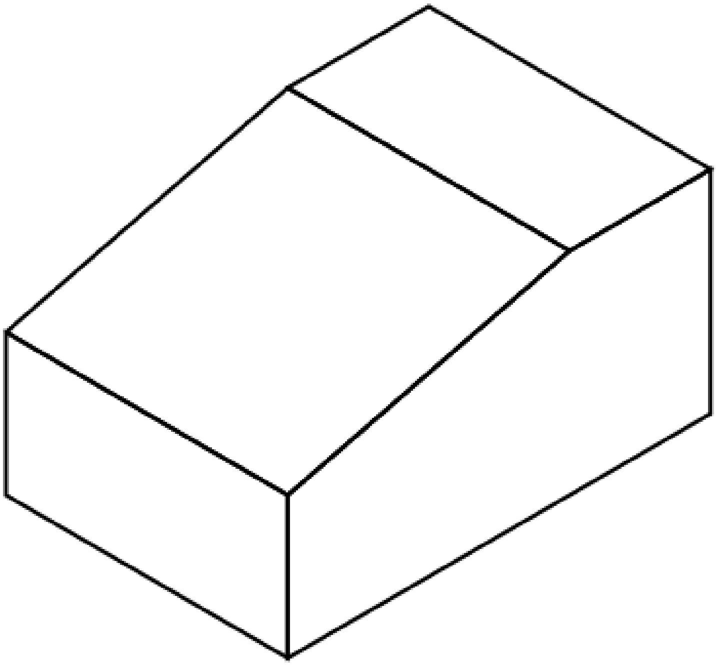


Figure 25 – Completed block

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://caul-cbua.pressbooks.pub/lined/?p=136#h5p-21

Key Takeaways

- **Practical techniques** can be learned and practised to make your freehand sketches neater and easier for others to visualize.
- **Use grid paper underneath, or draw axis lines**, when sketching pictorial views to help guide how you represent depth in your drawing.

Self Test - Sketching and Drawing Techniques

CHRIS STANDEN

1. What should you use as a guide when drawing straight lines that are parallel to the edge of the paper?
   a. Ruler
   b. Drawing surface
   c. Finger
   d. Visual cues

2. What should you do when drawing lines that are not parallel to the edge of the paper?
   a. Rotate the paper
   b. Position a ruler along the desired line
   c. Draw it lightly first
   d. Steady your drawing hand with your other hand

3. When drawing a rectangle, what should you do first?
   a. Draw the base
   b. Draw the vertical lines
   c. Rotate the paper 90°
   d. Locate the corners

4. Put these steps in the correct order to draw a circle
   a. Sketch the circle one quarter at a time
   b. Lightly draw a box the same size as the circle
   c. Locate the center
   d. Add light points along circumference line in each quarter of the box
   e. Erase box and center markings

5. What is the first step when making an isometric drawing of an object?

a. Lightly draw an orthographic view of the front face.

b. Lightly draw and label a representation of the isometric axis lines.

c. Lightly draw a dot at the location of the front face leftmost point of the object.

d. Lightly draw squares around where circular features will be.

5. Annotations and Notes

CHRIS STANDEN

Learning Objectives

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

- explain the purpose and characteristics of notes and annotations
- produce annotations for technical drawings

Most technical drawings include information beyond the view. These and referred to as "annotation" and "notes". They put the drawing into context and provide details that can only be described in words.

The terms "annotations" and "notes" are often used interchangeably, and specific engineering disciplines may use the terms differently. However, "Annotation" is a more general term that relates to any addition to a drawing that helps explain it. Annotations can identify parts, specify tolerances, or explain details. "Notes" are specific, individual statements, usually to provide instruction for assembly, fabrication, or testing.

Characteristics of Annotations and Notes:

Its important that your handwritten annotations and notes are clear. Always print and use standard lettering techniques. Annotations and notes on a CAD drawing should be appropriately sized and positioned such as they don't detract from the drawing itself.

When you create a drawing, whether a quick hand-drawn sketch or a formal drawing prepared with the aid of CAD software, you will be including annotation and notes.

The CAD-prepared electronic schematic shown below features a number of textual elements. Explore it by clicking on the numbered hotspots to see explanations of these features.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://caul-cbua.pressbooks.pub/lined/?p=470#h5p-12

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://caul-cbua.pressbooks.pub/lined/?p=470#h5p-22

Key Takeaways

- **A sketch by itself is rarely sufficient to convey the required information**. Annotations and notes support the drawing by adding supplementary information that cannot be drawn in. This includes dimensions, and other observed elements like weather, team members, colour, breakages, etc.
- **Text on a drawing must be printed and legible**. Dimensions must be clearly located with extension lines and arrows.

Self Test - Annotations and Notes

CHRIS STANDEN

Self Test – Annotations and Notes

1. The purpose of notes and annotations on a technical drawing is to: Select all that apply.

a. Explain in words the drawn features
b. Provide specific instructions related to drawing
c. Describe the drawing in words
d. Specify details about features
e. The version history of the drawing

2. Which of the following features would require notes? Select all that apply.

a. Purpose and pin-out of connectors
b. Finish color
c. Hidden features
e. Circuit connections
f. Insulation details
g. Specifications and standards to be met
h. Shape of component
i. Component tolerances
j. Dimensions or rooms
k. Heat treatments on metal components

3. Notes should be _________

a. Verbose
b. Brief

4. Notes should be __________

a. Abbreviated phrases
b. Clear statements
c. Full grammatically correct sentences

5. When is lower-case allowed for annotations and notes: Select all that apply.

a. Tolerance notes
b. Symbols and units such as mm or μF
c. List of notes positioned off to the side
d. Reference designators
e. Notes with leader lines

6. Engineering Notebook

CHRIS STANDEN

Learning Objectives

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

- discuss the purpose and value of the notebook
- list characteristics of prof. notebook entries
- write professional notebook entries
- discuss the value and risks of digital notebooks

Engineering notebooks in the industry can take many forms and serve many purposes. Whether they are called notebooks, logbooks, or field books, they are used in all engineering disciplines. They can take the form of bound hard-cover paper notebooks or special purpose books optimized for tasks such as surveying. Or they could take on a digital form and be accessed via tablets and phones. Notebooks are used to record everything from hours worked on a task to design ideas for new inventions.

Digital Notebooks

It is becoming increasing popular for engineers and technologists to use digital tools, instead of pen and paper notebooks, for recording observations and activities. Software like Microsoft OneNote allows easy entry and filing of notes for almost any purpose. A key advantage of digital notebooks is that they allow for easy integration of photos, video, and audio directly into the notebook entries. However it is harder (but not impossible) to add a hand drawn sketch to a digital notebook.

Most notebook software has versions that run on different devices – so that information recorded in the field on a tablet or cell phone can be seamlessly accessed from the office laptop.

Check your company policy before using a digital notebook to support your work, especially if you intend to use your own devices. Your employer may have concerns over protecting intellectual property that might prohibit the use of digital notebooks.

Example Engineering Notebook Entries

Explore these two notebook entries by clicking on the numbered hotspots. Notice that while the technical content is different, there is a lot of similarity in the types of information shown. Regardless of the discipline, all engineering notebook entries share some common features such as legibility, and the date and time.

