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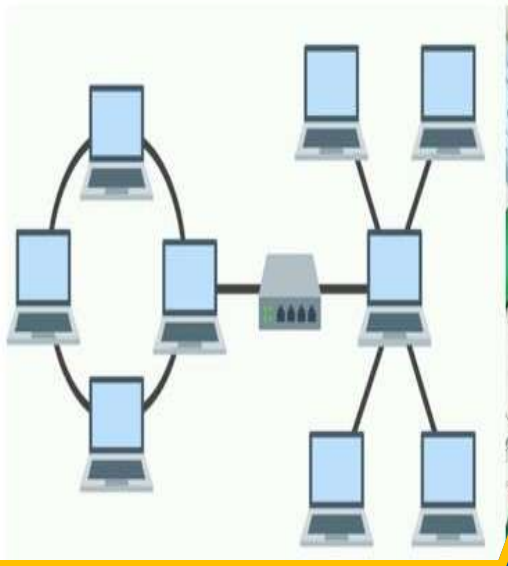

GENTD401

NETWORKING AND INTERNET TECHNOLOGIES

Basics of Technical Drawing

TRAINEE'S MANUAL

October, 2024

BASICS OF TECHNICAL DRAWING

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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COORDINATION TEAM

RWAMASIRABO Aimable

MARIA Bernadette M. Ramos

MUTIJIMA Asher Emmanuel

Production Team

Authoring and Review

MUTAGISHA Albert

NGENDAHAYO Aloys

Validation

MUKASHYAKA Olive
UWIDUHAYE Diane

Conception, Adaptation and Editorial works

HATEGEKIMANA Olivier

GANZA Jean Francois Regis

HARELIMANA Wilson

NZABIRINDA Aimable

DUKUZIMANA Therese

NIYONKURU Sylvestre

UMEREWENEZA Naasson

Formatting, Graphics, Illustrations, and infographics

YEONWOO Choe
SUA Lim
SAEM Lee
SOYEON Kim
WONYEONG Jeong
Name of formatting Person
MANIRAKORA Alexis

Financial and Technical support

KOICA through TQUM Project

TABLE OF CONTENT

ACRONYMS

2D: Two Dimensions

3D: Three Dimensions

ASME: American Society of Mechanical Engineering

CAD: Computer Aided Design

ISO: International Standards Organization

KOICA: Korea International Cooperation Agency

RTB: Rwanda TVET Board

TQUM: TVET Quality Management

INTRODUCTION

This trainee's manual includes all the knowledge and skills required in **Networking and Internet Technologies**, specifically for the module of **“Basics of Technical Drawing. ".** Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies. The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainee's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainee, you will start by addressing questions related to the activities, which are designed to foster critical thinking and guide you towards practical applications in the labor market. The manual also provides essential information, including learning hours, required materials, and key tasks to complete throughout the learning process.

All activities included in this training manual are designed to facilitate both individual and group work. After completing the activities, you will conduct a formative assessment, referred to as the end learning outcome assessment. Ensure that you thoroughly review the key readings and the 'Points to Remember' section.

MODULE CODE AND TITLE: GENTD401 BASICS OF TECHNICAL DRAWING

Learning Outcome 1: Identify drawing materials, instruments and equipment
Learning Outcome 2: Draw symbols, geometric figures and solids used in technical drawing.
Learning Outcome 3: Apply 2 and 3 dimensions.

Learning Outcome 1: Identify Drawing Materials, Instruments and Equipment

Indicative contents

1.1 Identification of drawing materials
1.2 Identification of drawing instruments
1.3 Identification of drawing equipment

Key Competencies for Learning Outcome 1: Identifying Drawing Materials, Instruments and Equipment

Knowledge	Skills	Attitudes
• Descriptions of technical drawing terminologies. • Identification of drawing materials • Identification of drawing instruments • `Identification of drawing equipment	• Selecting technical drawing materials used in technical drawing • Selecting technical drawing instruments used in technical drawing • Selecting technical drawing equipment used in technical drawing	• Having analytical skills while selecting technical drawing materials, instruments and equipment • Prioritization while selecting technical materials, instruments and equipment.

Duration: 10hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly drawing materials used in technical drawing according to their uses.
2. Identify correctly drawing instruments used in technical drawing according to their uses.
3. Identify correctly drawing equipment used in technical drawing according to the task assigned.
4. Select properly drawing materials used in technical drawing according to their uses.
5. Select properly drawing instruments used in technical drawing according to their uses.
6. Select properly drawing equipment used in technical drawing according to the task assigned.

Resources

Equipment	Tools	Materials
• Drawing board • Mini-drafter	• Ink-pen • Paper cuter • One-meter straight drawing ruler with handle • Right angle ruler • Protractor • Drawing compass • Engineering pencils • Drawing template • French curves • Set squares • T square	• Paper • Rubber • Pen ink • Propelling pencil

Indicative content 1.1: Identification of Drawing Materials

Duration: 4hrs

Theoretical Activity 1.1.1: Identification of technical drawing materials

Tasks:

1. Answer the following questions:

i. What do you understand by the following technical drawing terminologies?
   a. Technical drawing
   b. Point
   c. Line
   d. Plane
   e. Projection

ii. Identify the drawing materials based on their uses.

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary

5: Read the key readings 1.1.1.

Key readings 1.1.1.: Identification of drawing materials

- **Definition of a technical drawing**

Technical drawing, also known as drafting, is a form of graphic communication used in engineering, architecture, and other technical fields. It conveys precise information about the shape, size, and specifications of an object. These drawings are often created using standardized symbols, notations, and measurements to ensure clarity and accuracy.

- **Line**

- A line is an infinite series of points extending in opposite directions without width or thickness. It is defined mathematically as the shortest distance between two points.
- A line in technical drawing is a continuous mark with specific properties (such as thickness, length, or style) that defines the edges, borders, or outlines of an object.

Different types of lines represent different features:

- **Continuous line**: Represents visible edges.

- **Dashed line**: Represents hidden or internal features.
- **Centerline**: Indicates symmetry or the center of circular parts.

- **Plane**

A plane in technical drawing is a flat, two-dimensional surface that can be used to represent one of the views of a 3D object (such as top, front, or side). Planes are essential in projections, where objects are viewed or sliced along specific planes to understand their geometry.

- **Projection**

Projection refers to the method of representing a 3D object on a 2D plane. It involves creating views (top, front, side) of the object as seen from different angles. There are two main types:

- **Orthographic projection**: Shows multiple views of an object on different planes (e.g., top, front, side).
- **Pictorial projection**: Represents an object in a single view but from a 3D perspective, such as isometric, oblique, or perspective projections.

- **Dimension**

Dimensions in technical drawing are numerical values that specify the size, length, width, height, or distance between features of an object. They provide critical information about the exact scale and measurements required for fabrication or construction.

- **Shape**

A shape refers to the external contour or outline of an object. In technical drawings, shapes are depicted by combining lines, planes, and curves to represent the form of 2D and 3D objects.

- **Sections**

Sections in technical drawing are views that represent an object as if it were cut through, showing the internal features that are not visible in normal views.

There are types of section based on the **position and path of the cutting plane** through the object.

- **Full section**: Shows a view of the object cut entirely through.
- **Half section**: Shows only half of the object cut through.
- **Offset section**: Represents a view where the cutting plane changes direction to reveal features that are not aligned.

The choice between full, half, or offset sections depends on:

1. **Object Complexity:**
   - Full sections are better for simple objects with uniform internal features.
   - Offset sections are for complex objects with multiple, non-aligned features.
2. **Symmetry:**
   - Half sections are ideal for symmetrical objects where only half needs to be detailed.
3. **Design Intent:**
   - Designers use sections to highlight the most critical details for manufacturing or inspection.

- **View**

A view is the representation of an object from a specific angle in technical drawing.

1. Orthographic View (Orthographic Projection)

- Definition: An orthographic view represents an object using multiple 2D views, typically showing the top, front, and side. These views are positioned relative to each other in a consistent manner (e.g., top view above the front view).

  Its Purpose is to show different aspects of an object without distortion, ensuring clear understanding of dimensions and features.

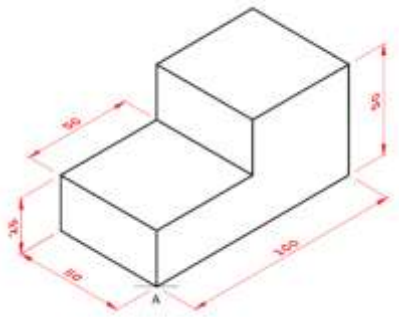
- **Example Use Case:** Used in engineering drawings, architectural plans, and machine parts.

There are several types of views:

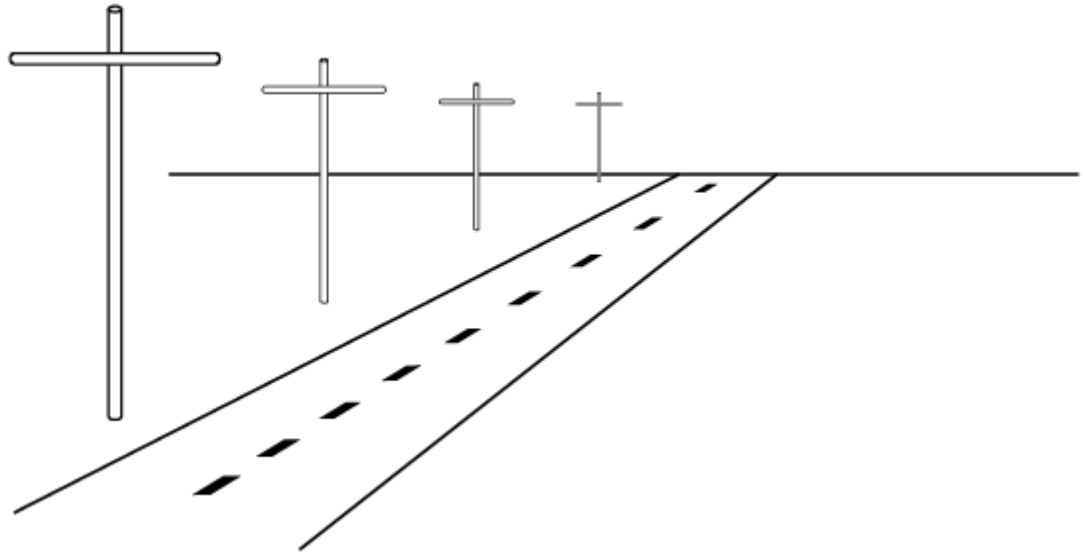
- Top view (Plan view): A view of the object as seen from above.
- Front view (Elevation): A view of the object as seen from the front.
- Side view (Elevation): A view from the side.
- Isometric view: A 3D representation showing multiple faces of an object in one view.

2. Isometric View

- Definition: An isometric view is a type of axial view where the object is rotated along three axes to show a 3D representation. The angles between the axes are 120°.
- Provides a 3D view of the object on a 2D plane, useful for visualizing complex shapes and structures.
- Example Use Case: Frequently used in product design, technical presentations, and assembly drawings.



3. Perspective View

- **Definition:** A perspective view shows how an object appears from a specific viewpoint, where lines converge to a vanishing point. This mimics how the human eye perceives objects in real life.
- To show a more realistic view of an object, offering depth and dimension by incorporating perspective.
- **Example Use Case:** Commonly used in architectural renderings and product presentations.
- 

4. Section View

- A section view reveals the internal features of an object by showing the view of its "cut" surface, as if the object has been sliced through.
- To illustrate hidden or internal details that are not visible in the standard exterior views.
- Example Use Case: Used in mechanical parts, assemblies, and when showing complex internal structures.

5. Auxiliary View

- Definition: An auxiliary view is an additional view used to show an inclined surface or feature that does not align with the principal projection planes (front, top, side).
- Purpose: To show features that are not clearly represented in standard orthographic views.
- Key Feature
  - Projection onto an inclined plane: The view is projected perpendicular to the inclined surface.

- Used to depict slanted surfaces and other features at angles to the main projection planes.
- Example Use Case: When drawing parts with angled or sloped features (e.g., an inclined surface on a machine part).

6. Detail View

- A detail view focuses on a specific area of a drawing to show intricate or small features in greater detail.
- It is used to is to magnify a portion of a drawing for clarity, often for small or complex features that are difficult to interpret at full scale.
- Example Use Case: Used in areas where small features like screw threads, holes, or intricate part details need to be clarified.

7. Exploded View

- Definition: An exploded view shows the components of an assembly in a way that illustrates how the parts fit together, with each part separated slightly.
- It is used to help understand the assembly process and how individual parts relate to the whole.
- **Example Use Case:** Frequently used in assembly instructions, exploded diagrams, and product manuals.

8. Broken-Out View

- A broken-out view is similar to a section view but only a portion of the object is "cut" and exposed, rather than cutting through the entire object.
- It is used to show internal details in a specific area without the need for a full section view.
- Example Use Case: Used for showing detailed internal features in specific areas, such as a cavity or a mechanism inside an object.

9. Elevation View

- An elevation view is a projection that shows the exterior of a building, structure, or object from a specific direction (usually the front, back, left, or right).
- It is used to represent the vertical aspect of an object, showing its height and external features.
- **Example Use Case**: Used in building plans, elevations of facades, and exterior views of objects.