Surveying example

This portion of a notebook page represents data collected by a survey team.

An interactive H5P element has been excluded from this

version of the text. You can view it online here:
https://caul-cbua.pressbooks.pub/lined/?p=484#h5p-11

Electronics Example

This portion of a notebook page represents some research on transistor amplifiers.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://caul-cbua.pressbooks.pub/lined/?p=484#h5p-10

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://caul-cbua.pressbooks.pub/lined/?p=484#h5p-23

Key Takeaways

- Engineers and technologists use Engineering Notebooks to **record everything from hours worked on a task to design ideas for new inventions.**
- **Entries often include a sketch**, and all text should be printed for legibility. Always include the date and time.

Self Test - Engineering Notebook

CHRIS STANDEN

Self Test – Engineering Notebook

1. What is one characteristic of **all** notebook entries?
   a. They should be written with an ink pen as a permanent record
   b. They should be legible so that others can use your information
   c. They should be written in third person

2. What is one item that should be present in all notebook entries?
   a. Author name
   b. Employer name
   c. Date and time
   d. Hours worked at task

3. Descriptive text in a notebook entry helps… (select all that apply)
   a. Set the context
   b. Describe the setting
   c. Detail the team members
   d. Explain how the results were observed

4. What should you do if you make a mistake with an entry in your notebook?
   a. Erase and re-write it
   b. Rip out the page and start again
   c. Cross out the mistake and re-write it
   d. Conceal the mistake with a dark marker and re-write it

5. Collected data should be… (select all that apply)

a. Presented tabular form

b. Written neatly so others can read them

c. Summarized before writing in notebook

d. Used in calculations

e. Rounded to nearest full engineering unit

7. Surveying Field Notes

SCOTT NORTON

Learning Objectives

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

- Create integrated sketch and notebook entries

Surveying is a field where surveyors need excellent observation and measurement skills (Chapter 1). Surveyors use a variety of measuring devices to capture distances, angles, and positions on or near the surface of the earth.

While many of these measuring devices can collect and store data electronically in field data collectors, hand-written field notes are still needed to better understand and interpret the collected data. Good field notes are neat, legible, organized, and complete without redundancies providing necessary extra information not electronically collected in the field.

Field notes are written in a survey field book. The field book generally includes a title page and a table of contents at the beginning.

The form and format of surveying field notes will vary depending on the type of survey completed; however, the notes often include such things as:

- Job/Project name
- Date and possibly the time of day

- Weather
- A list of survey crew members (who performed the survey)
- Instruments used (type and identification numbers)
- Description of key points (reference monuments, key occupied points, etc.)
- Sketches (placed on the right side of a field notebook sheet)

Contents of Surveying Field Note sketches:

- Location of key items such as buildings, roadways, water bodies, large trees, existing infrastructure, monuments, etc.
- Orientation (e.g., include a north direction arrow)
- Direction of survey
- Profiles and elevations of topography
- Routes (roadways and paths) with stationing numbers
- Sizes and dimensions of key objects
- Other relevant information that could be useful to better interpret the collected data and/or provide necessary information for designers who will use the field data and notes

Note: Field note sketches are not drawn accurately to scale, though they should at least be roughly to scale.

Guidelines for Survey Field Notes and Sketches

1. Recorded in pencil
2. Neatly printed
3. Measurements recorded as/when taken
4. Perform math checks and quality calculations while in the field to identify computational errors and/or measurement errors
5. Sketches should use straightedges for all line work

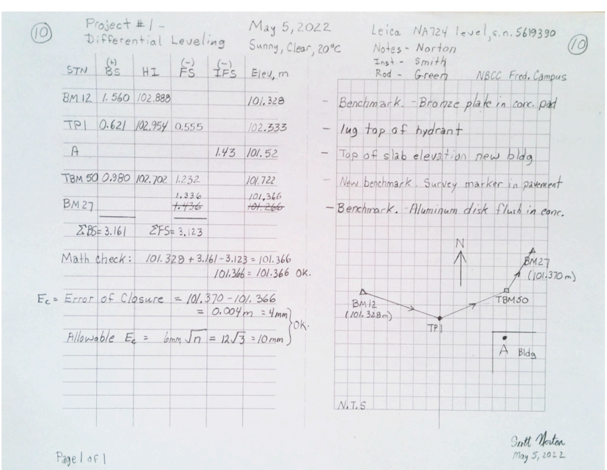
6. Include a north arrow (often pointing up) to orientate the sketch
7. Do not overcrowd the notes and sketches
8. Do not erase mistakes – strike out with a single line and write the correction above
9. If there are many errors, void the whole page by crossing out
10. Never tear out the page

Note: *surveying field notes written in pencil are typically allowed to be submitted as legal evidence in a court. Therefore, erasing is not recommended, because it could affect the credibility of the field notes.*

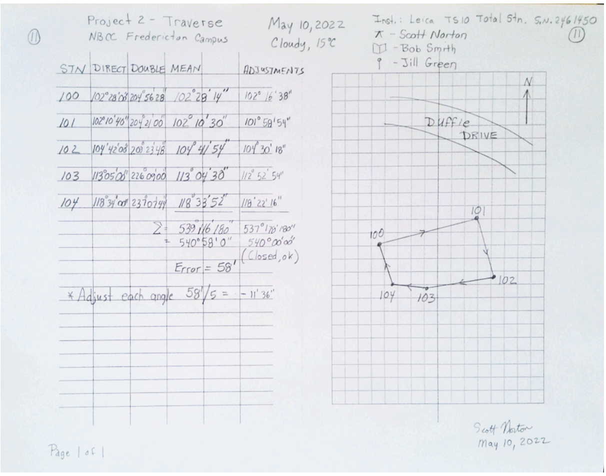
9. Mistakes in other (non-measured) entries (descriptions, calculations, etc.) may be erased and reentered
10. Lettering and text on sketches should be read left-to-right

Example Survey Field Notes

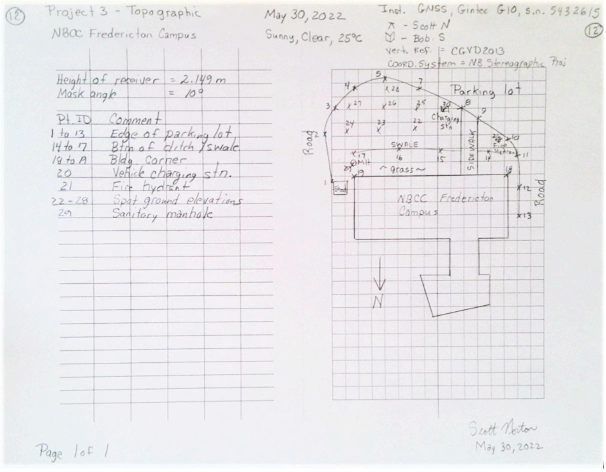
The type of survey will dictate the necessary information to measure and record. The following figures provide field note examples of three common survey types.