Common technical drawing materials and their uses

SN	Name of material	Image	Uses (descriptions)
1	Graphite Pencils		Detailed work, shading, and line drawing.

2	Charcoal		Black material that creates expressive lines and tones.
3	Crayon		Similar to pastels but often have a waxy binder, making them less prone to smudging. They are popular for their vibrant colors.
4	Marker		Pens that contain liquid or gel ink. They offer a wide range of colors and line widths, and some are designed for specific surfaces (e.g., whiteboard markers).
5	Paper		The surface on which drawings are created.
6	Erasers		Used to remove or lighten pencil marks.
7	Sharpeners		Used to sharpen pencils and other drawing tools.

Practical Activity 1.1.2: Selecting technical drawing materials

Task:

1: Do the task described below:

i. You are requested to go in the workshop and select technical drawing materials according to the assigned task

2: Present the criteria for selecting technical drawing materials

3: Referring to the selection criteria presented in step 2, select technical drawing materials

4: Present the selected materials to the trainer or classmates

4: Read the key readings 1.1.2

5: Perform the application of learning 1.1.

Key readings 1.1.2 Selecting technical drawing materials

- **Drawing Paper**

Material: Choose smooth, durable paper for technical drawings. Common weights range from 80-120 GSM.

Size: Select appropriate sizes (A2, A3, A4) based on the scale of your drawings. Larger sizes are ideal for detailed work.

Finish: A smooth finish aids in achieving crisp lines and accurate representations.

- **Tracing Paper**

Purpose: Use tracing paper for overlays and iterative design processes.

Transparency: Look for high-quality, translucent tracing paper that allows easy visibility of underlying drawings.

Weight: Opt for lighter weights for easier handling during revisions.

- **Vellum Paper**

Characteristics: Vellum is a durable, smooth surface that holds ink well without smudging.

Use Case: Ideal for final drafts and presentations due to its professional appearance.

Durability: Choose high-quality vellum for archival projects as it resists tearing and fading.

- **Cardstock**

Weight: Heavier than standard drawing paper, providing sturdiness for presentations.

Application: Use cardstock for finished drawings or documents that need to withstand handling.

Finish: Look for smooth cardstock for cleaner lines and ink application.

- **Graphite Pencils**

Hardness Scale: Use H pencils for fine lines and B pencils for darker, bolder lines.

Purpose: Hard pencils are suitable for preliminary sketches; softer pencils work better for shading and final touches.

- **Mechanical Pencils**

Lead Sizes: Select lead thickness based on your drawing needs (0.3mm for fine details, 0.5mm or 0.7mm for broader lines).

Convenience: Mechanical pencils eliminate the need for sharpening, ensuring consistent line width.

- **Charcoal Pencils**

Usage: Ideal for sketching and shading, providing a rich contrast.

Selection: Choose from soft to hard charcoal pencils based on desired shading depth.

- **Types of Ink**

Permanent Ink: Essential for long-lasting results; prevents fading and smudging.

Waterproof Ink: Opt for this type to ensure durability when drawings are exposed to moisture.

- **Technical Pens**

Line Weight: Choose pens with varying line weights for different aspects of your drawing.

Quality: Look for reputable brands that offer consistent ink flow and precision.

- **India Ink**
- **Pigmentation**: Offers deep, rich black lines; suitable for finalizing detailed drawings.
- **Application**: Ideal for both line work and shading.
- **Types of Erasers**
- **Vinyl Erasers**: Effective for clean erasures without damaging the paper.
- **Kneaded Erasers**: Great for lifting graphite without leaving residue; shapeable for precision.

Points to Remember

- It's essential to know some technical drawing terminologies before starting to perform technical drawing such as: technical drawing, line, point, and projection
- Before performing technical drawing, it is better to be able to identify the following drawing materials: pencils, charcoal, crayon, marker, paper, eraser and sharpener.
- While selecting technical drawing materials, take into consideration the following criteria:
  - ✓ Prioritize durability and quality to ensure longevity and precision of materials.
  - ✓ Choose materials that suit the specific project requirements, such as medium and scale.
  - ✓ Consider comfort and ease of use, especially for materials that will be used for long

Application of learning 1.1.

Suppose that there is an ABC company that wishes to draw a detailed blueprint of a LAN network. Refer to the key readings 1.1.2 and help that company to select technical drawing materials that will be used to draw the aforementioned drawing.

Indicative content 1.2: Identification of Drawing Instruments

Duration: 4 hrs

Theoretical Activity 1.2.1: Identification of technical drawing instruments

Tasks:

1: Answer the following questions:

i. What is the difference between a drawing board and a protractor?

ii. Identify the drawing instruments based on their uses.

2: Write your findings on papers or flipcharts.

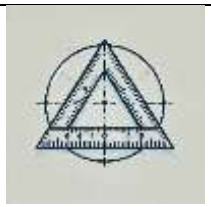
3: Present the findings to the trainer or classmates

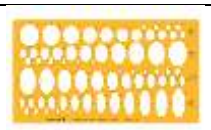
4: Ask questions for clarification where necessary

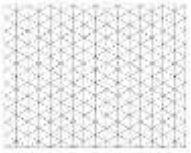
5: Read the key readings 1.2.1.

Key readings 1.2.1.: Identification of Drawing Instruments

Drawing Instruments and their uses

SN	Name of material	Image	Uses (description)
1.	T-square		It is used to draw horizontal lines and to align other drawing instruments, ensuring accuracy in layout.
2.	Set square		It helps create precise angles (typically 30°, 45°, and 60°) and are used in conjunction with a T-square for accurate drawings.
3.	Compass		It is used to draw arcs, circles, and create precise measurements between points.

4.	Protractor		It measures and constructs angles, allowing for precise angular dimensions in drawings.
5.	Scale ruler		It provides measurements in various scales (e.g., architectural, engineering) to ensure accurate dimensions in scaled drawings.
6.	French curve		It is used to draw smooth curves of varying shapes and are especially useful in creating complex, non-linear designs.
7.	Drafting brush		It is used to clean the drawing surface of eraser debris and dust, keeping the workspace tidy.
8.	Circle template		It allows for the easy drawing of circles of various diameters, ensuring uniformity in designs.
9.	Ellipse template		It helps in drawing precise ellipses, which can be challenging to create freehand.
10.	Straightedge		It is used to draw straight lines and can serve as a guide for cutting and measuring.
11.	Drawing board		It provides a stable and flat surface for drawing and drafting, allowing for precise work.

12.	Adjustable triangle		It creates different angles and are useful for drawing various geometric shapes.
13.	Isometric grid		It is used for creating isometric drawings, which represent three-dimensional objects in two dimensions.
14.	Drafting pencil		It provides consistent line quality and precision for detailed technical drawings, available in various lead hardness.
15.	Color wheel		It helps understand color relationships and assists in selecting harmonious color schemes for drawings.
16.	Mechanical pencil		It provides a fine, consistent line for detailed work and are easily refillable with lead.
17.	Fine-tip pens		It is used for inking and outlining technical drawings, providing clean and precise lines.
18.	Eraser (kneaded and standard)		It lifts graphite and allow for gentle erasing without damaging the paper, while standard erasers are used for more aggressive removal of pencil marks.

19.	Stylus (for digital drawing)		It allows for precise control when drawing on digital devices, mimicking the feel of traditional drawing instruments.
20.	Digital tablet		It enables artists and designers to create and edit drawings digitally, often featuring pressure sensitivity for varied line thickness

Practical Activity 1.2.2: Selecting technical drawing materials

Task:

1: Do the task described below:

i. You are requested to go to the workshop and select technical drawing instruments according to the assigned task.

2: Present the criteria for selecting technical drawing instruments

3: Referring to the selection criteria presented in step 2, select technical drawing instruments

4: Present the selected instruments to the trainer or classmates

4: Read the key readings 1.2.2

5: Perform the application of learning 1.2.

Key readings 1.2.2: Selecting technical drawing instruments

- **Types of technical drawing instruments**

✓ **Pencils and Leads**

Mechanical Pencils: Offer consistent line widths and eliminate the need for sharpening. Common sizes range from 0.3mm for detailed work to 0.7mm for bolder lines.

Graphite Pencils: Available in varying degrees of hardness, from H (hard) for fine lines to B (soft) for darker lines. Selection depends on the intended use—drafting vs. shading.

✓ **Rulers and Scales**

Straight Rulers: Typically made of plastic or metal, used for drawing straight lines and measuring distances accurately.

Scale Rulers: Specialized rulers with different scales (metric and imperial) that allow users to create scaled drawings easily, important for architectural and engineering designs.

✓ **Protractors**

Standard Protractors: Semicircular or circular tools for measuring and drawing angles accurately. A must-have for creating precise geometric shapes and angles in technical drawings.

✓ **Set Squares**

Types: Right-angle set squares (45° and 30°-60°) used for drawing perpendicular lines and angles. Important for ensuring accuracy in technical drawings.

✓ **Compasses and Dividers**

Compasses: Used for drawing circles and arcs, adjustable for varying radii. Selecting a compass with a firm grip and smooth adjustment mechanism is crucial for accuracy.

Dividers: Similar to compasses, but with pointed ends for transferring measurements. Essential for marking distances accurately on drawings.

- **Criteria for Selection**

✓ **Purpose and Application**

Determine the specific needs based on the type of drawing (e.g., architectural, engineering, artistic) to select the most appropriate instruments.

For instance, a detailed architectural plan may require precision instruments like scale rulers and protractors, while conceptual sketches may benefit more from versatile drawing pencils.

✓ **Accuracy and Precision**

Instruments should be chosen based on the level of precision required in the work. Higher accuracy instruments are necessary for technical drawings that require strict

adherence to measurements and angles.

For example, choose high-quality compasses and protractors with clear markings for accuracy.

✓ **Durability and Quality**

Evaluate the materials and construction of the instruments. High-quality instruments tend to last longer and provide consistent performance.

Look for tools made from durable materials such as metal or high-grade plastic to ensure longevity.

✓ **Comfort and Usability**

Consider the ergonomic design of the instruments, especially those held for extended periods, such as pencils and rulers.

Instruments that are comfortable to hold and easy to use can enhance productivity and reduce fatigue.

Points to Remember

- While identifying drawing Instruments it is better to consider instruments such as: T-square, set square, compass, protractor, scale ruler, French curve, drawing board.
- While selecting technical drawing instruments, take into consideration the following criteria:
    - Choose durable and stable instruments
    - Consider portability and ease of storage for items
    - Select instruments that provide clear visibility

Application of learning 1.2.

Suppose that there is an XYZ institution that wishes to draw a detailed blueprint of a LAN network. Refer to the key readings 1.2.2 You are tasked to help that institution select technical drawing instruments that will be used to draw the aforementioned drawing.

Indicative content 1.3: Identification of Drawing Equipment

Duration: 4 hrs

Theoretical Activity 1.3.1: Identification of drawing equipment

Tasks:

1: Answer the following questions:

i. Define the term drawing Equipment
ii. Identify the drawing equipment based on their uses.

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary.

5: Read the key readings 1.3.1.

Key readings 1.3.1 Identification of Drawing Equipment

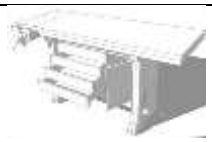
Definition of Drawing Equipment:

Drawing equipment refers to the tools and devices used to assist in creating accurate and precise technical or artistic drawings. These items are typically larger or more durable than drawing instruments and are essential for setting up and maintaining the drawing process.

Drawing Equipment and their uses

SN	Name of material	Image	Uses (description)
✓	Drafting table		Provides a flat, adjustable surface for drawing and drafting. The adjustable angle allows for ergonomic working positions.
✓	Light box		Illuminates drawings from beneath, making it easier to trace images or patterns onto another sheet of paper.

✓	Computer (with CAD software)		Used for creating, modifying, analysing, and optimizing designs in digital format, facilitating precision and ease of adjustments.
✓	Plotter		A printer designed for printing vector graphics, capable of producing large-scale technical drawings, blueprints, and architectural plans.
✓	Printer (for large formats)		Prints high-quality, large-format images and drawings, often used for posters, banners, and architectural designs.
✓	Scanner		Digitizes paper drawings and documents, converting them into electronic formats for easy storage, sharing, and editing.
✓	Cintiq tablet		A graphics tablet with a display, allowing artists and designers to draw directly on the screen using a stylus, providing a natural drawing experience.
✓	Cutting mat		Protects surfaces while cutting paper or other materials; often self-healing to resist damage and prolong its usability.
✓	Projector		Projects images or drawings onto surfaces, useful for presentations or tracing outlines onto larger media.
✓	CAD workstation		A specialized computer setup optimized for running CAD software, featuring powerful processors and graphics capabilities for complex designs.