Differential levelling using an automatic level (elevation determination)



Traverse Survey (angles and coordinate determination)



Topographic Survey (Horizontal and vertical positions for natural and constructed surfaces and items)

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://caul-cbua.pressbooks.pub/lined/?p=421#h5p-24

Key Takeaways

- **The surveyor's field book** is a special application of the Engineering Notebook, and entries share many of the same characteristics as engineering notebook entries.
- **Incorrect measurements and calculations** written in field notes are not erased; they are crossed out and re-written.
- Surveying field notes are **admissible in court as evidence**.

Self-Test - Surveying Field Notes

SCOTT NORTON

Self-Test – Surveying Field Notes

1. Since modern survey equipment often include data collectors, it is not necessary to record observations and details in a field book.
   a. True
   b. False

2. Which of the following pieces of information should always be recorded in surveying field notes regardless of the type of field notes:
   a. Time of day
   b. Vertical reference system used
   c. Instrument model and serial number
   d. Coordinate system used

3. Where should you place sketches on a standard field notebook page?
   a. The top of the page
   b. The left-side page
   c. The right-side page
   d. At the bottom of the page

4. Field note sketches should be drawn exactly to scale using an appropriate scale ruler.
   a. True
   b. False

5. Why should you never erase an incorrectly recorded measured value in your survey field notes?

a. Because it could lead to messy notes that someone else may not understand

b. Because you need to know the value of the mistake

c. The field notes could be used in a court of law and erasing the pencil entries could bring into question, the credibility of the notes.

d. You may inadvertently erase a correct measured value and then have to remeasure that value

6. A known (given) elevation for a benchmark monument was recorded incorrectly in your field notes. Is it okay to erase this value and rewrite it?

a. Yes

b. No

8. Determine Dimensions from Drawings

CAMOSUN COLLEGE

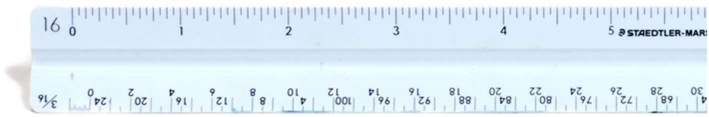
Learning Objectives

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

- Use scale rulers to determine actual dimensions from drawings

Scale drawings are accurate and convenient visual representations made and used by engineers, architects, and people in the construction trades. The accuracy is achieved because the drawing is proportional to the real thing. The convenience comes from the size of the drawing. It is large enough to provide the desired detail but small enough to be handy.

The flexibility to draw proportionally in different sizes is provided by scales. For the purposes of representation, we will only be concerned with reduction scales. Reduction scales make the drawing smaller than the object. The kinds of rulers we will be discussing for making scaled drawings are the architect's scale and the metric scale, both shown in Figure 1.



Architect's scale ruler

Metric scale ruler

Figure 1 – Architect's and metric rulers

The scale of the drawing is always written on the drawing, unless the drawing is not drawn to scale. In the latter case, this will be indicated by the "not to scale" abbreviation (NTS). The scale is the ratio of the size of the drawing to the object. For drawings smaller than the object, the ratio is that of a smaller distance to a larger one.

The architect's scales use ratios of inches to a foot. The most common architect's scale used is 1/4 inch to the foot, written on drawings as:

Scale 1/4" = 1'-0"

This means that a line 1/4" long on the drawing represents an object that is one foot long. At the same scale, a line 1½" long represents an object 6' long, because 1½" contains 6 quarter-inches.

Metric scale ratios use the same units in both ratio terms, resulting in an expression of how many times smaller than the object the drawing is. For example, the standard metric scale ratio that corresponds approximately to ¼" = 1'-0" is written on drawings as "Scale 1:50."

This means that the object is 50 times as large as the drawing, so that 50 mm on the object is represented by 1 mm on the drawing.

For another example, 30 mm on the drawing represents 50 × 30 mm = 1500 mm (or 1.5 metres) on the object.

Figure 2 lists the scale ratios used for building plans and construction drawings in both metric and the approximate equivalent architectural scale ratios.

Type of Drawing	Common Metric Ratios	Imperial Equivalents and Ratios		Use
Site plan	1:500 1:200	1″ = 40′-0″ 1/16” =1′-0″	1:480 1:192	• To locate the building, services and reference points on the site
Sketch plans	1:200	1/16” =1′-0″	1:192	• To show the overall design of the building • To indicate the juxtaposition of the rooms and locate the positions of piping systems and components
General locations	1:100	1/8” =1′-0″	1:96	
Drawings	1:50	1/4“ =1′-0″	1:48	
Construction details	1:20 1:10 1:5 1:1	1/2” =1′-0″ 1″ = 1′-0″ 3″ =1′-0″ Full size	1:24 1:12 1:4 1:1	• To show the detail of system components and assemblies

Figure 2 – Preferred scales for building drawings

Architect’s (imperial) scales

Traditional architectural measurements of length are written very precisely in feet and inches using the appropriate symbols for feet and inches separated by a dash (e.g., 4‘-3 ½“ and 7‘-0″). This is the way that all imperial measurements are written on construction drawings.

Listed below are the scales found on the architect’s triangular scale ruler.

1. 3/32” =1′-0″
2. 3/16” = 1′-0″
3. 1/8” = 1′-0″
4. ¼” = 1′-0″
5. ¾” = 1′-0″
6. 3/8” = 1′-0″
7. 1″ =1′-0″
8. ½” = 1′-0″
9. 1½” = 1′-0″
10. 3″ = 1′-0″
11. 1″ = 1″ (full size—use the scale labelled 16)

Figure 3 shows one face of an architect’s imperial triangular scale ruler. There are two edges on each face and each edge contains two scales that run in opposite directions. At each end of an edge, a number or fraction indicates the distance in inches that represents one foot. The top edge is in eighths of an inch from left to right, and in quarters of an inch from right to left. Note that the 1/8“ scale from 0 to the right end represents 95 feet, and the ¼“ scale from 0 to the left end represents 47 feet.

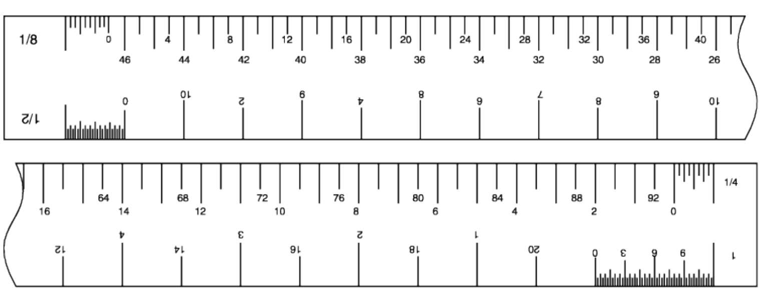


Figure 3 – One face of an architect's ruler (NTS)

At each end, between the zero and the number indicating scale, the length representing one foot is subdivided into 6, 12, 24, or more parts to indicate inches and, in some scales, fractions of an inch. For example, each of the six marks on the 1/8" scale represents two inches, while each mark equals a quarter of an inch on the 1" reduction scale and one inch on the ¼" scale.

Now look at the 1½" scale in Figure 4. The subdivided unit is divided into inches and fractions of an inch. Reading left from the zero, notice the figures 3, 6, and 9, which represent measurements of 3", 6", and 9". From the zero to the first long mark represents 1". Between the zero and the one-inch mark there are four spaces, each of which represent one-quarter of an inch.

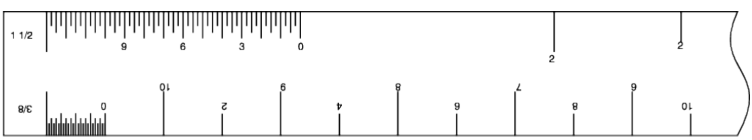


Figure 4 – Units in an architect's scale ruler (NTS)

Piping drawings usually use a 1/8" scale for larger buildings, a ¼" scale for smaller buildings and houses, and a ½" scale for details. Each drawing will state in the title box the scale that is used. Sometimes when special details are given, the scale is placed directly under the detail.

To draw or measure a length to scale, first find the edge of the ruler containing the scale. One end of the length will rest exactly on one of the foot marks of the scale, and the other end should rest either on the zero marker or somewhere on the inch subdivision of the scale. The length can then be marked and drawn or read off from a drawing.

Figures 5 and 6 demonstrate this manner of reading dimensions from four of the ratios on the architect's scale.

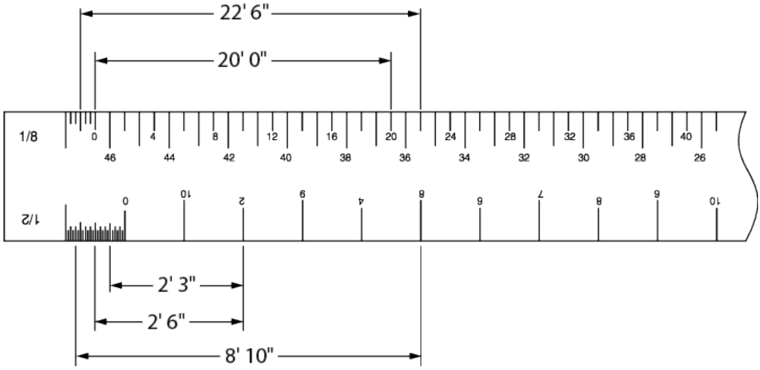


Figure 5 – Reading dimensions using an architect's ruler (NTS)

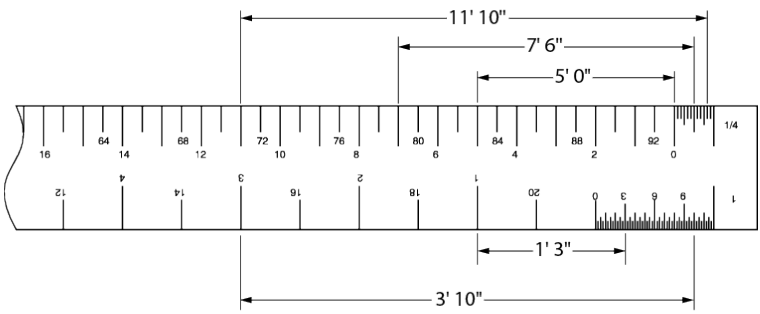


Figure 6 – Reading dimensions using an architect's ruler (NTS)

Architectural units have feet divided into inches, whereas engineering units divide feet into tenths and hundredths. Engineers' scales are not used to make piping drawings.

Metric scales

A triangular metric scale is similar to the architectural scale in that it has six edges, but it has only one scale ratio per edge. The ratio is marked at the left end of the scale. For example, the scale of 1:50 means that 1 mm on the drawing represents 50 mm on the object. This means that the object is 50 times larger than the drawing of it. An object 450 mm long would be represented by a line 9 mm long (450 mm/50).

Figure 7 shows one of the three sides of a metric scale. The scale labelled 1:50 is read from left to right, from 0 to 15 m. The 1:5 scale (on the bottom) can also be read from left to right (0 to 600 mm) by turning the scale around.

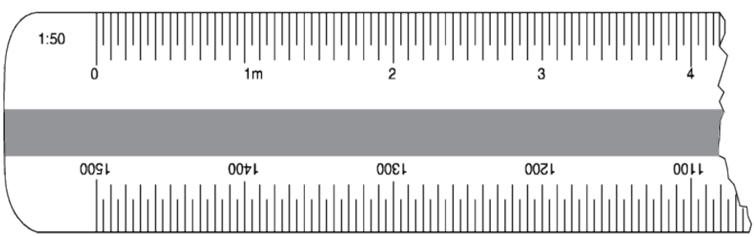


Figure 7 – One side of a metric ruler

If the ratio is 1:1, it means that 1 mm on the drawing represents 1 mm. In other words, the object in the drawing is being drawn to its actual size.

The ratios most often used in drawings are 1:100 for larger buildings, 1:50 for smaller buildings, and 1:20 for details.

You will notice that all the edges on a metric scale are marked with spaces that are 1 mm apart, similar to a metric tape measure. The difference is that each edge is marked off or labelled according to a different ratio, so that proportionate lengths are read directly from the scale. This eliminates the need to calculate dimensions.

Figure 8 shows common metric scales for comparison. Notice that all the scales shown are labelled in metres and that 0.5 m = 500 mm. All the scales in Figure 8 are marked at the scaled position of 250 mm.

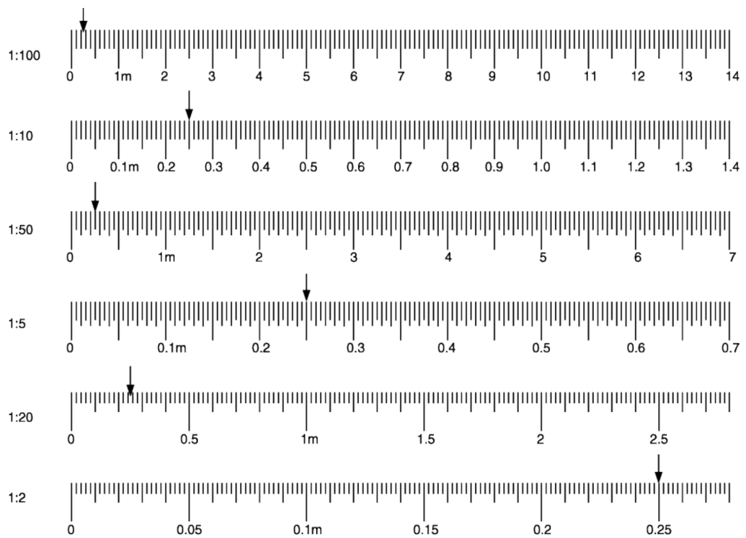


Figure 8- Metric scales marked at 250 mm

The length of an object represented on a drawing in a metric scale is found by measuring the drawn object with a metric ruler of the proper scale. You can also measure the drawing with any metric tape measure and multiply that by the scale ratio.

Obtain dimensions from drawings

The best way to get exact dimensions from drawings is to use the explicit dimensions (in millimeters or in feet and inches) written between the dimension lines. Any measurements that you need should be somewhere on the drawings. Drawings normally only give each dimension once. If there are a number of parallel lengths, only one will have a measurement. To find the dimension you need, you may need to refer to other views or you may have to add or subtract other dimensions.