✓	Plotting arm		A mechanical device that holds a pen or other drawing instrument and moves it across a drawing surface, allowing for precise, automated drawing.
✓	Whiteboard		Used for brainstorming, sketching ideas, or presenting information; can be easily erased and reused.
✓	Blackout blinds (for light-sensitive work)		Block out external light to create a controlled environment for sensitive materials or processes, enhancing visibility during drawing.
✓	Measuring tape		A flexible tape used to measure distances and dimensions accurately, essential for ensuring precise measurements in technical drawings.
✓	Workbench		Provides a sturdy surface for working on drawings or models, often equipped with storage and tools for convenience.
✓	Tool organizer		Keeps tools and instruments neatly arranged and easily accessible, improving efficiency and workspace organization.
✓	Storage cabinet (for materials)		Stores drawing materials, papers, and equipment securely, helping to maintain an organized workspace.
✓	File folders (for plans)		Organizes and protects physical drawings and plans, preventing damage and making retrieval easy.

✓	Binder (for organizing drawings)		A folder with rings that holds loose papers, ideal for organizing and protecting sets of drawings or documents.
✓	Photocopy machine		Copies documents and drawings, allowing for easy reproduction of designs for distribution or record-keeping.

Practical Activity 1.3.2: Selecting technical drawing equipment

Task:

Tasks:

1: Do the task described below:

i. You are requested to go to the workshop and select technical drawing equipment according to the assigned task.

2: Present the criteria for selecting technical drawing equipment

3: Referring to the selection criteria presented in step 2, select technical drawing equipment

4: Present the selected equipment to the trainer or classmates

4: Read the key readings 1.3.2

5: Perform the application of learning 1.3.

Key readings 1.3.2. Selecting technical drawing equipment

- **Criteria for Selecting technical drawing equipment**

✓ **Purpose and Use**

Identify Requirements: Determine the specific type of drawings you will be creating (e.g., architectural, mechanical, electrical).

Choose Equipment Accordingly: Select equipment tailored to your needs, ensuring it can handle the required complexity and detail.

✓ **Compatibility**

Integration with Other Tools: Ensure the equipment you choose can work seamlessly with your existing tools and materials.

Adjustability: Look for equipment that can be adjusted or modified to accommodate different drawing styles or preferences.

- ✓ **Ergonomics**

Comfort and Usability: Select equipment designed for comfortable use over extended periods. This includes adjustable heights for drafting boards and grips on compasses.

Ease of Use: Equipment should facilitate smooth and effortless drawing to reduce fatigue and increase productivity.

- ✓ **Quality and Durability**

Material Quality: Look for equipment made from high-quality materials that ensure longevity and consistent performance.

Brand Reputation: Consider brands known for their reliability and durability, as this often translates to better quality equipment.

- ✓ **Cost**

Budget Consideration: Set a budget for your technical drawing equipment, keeping in mind that quality often correlates with price.

Value for Money: Assess whether the equipment offers good features and durability for the price. Investing in higher-quality equipment may save money in the long run.

Points to Remember

- While Identifying drawing equipment take into consideration the following equipment : drafting table, light box, computer (with cad software), plotter, printer (for large formats), scanner, cintiq tablet, cutting mat, projector, CAD workstation, plotting arm, whiteboard, blackout blinds (for light-sensitive work), measuring tape.
- While selecting technical drawing equipment, take into consideration the following criteria:
    - ✓ Ensure durability, reliability and performance of equipment
    - ✓ Ensure accessibility and ease of procurement when needed

Application of learning 1.3.

Suppose that ABC school wishes to draw a detailed blueprint of a LAN network. Referring to the key readings 1.3.2 you are tasked to select technical drawing equipment that will be used to draw the aforementioned drawing.

Learning outcome 1 end assessment

Theoretical assessment

Q1. Read the following questions then answer by TRUE if the statement is correct or by FALSE if the statement is incorrect:

i. Tracing paper is used to make transparent copies of technical drawings.
ii. Graphite pencils are used in technical drawing for shading only.
iii. Ink is often used for permanent technical drawings that require high precision.
iv. Polyester drafting film is a type of drawing paper used for rough sketches.

Q2. Match the following technical drawing materials, instruments and equipment (in column B) with their corresponding uses (in column C). Write the letter of the correct answer in the provided blank space (in column A)

Column A	**Column B**	**Column C**
Answers	**Materials/instruments/equipment**	**Uses**
1……..	• T-Square	a) Used to measure angles in degrees
2…….	• Compass	b) Used for drawing straight, horizontal lines
3…….	• Protractor	c) Used to withdraw circles
		d) Used to draw circles and arcs.

Q3. Fill in the blanks with the appropriate words. Select from the given choices in the box

Set squares, drawing board**,** drafting machine , plotter, light box

i. **……**is used to provide a flat, stable surface for technical drawings.
ii. **……**is a piece of equipment that combines the functions of a T-square and protractor for precise angle measurements and straight lines.
iii. **……** are triangular-shaped instruments that are used for drawing standard angles, typically 30°, 45°, 60°, and 90°.

Practical Assessment

ABC School wants to upgrade its network to support its digital learning. The school wants to design a network blueprint outlining materials, instruments and equipment placement: (routers, switches, and access points). You are tasked to help the school perform the following task:

a) Select the technical drawing materials, instruments and equipment that will be used to draw the aforementioned drawing

END

References

Books

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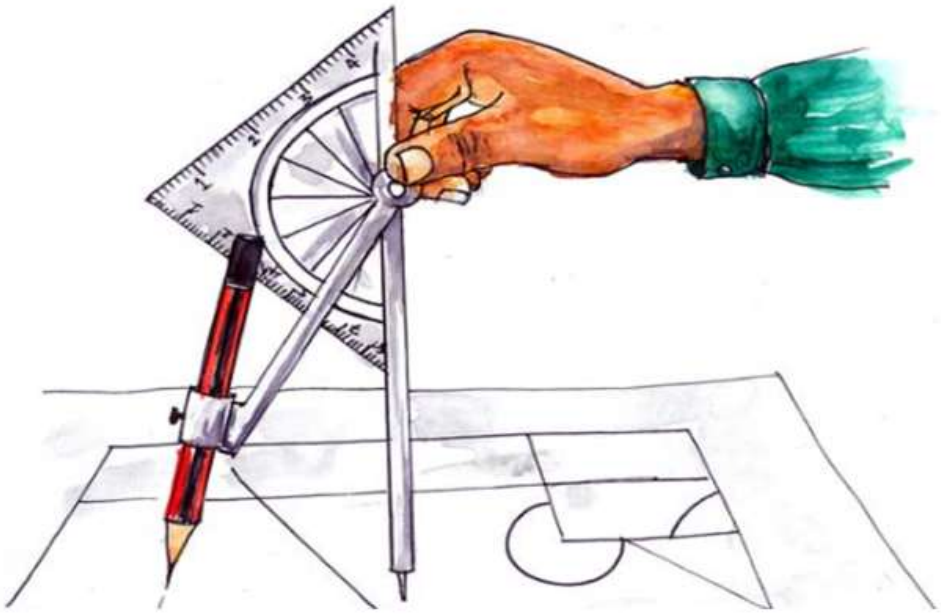
Leake, J., & Borgerson, J. (2012). The Engineering Design Graphics Sketching Workbook (4th ed.). Wiley.