Measuring lines on a drawing to determine the measurement is not an accurate way to extract dimensions. This is because the drawing is only a representation and may not be exact. Photocopies of drawings may not be to the scale of the original.

The scale of the drawing and your accuracy in measuring will lead to inaccuracies. For example, if the scale of a drawing is 1/8“ = 1‘-0“, an error of 1/32“ in measuring the plan amounts to 3“ of error in the object measured. Detail drawings permit more exactness because they are proportionately larger. Details, however, often require more exactness and usually contain any needed dimensions.

When accuracy is not required and approximate dimensions are adequate, measuring plans is a quick method of taking off material for estimating the cost of a job. In such cases, 10% is usually added for cut-off and waste allowance.

Measuring plans is not accurate enough for measuring materials for cutting and installation purposes.

If you use the scale of the drawing, it will be simple to read off the measurements. However, in the field, you will often need approximate measurements and the only measuring tool at hand will be a measuring tape.

A steel pocket tape measure has a movable hook on the end that allows accurate measuring both when butted against a surface or when hooked on the end of an object (Figure 9). The end of the flexible tape itself is shortened to allow for the hook.

Figure 9 – Tape measure with movable hook

To avoid any error and in order to place the tape flat on the drawing, use a convenient unit mark, such as 100 mm, as the starting point for measuring, as in Figure 10.

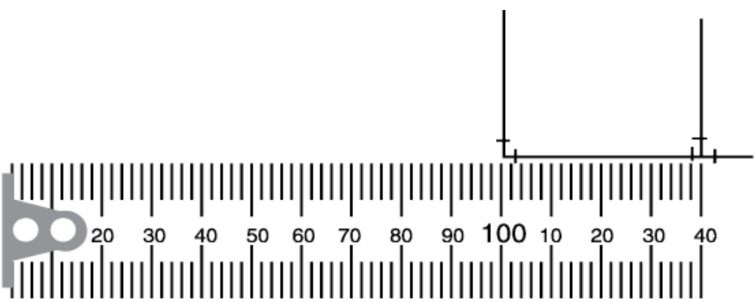


Figure 10 – Measuring metric drawings

The distance between the dimension lines is 40 mm. Since the scale is 1:50, the centre-to-centre length is:

40 mm × 50 = 2000 mm

If the scale had been 1:100, the length would be 40 mm × 100 = 4000 mm.

Follow the same procedure to determine approximate lengths from imperial scale drawings. An imperial tape measure is used in the same way to find a length on the drawing in inches. As an example, suppose the length is 7½”. To find the length represented, use the scale of the drawing.

In every case, if you divide the length on the drawing by the scale fraction or number, you will be calculating the length in feet. Since dividing by a fraction is the same as multiplying by its reciprocal, you multiply the drawn length in inches by:

4 when the scale is ¼” = 1′-0″

8 when the scale is 1/8” = 1′-0″

2 when the scale is ½” = 1′-0″

The reciprocals of all standard scales used by architects are shown in Figure 11.

Scale	3/32	1/8	3/16	1/4	3/8	1/2	3/4	1	1 1/2 (3/2)	3
Reciprocal	32/3	8	16/3	4	8/3	2	4/3	1	2/3	1/3

Figure 11 – Reciprocals of standard scales

The 7½“ length on a drawing scaled ¼“ = 1′-0“ would represent 7 ½” × 4 = 30′.

On a scale of 3/8“ = 1‘-0“, the same 7 ½“ drawing length would represent 7½” × 8/3 = 20′.

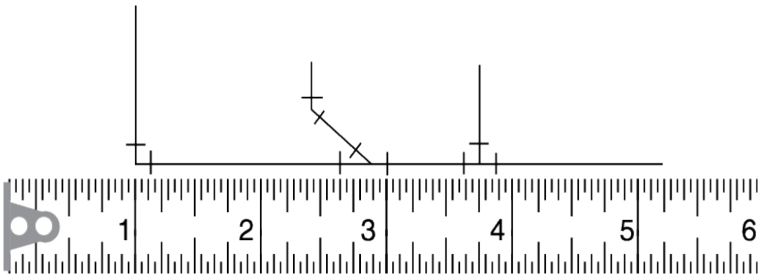


Figure 12 – Reading lengths of piping runs

Figure 12 is part of a piping run drawn to the scale of 1/8“= 1′ -0″. The total length of the run is 4¼” × w8 = 34″.

Self Test

Now complete the Learning Task Self-Test.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://caul-cbua.pressbooks.pub/lined/?p=95#h5p-25

Key Takeaways

- **There is a precise relationship** between the size of the drawing elements and the actual object portrayed in the drawing.
- **An Architect's scale** is used for imperial measurements and allows easy reading of feet and inches. A Metric scale is used for metric measurements and allows for the reading of decimal points.
- The **actual dimension can be determined** from a scale drawing using the appropriate scale on a scale ruler.

Self Test - Determine Dimensions from Drawings

CAMOSUN COLLEGE

Self Test – Determine Dimensions from Drawings

1. Scale rulers are available in both imperial and metric.
   a. True
   b. False
   Feedback: Scale rulers are available in both imperial and metric.

2. Which scale ruler would be most likely to have a ¼“ to 1‘ scale on it?
   a. Metric scale ruler
   b. Architect’s scale ruler
   c. Civil engineer’s scale ruler
   d. Mechanical engineer’s scale ruler
   Feedback: Architect’s scales are in feet and inches

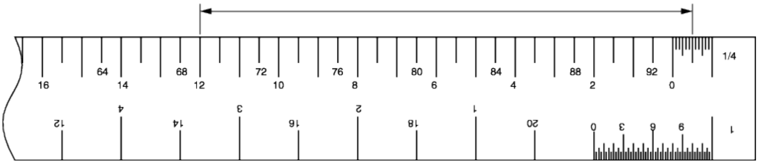
3. How many scale ratios per edge do metric scale rulers have?
   a. 1
   b. 2
   c. 3
   d. 4
   Feedback: Metric scales have 1 scale per edge while architect’s scales have two per edge running in opposite directions.

4. What is the best way to get exact dimensions from a drawing?

a. Measure using a tape measure.
b. Exact dimensions aren't important.
c. Scale it with your combination square.
d. Use the dimension written between the dimension lines.
Feedback: Many of the required dimensions are written on the drawing between dimension lines. Use those values if they are given for the dimension you need.

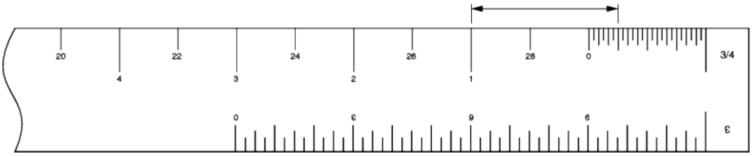
5. If a line measures 4½", what is the equivalent in ¼" =1' scale?
a. 9"
b. 18'
c. 9'
d. 18"
Feedback: 4½" at a scale of ¼"=1' is 18'

6. What is the measurement of the line shown?
a. 68'
b. 6'3"
c. 80'
d. 12'6"



Feedback: Read the 12 ft off the scale away from the edge, and add the inches to the right of 0. On this scale the small ticks are inches.

7. What is the measurement of the line shown?
a. 1'3"
b. 1'6"
c. 27'3"
d. 27'6"



Feedback: Read the 1 ft off the scale and add the inches to the right of 0. Note the small ticks on this scale show half inches.

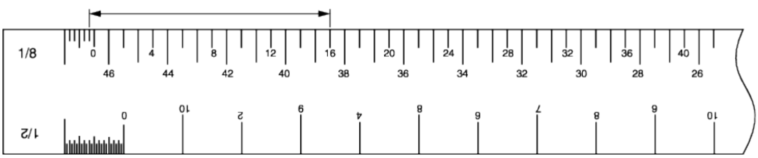
8. What is the measurement of the line shown?

a. 16’2″

b. 16‘4“

c. 16‘6“

d. 16‘9“



Feedback: Read the 16 ft off the scale and add the inches to the right of 0. Note the small ticks on this scale show two inches per tick.

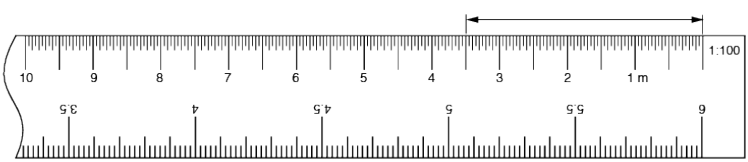
9. What is the measurement of the line shown?

a. 35 mm

b. 3.5 m

c. 35 m

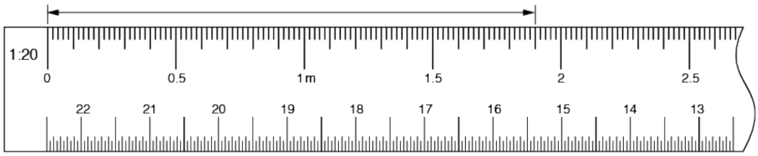
d. 350 m



Feedback: Read the value of 3.5m is read off the scale by taking the 3 and adding in the decimal point based on the small tick marks. Note the small tick on this scale are 0.05m

10. What is the measurement of the line shown?

a. 0.19 m
b. 1.9 m
c. 19 m
d. 190 m



Feedback: Read the value of 1.9m is read off the scale by taking the 1.5 and adding to the decimal point based on the small tick marks. Note the small tick on this scale are 0.02m.

Self Test Answer Key

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Self Test – Observations

1. What is the context of your observation task? Ans. To take physical measurements and details of shape of fridge for a digital model.
2. What specifically should you look for? Ans. Look for shape features, complete set of outside dimensions, location of door hinges, dimension of doors.
3. What senses are you going to need to make your observations? Ans. Visual mostly.
4. What features did you observe? Ans. Curvature of door edges, thickness of magnetic seal, gap under fridge, color,
5. What features can you ignore? Ans. Noise, power cord, internal features
6. Will you be on the lookout for abnormalities or environment? Ans.
7. What measurements will you take? Ans. Outside dimensions and size/placement of doors, etc.
8. Will you take a photo? Ans. Yes
9. What value will the photo have? Ans. The photo will show the curvature features of the door and the hinge location and shape.

Self Test – Lines, Lettering, and Dimensions

1. Which line in a drawing should be the darkest and thickest?

c. Object line

Feedback: The object line identifies shape features of the item so should be the darkest.

2. Which type of line in a drawing is a broken line of alternating short and long dashes.

a. Centre line

Feedback: The center line is a broken line of alternating short and long dashes.

3. What is the name of a line in a drawing that shows a hidden feature?

c. Hidden line

Feedback: The hidden line shows features hidden behind other features

4. A break line shows where part of an object in a drawing has been removed.

a. True

Feedback: Break lines are used to shorten the object by removing part in the middle.

5. A drawing should have all dimensions shown in every view.

b. False

Feedback: Any particular dimension should be shown in one view only.

6. Which line is used to shows notes or specifications in a drawing?

a. Leader line

Feedback: A leader line links a note to the place on the drawing that it refers to.

7. How are alternate positions of moving parts shown in a drawing?

d. With a phantom line

Feedback: Phantom lines are used to alternate positions.

8. What does a sectional view in a drawing normally show?

c. Internal features of a part

Feedback: A sectional view shows internal features such as the construction of a wall.

9. What do the arrows that locate a sectional view in a drawing indicate?

d. Direction of observation when the section is drawn

Feedback: arrows that locate a sectional view indicate direction of observation

10. In the drawing, indicate what type of dimensions are shown by D2 and D4

a. Size dimensions

Feedback: Size dimensions show the extent of a feature while position dimensions show the placement of a feature relative to another feature of the drawing.

Self Test – Views and Projections

1. b. Pictorial
2. b. 30°
3. d. Vanishing points
4. c. 30°–45°
5. b. False

6. a. Plan view
7. c. 3
8. A. 10

   B. 11
   C. 5
   D. 6
   E. 1
   F. 12
   G. 7
   H. 2
   I. 8
   J. 4
   K. 9
   L. 3
9. b. Floor plan
10. d. Elevation drawings

Self Test – Sketching and Drawing Techniques

1. What should you use as a guide when drawing straight lines that are parallel to the edge of the paper?

c. Finger

Feedback: Hold your little finger such that it touches the edge of the paper as you draw the line.

2. What should you do when drawing lines that are not parallel to the edge of the paper?

a. Rotate the paper

Feedback: Rotate the paper so that the line you are drawing is either vertical or horizontal.

3. When drawing a rectangle, what should you do first?

d. Locate the corners

Feedback: When drawing a rectangle, first identify the location of the corners.

4. Put these steps in the correct order to draw a circle

Correct order is c. b. d. a. e.

Feedback: Drawing a box enclosing the desired circle will help sketch a circle that is circular.

5. What is the first step when making an isometric drawing of an object?

b. Lightly draw and label a representation of the isometric axis lines.

Feedback: The star shaped isometric axis representation will show you the correct angle and direction to draw the features and lines on.

Self Test – Annotations and Notes

1. The purpose of notes and annotations on a technical drawing is to: Select all that apply.

    b. Provide specific instructions related to drawing

    d. Specify details about features

    Notes and annotations provide extra information about the features on the drawing, other than that which was drawn.

2. Which of the following features would require notes? Select all that apply.

    a. Purpose and pin-out of connectors

    b. Finish colour

    f. Insulation details

g. Specifications and standards to be met

i. Component tolerances

k. Heat treatments on metal components

Any feature that required a written explanation would require a note.

3. Notes should be __________

b. Brief

Brief notes are best so long as they are correct and complete

4. Notes should be __________

b. Clear statements

Notes must be clear statements regardless of whether they are full sentences.

5. When is lower-case allowed for annotations and notes: Select all that apply.

b. Symbols and units such as mm or μF

c. List of notes positioned off to the side

Drawing standards call for upper-case on the actual drawing itself except for units that require lower-case. A list of notes off to the side can in some contexts be a mix of upper and lower case.