Madsen, D. A., & Madsen, D. P. (2016). Engineering Drawing and Design (6th ed.). Cengage Learning.

Simmons, C. H., & Maguire, D. E. (2012). Manual of Engineering Drawing (4th ed.). Elsevier.

Web Links

https://www.google.com/search?q=Apply+basic+concepts+of+technical+drawing
https://www.google.com/search?q=Apply+lines+and+symbols+used+in+drawing
https://www.google.com/search?q=Perform+dimensional+drawing



Indicative contents
2.1 Description of drawing sheet **2.2 Identification of symbols and geometric figures in engineering drawing** **2.3 Drawing Lettering** **2.4 Application of drawing scale** **2.5 Application of drawing dimensions**

Key Competencies for Learning Outcome 2: Draw Symbols, Geometric Figures and Solids used in Technical Drawing

Knowledge	Skills	Attitudes
• Description of drawing sheet • Identification of symbols and geometric figures in engineering drawing • Description of lettering drawing • Description of scale • Description of dimensioning	• Selecting drawing sheet series • Drawing geometric figures • Drawing lettering • Applying drawing scale • Dimensioning the drawing	• Paying attention to details on drawings required for better precision and accuracy • Having clarity and legibility to ensure that all drawings are easy to read • Being consistent to ensure that all elements in your drawing are proportional and consistent in scale

Duration: 20hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly drawing sheet layout according to the ISO standards.
2. Identify accurately symbols and geometric figures according to their style.
3. Select properly drawing sheet series according to the ISO standards
4. Draw properly lettering drawing according to the user need.
5. Apply adequately drawing scale according to the ISO standards.
6. Apply appropriately drawing dimensions according to technical standard

Resources

Equipment	Tools	Materials
• Drawing board • Calculator • Mini drafter	• Ink-pen • Paper cuter • One-meter straight drawing ruler with handle • Right angle ruler • Protractor • Drawing compass • Engineering pencils • Drawing template • French curves • Set squares • T square	• Paper • Rubber • Pen ink • Propelling pencil

Indicative content 2.1: Description of Drawing Sheet

Duration: 2 hrs

Theoretical Activity 2.1.1: Description of drawing sheet

Tasks:

1: Answer the following questions:

i. What do you understand by the term drawing sheet?
ii. Why is title block important in technical drawing?
iii. List the elements of drawing sheet layout.

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary.

5: Read the key readings 2.1.1.

Key readings 2.1.1.: Description of drawing sheet

- **Definition**

Drawing papers or drawing sheets are the materials on which the drawings are made.

- **Types of drawing sheet**

- Dimensional sheet (grid paper)
- Tracing paper
- Bristol

These are: white plain paper, Dimensional sheet or grid paper (profile paper, plane/profile paper, cross section paper), tracing paper and Bristol paper.

✓ **Classification of drawing sheets**

- Based on size
- Based on finish
- Based on weight

Based on sizes.

Standard drawing sheet sizes are in three series designated An, Bn & Cn. Most popular series used in masonry basic drawing are An Series drawing papers.

✓ **Steps of finding a series paper format sizes**

Example: in order to get A1

Step 1: take the preceding paper size A0 (841*1189) mm

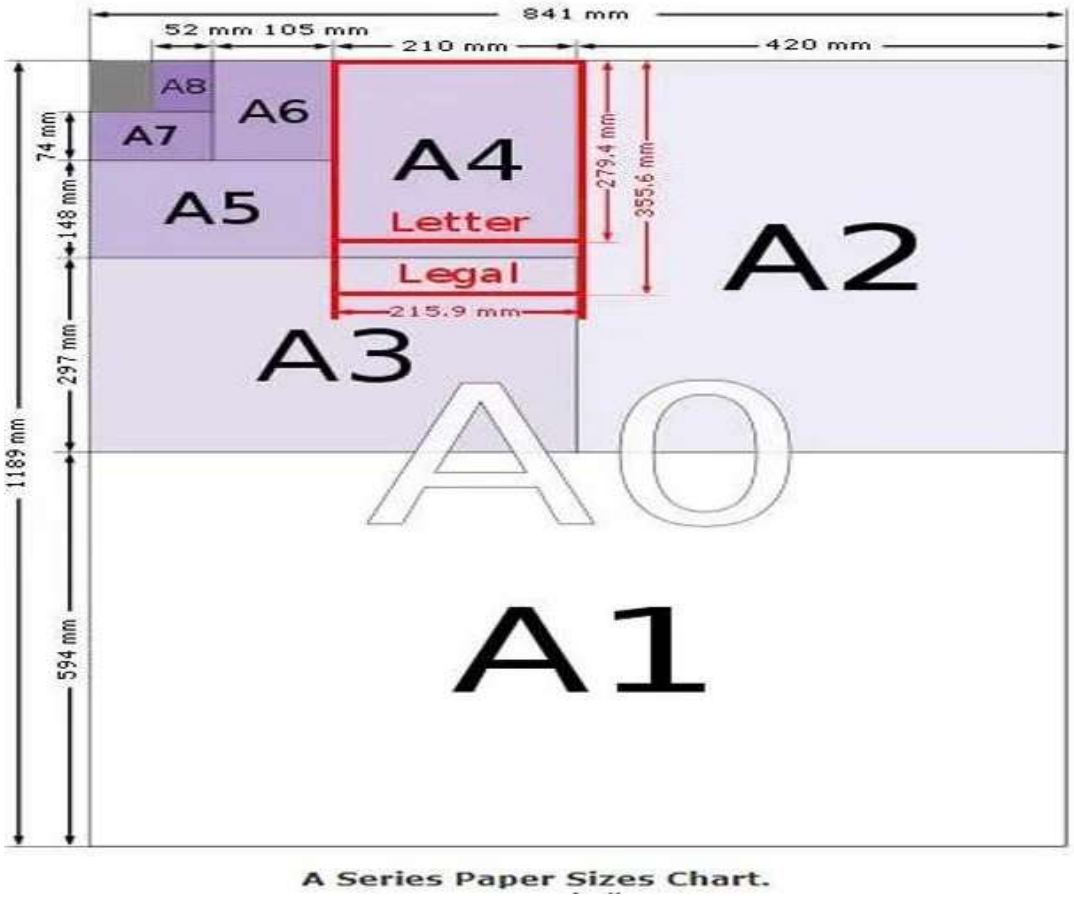
Step 2: fold AO PAPER length into two with 1189/2=594mm, 1 neglected

Step 3: consider the obtained value on step 2 as the width of concerned paper format (the following paper)

Step 4: (841mm) the former width of A0 has become the length of the following paper (A1) paper.

There is also larger size like 2A0 and 4A0 however, at school we will be using A4 size. A0 is a rectangle with an area of 1m2. All A size sheets have their edge lengths in the same proportion. This proportion is in the ratio of short side to the long side and is equal to 1:2.

Each lower size in the **A** series is obtained by exactly dividing the **A** sheet along its middle as shown in the following figure:



A Series Paper Sizes Chart.

- **Part of drawing sheet layout**

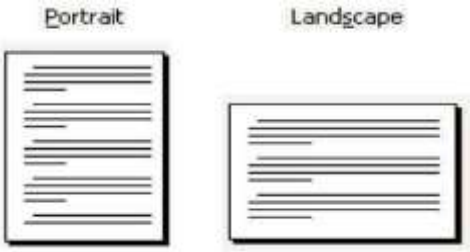
Margin: margin is provided around the sheet by drawing margin lines. The provision of margin lines will enable prints to be trimmed along margin lines. Prints after trimming would be of recommended sizes of sheets.

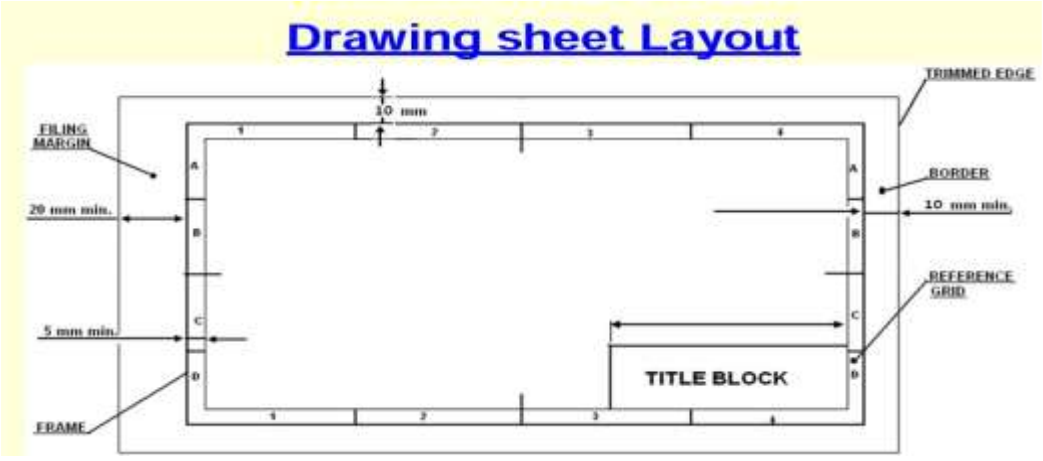
Title block: The title block is an important feature in the drawing because it gives all the information of the prepared drawing. It is proved at the right hand bottom corner of the sheet.

- ✓ **All the block should contain at least the following information:**

- Name of the Firm/School/College
- Name of the Object (Work piece)
- Number of the drawing (particularly useful for reference where more than one drawing is concerned typically in assembly drawings)
- Format of the paper used (paper size)
- Scale used
- Dimensioning unit (usually millimeters mm)
- Symbol for the method of projection used
- Date when the drawing was finished

Depending on the shape and size of the object being represented on the drawing, the drawing sheet can be taken in the Portrait or Landscape position.





Practical Activity 2.1.2: Selecting drawing sheet

Task:

1: Do the task described below:

i. You are requested to go to the workshop and select drawing sheet according to the assigned task.

2: Present the criteria for selecting drawing sheet

3: Referring to the selection criteria presented in step 2, select drawing sheet

4: Present the selected sheet to the trainer or classmates

4: Read the key readings 2.1.2

5: Perform the application of learning 2.1.

Key readings 2.1.2: Selecting drawing sheet

When selecting a drawing sheet, here are some key criteria to consider:

- **Sheet Size and Scale**:

  Size: Choose a sheet size that is appropriate for the project, considering the level of detail required and the space needed to effectively communicate the design.

  Scale: Select a scale that allows for clear and concise representation of the design elements.

- **Material and Finish**:

  Material: Select a sheet material that suits the project requirements, such as paper, film, or vellum.

  Finish: Consider the finish of the sheet, including texture, smoothness, and translucency.

- **Line Quality and Erasability**:

  Line Quality: Opt for a sheet that allows for smooth, consistent line work.

  Erasability: Consider the erasability of the sheet if mistakes need to be corrected.

- **Archival Quality and Durability**:

Archival Quality: If the drawing is intended for long-term preservation, choose a sheet that meets archival standards for durability and resistance to degradation.

Points to Remember

- Use different types of paper in order to clarify clearly the drawing sheets.
- Remember to organize and align elements on the drawing sheet.
- Leave sufficient margins and borders around the drawing to create a clear and uncluttered layout.
- While selecting drawing sheets, take consideration of the following criteria:

✓ Ensure the size of sheet

✓ Considering the level of detail required and the space needed to effectively communicate the design.

Application of learning 2.1.

As Technician in Networking draw a specified drawing sheet layout on a landscaping paper by showing each element location.

Indicative content 2.2: Identification of Symbols and Geometric Figures in Engineering Drawing

Duration: 6 hrs

Theoretical Activity 2.2.1: Description of geometric figures and symbols

Tasks:

1: Answer the following questions:

i What do you understand by the term drawing line?

ii Why is angle important in technical drawing?

iii Identify the types of drawing triangle.

iv Enumerate different uses of drawing symbols.

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary.

5: Read the key readings 2.2.1.

Key readings 2.2.1.: Description of geometric figures

- **Definition of a point**

  In drawing, a point is a fundamental concept that represents a precise location in space.

  It is a dimensionless entity that has no length, width, or height, but serves as a reference or anchor for other geometric elements.

- **Types of lines and their uses**

✓ **Visible Outlines, Visible Edges:**

(Continuous wide lines) the lines drawn to represent the visible outlines/ visible edges / surface boundary lines of objects should be outstanding in appearance.

✓ **Dimension Lines:**

(Continuous narrow Lines) Dimension Lines are drawn to mark dimension.

✓ **Extension Lines:**

(Continuous narrow Lines). There are extended slightly beyond the respective dimension lines.

- ✓ **Construction Lines:**

  (Continuous narrow Lines) Construction Lines are drawn for constructing drawings and should not be erased after Completion of the drawing.

- ✓ **Hatching / Section Lines:**

  (Continuous Narrow Lines) Hatching Lines are drawn for the sectioned portion of an object. These are drawn inclined at an angle of 45° to the axis or to the main outline of the section.