Self Test – Engineering Notebook

1. What is one characteristic of **all** notebook entries?

b. They should be legible so that others can use your information

No matter the discipline or purpose, notebook entries must be legible, and not just to the author.

2. What is one item that should be present in all notebook entries?

c. Date and time

As a minimum, all notebook entries should specify the date and time that they were written.

3. Descriptive text in a notebook entry helps… (select all that apply)

a. Set the context

b. Describe the setting

c. Detail the team members

d. Explain how the results were observed

Descriptive text in a notebook entry is anything that provides background information helpful to later understand the entry.

4. What should you do if you make a mistake with an entry in your notebook?

c. Cross out the mistake and re-write it

Mistakes should be crossed out with a single neat line. You should not try to hide the mistake since you may wish to see the mistake you made later and explain how you fixed it. Never tear out a page from an engineering notebook.

5. Collected data should be… (select all that apply)

a. Presented tabular form

b. Written neatly so others can read them

It is best to write collected data in your notebook exactly as taken. Do not write it out somewhere else first and don't summarize or processed your values first. Make sure your writing is neat. If there are multiple related readings, they should be recorded in a table with labelled column headers.

Self Test – Surveying Field Notes

1. b. False
2. c. Instrument model and serial number
3. c. The right-side page
4. b. False
5. c. The field notes could be used in a court of law and erasing the pencil entries could bring into question, the credibility of

the notes.
6. A. True (it is not a measured value but a known value)

Self Test – Determine Dimensions from Drawings

1. Scale rulers are available in both imperial and metric.
a. True
Feedback: Scale rulers are available in both imperial and metric.

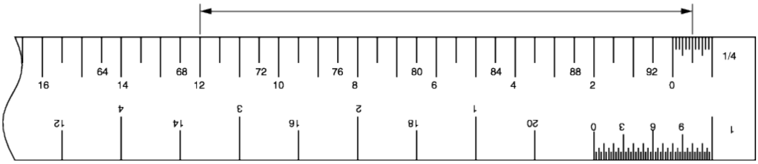
2. Which scale ruler would be most likely to have a ¼" to 1' scale on it?
b. Architect's scale ruler
Feedback: Architect's scales are in feet and inches

3. How many scale ratios per edge do metric scale rulers have?
a. 1
Feedback: Metric scales have 1 scale per edge while architect's scales have two per edge running in opposite directions.

4. What is the best way to get exact dimensions from a drawing?
d. Use the dimension written between the dimension lines.
Feedback: Many of the required dimensions are written on the drawing between dimension lines. Use those values if they are given for the dimension you need.

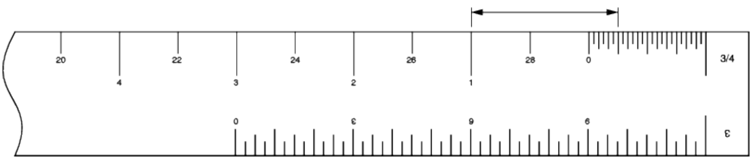
5. If a line measures 4½", what is the equivalent in ¼" =1' scale?
b. 18'
Feedback: 4½" at a scale of ¼"=1' is 18'

6. What is the measurement of the line shown?
d. 12'6"



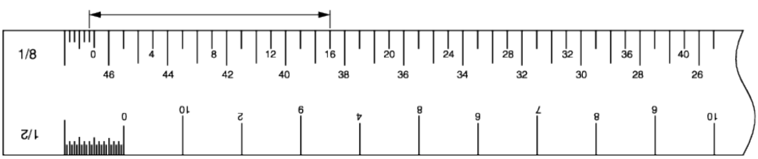
Feedback: Read the 12 ft off the scale away from the edge, and add the inches to the right of 0. On this scale the small ticks are inches.

7. What is the measurement of the line shown?
a. 1‘3“



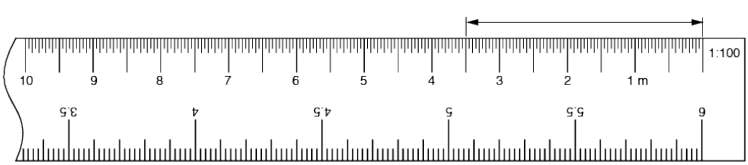
Feedback: Read the 1 ft off the scale and add the inches to the right of 0. Note the small ticks on this scale show half inches.

8. What is the measurement of the line shown?
a. 16’2″



Feedback: Read the 16 ft off the scale and add the inches to the right of 0. Note the small ticks on this scale show two inches per tick.

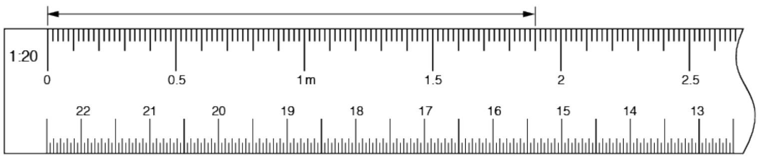
9. What is the measurement of the line shown?
b. 3.5 m



Feedback: Read the value of 3.5m is read off the scale by taking the 3 and adding in the decimal point based on the small tick marks. Note the small tick on this scale are 0.05m

10. What is the measurement of the line shown?

b. 1.9 m



Feedback: Read the value of 1.9m is read off the scale by taking the 1.5 and adding to the decimal point based on the small tick marks. Note the small tick on this scale are 0.02m.

PART II

PRACTICE

Practical Exercise 1 - Orthographic Views

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Activity Objectives

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

- make orthographic sketches

Use sketching techniques to produce orthographic sketches of the following figures. For the purposes of these exercises, do not be concerned with dimensions. Concentrate on producing good, dark outlines, good circular shapes, and correctly drawn hidden and centre lines.

1. Sketch one orthographic view of the object shown pictorially in Figure 1. Remember that the holes in the gasket are circular (not elliptical as they appear in the three-dimensional sketch shown). Add a title block with the following:

   Title: Gasket
   Sk. No.: D-1/031
   Sk. by: (your name)
   Date: (today's date)

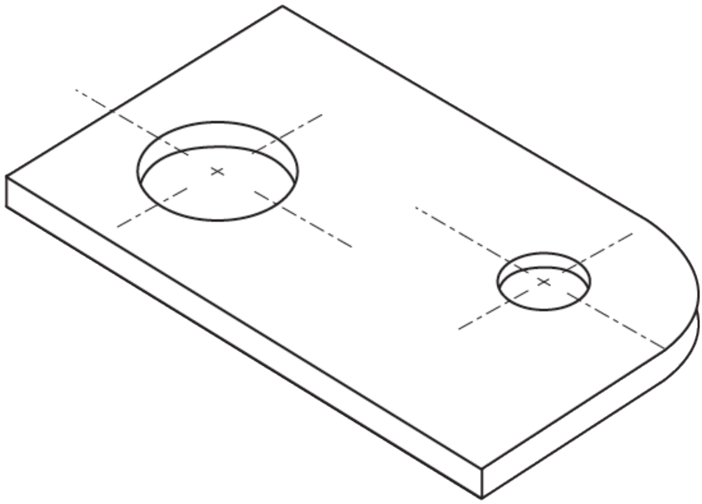


Figure 1 – Gasket

2. Sketch two orthographic views (front view and top view), in the approximate scale of the object shown pictorially in Figure 2. Remember to place the views correctly and make sure that all hidden lines are clearly shown. Add a title block with the following:

   Title: Stop piece
      Sk. No.: D-1/032
      Sk. by: (your name)
      Date: (today's date)

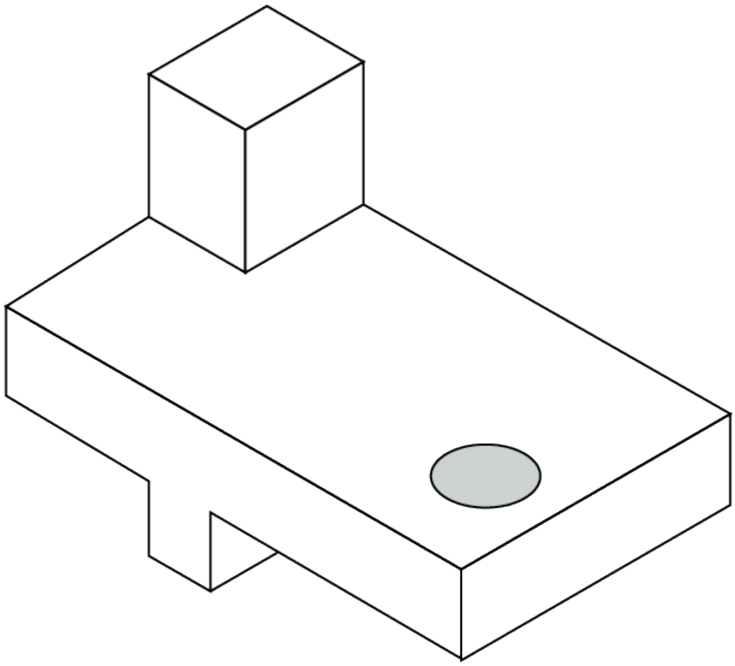


Figure 2 – Stop piece

Practical Exercise 2 - Dimensioned Orthographic View

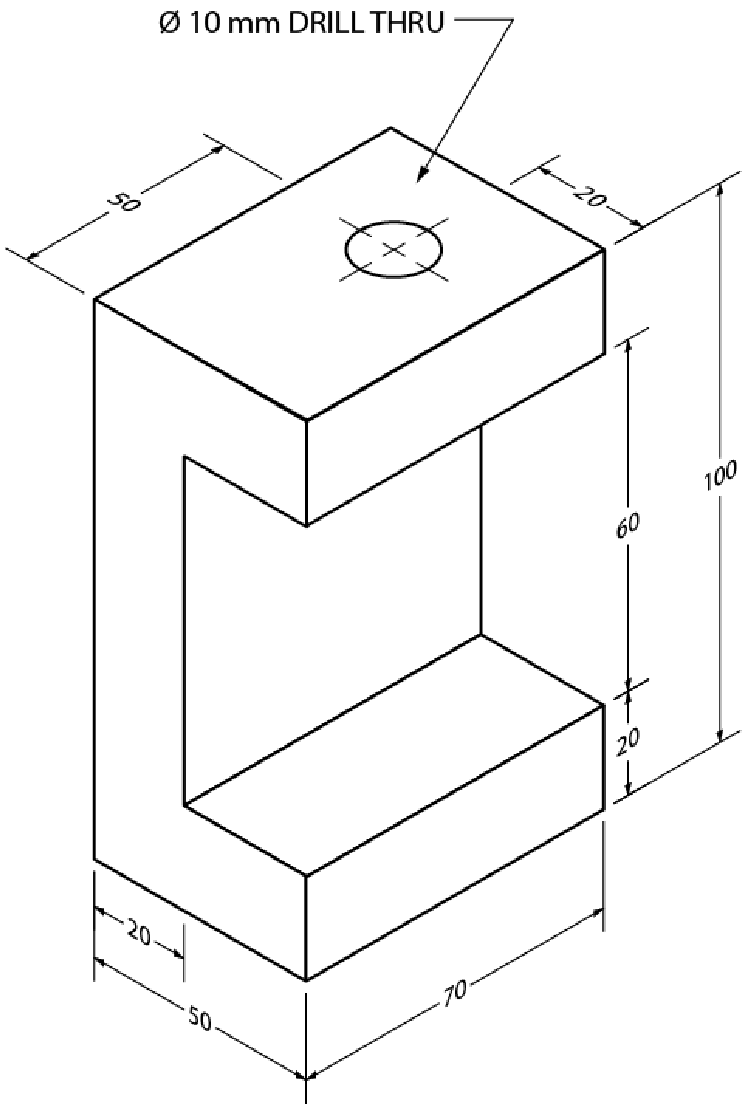
CAMOSUN COLLEGE

Activity Objectives

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

- Make an orthographic three-view, fully dimensioned sketch of a simple object

Sketch the necessary views of the object shown in the pictorial drawing below and dimension fully. Sketch to approximate scale to suit your sheet size.



Add a title block with the following:

Title: Clamp Bracket

Sk. No.: D1/PC3

Sk. by: (your name)

Date: (today's date)

Practical Exercise 3 - Isometric Sketches

CAMOSUN COLLEGE

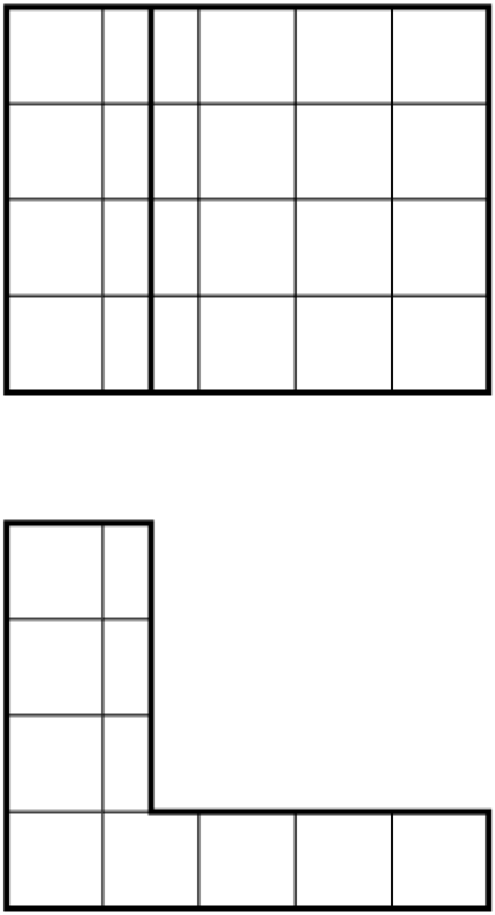
Activity Objectives

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

- Make isometric sketches

Given the orthographic sketches shown of the two objects in 1 and 2, make isometric sketches of each object to the same scale as the object shown. Borders and title blocks are not necessary for these sketches.

1.



2.