- ✓ **Guide Lines:**

  (Continuous Narrow Lines) Guide Lines are drawn for lettering and should not be erased after lettering.

- ✓ **Break Lines:**

  (Continuous Narrow Freehand Lines) Wavy continuous narrow line drawn freehand is used to represent break of an object.

- ✓ **Break Lines:**

  (Continuous Narrow Lines with Zigzags) Straight continuous ~arrow line with zigzags is used to represent break of an object.

- ✓ **Dashed Narrow Lines:**

  (Dashed Narrow Lines) Hidden edges / Hidden outlines of objects are shown by dashed lines of short dashes of equal lengths of about 3 mm, spaced at equal distances of about 1 mm. the points of intersection of these lines with the outlines / another hidden line should be clearly shown.

- ✓ **Centre Lines**:

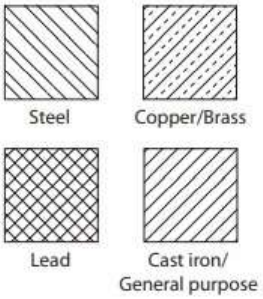
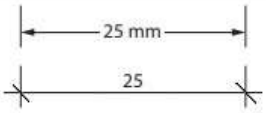
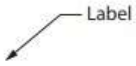
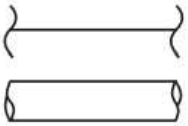
  (Long-Dashed Dotted Narrow Lines) Centre Lines are drawn at the centre of the drawings symmetrical about an axis or both the axes. These are extended by a short distance beyond the outline of the drawing.

- ✓ **Cutting Plane Lines:**

  Cutting Plane Line is drawn to show the location of a cutting plane. It is long-dashed dotted narrow line, made wide at the ends, bends and change of direction. The direction of viewing is shown by means of arrows resting on the cutting plane line.

- ✓ **Border Lines:**

  Border Lines are continuous wide lines of minimum thickness 0.7 mm

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		Unbroken lines arranged in a pattern, usually straight and at a 45° 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		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		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		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.

- **Angles and their types**

When two straight lines meet (AB and AC below), they form an angle. Angles are measured in degree (^{0}). There are 360^0 in a circle. Angles can be drawn and measured using a protractor.

- Acute angle
- Right angle
- Obtuse angle
- Straight angle

- Reflex angle
- Full rotation angle

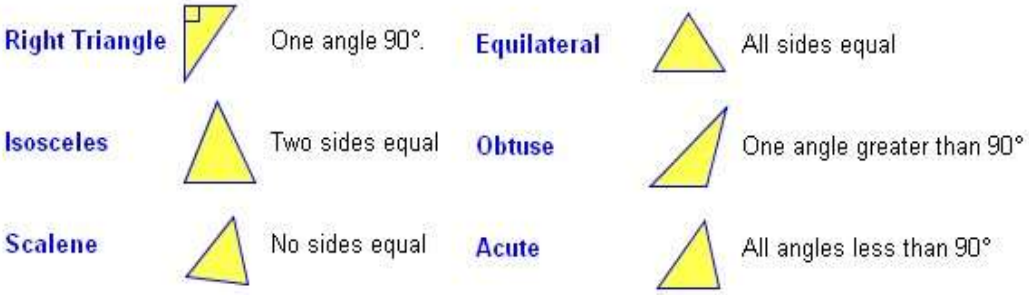
	Degrees	Radians
Zero	$a = 0$	$a = 0$
Acute	$0 < a < 90°$	$0 < a < \pi/2$
Right	$a = 90°$	$a = \pi/2$
Obtuse	$90° < a < 180°$	$\pi/2 < a < \pi$
Straight	$a = 180°$	$a = \pi$
Reflex	$180° < a < 360°$	$\pi < a < 2\pi$
Full	$a = 360°$	$a = 2\pi$

	Degrees	Radians
Zero	$a = 0$	$a = 0$
Acute	$0 < a < 90°$	$0 < a < \pi/2$
Right	$a = 90°$	$a = \pi/2$
Obtuse	$90° < a < 180°$	$\pi/2 < a < \pi$
Straight	$a = 180°$	$a = \pi$
Reflex	$180° < a < 360°$	$\pi < a < 2\pi$
Full	$a = 360°$	$a = 2\pi$

- **Triangles and their types**

A triangle: is a closed geometric figure having three sides and three angles.

Triangles are classified into the following groups, depending on various properties. Note that a given triangle can be in more that one group. For example, it could be both a right triangle and a scalene triangle at the same time.



- **Quadrilaterals and their proprieties**

The word quadrilateral has its origin from the two words “quadric” meaning four and “lateral” meaning sides. Thus, a quadrilateral is that geometrical figure which has four sides, enclosing a part of the plane.

- **Description of engineering symbols**

Engineering symbols are standardized graphical representations used in engineering drawings and technical documentation to convey specific information about

components, processes, or systems. These symbols help engineers, architects, and technicians communicate complex ideas clearly and concisely.

- **Description of solid object**

Definition: A solid is normally a sample of matter that retains its shape when not confined. In engineering drawing a solid is an object having three dimensions which are the length, breadth and height or thickness. It is bounded by planes faces or curved surfaces or a combination of both.

- **Types of solids:**

✓ **Prism:**

A prism is a solid with two identical faces that are connected by a rectangular solid. Examples of prisms include cubes, rectangular prisms, and triangular prisms.

✓ **Pyramid:**

A pyramid is a solid with a polygon base and triangular faces that meet at the apex. Examples of pyramids include square pyramids, triangular pyramids, and pentagonal pyramids.

✓ **Cone:**

A cone is a solid with a circular base and a curved surface that tapers to a point.

✓ **Cylinder:**

A cylinder is a solid with two parallel and circular bases connected by a curved surface.

✓ **Sphere:**

A sphere is a solid that is symmetrical about its center and has all points on its surface equidistant from the center.

✓ **Torus:**

A torus is a solid that is shaped like a doughnut, with a central hole and a curved surface.

✓ **Hemisphere:**

A hemisphere is half of a sphere, with a curved surface and a circular base.

✓ **Ellipsoid:**
An ellipsoid is a solid that is symmetrical about its center and has three unequal axes.

✓ **Tetrahedron:**

A tetrahedron is a solid with four triangular faces that meet at the vertices

Practical Activity 2.2.2: Drawing geometrical figures and symbols

Task:

1: Do the task described below:

i. You are requested to go to the workshop and draw geometrical figure and symbols according to the assigned task.

2: Present the steps for geometrical figures and symbols

3: Referring to the step presented in step 2, draw geometrical figure

4: Present the geometrical figure and symbols drawing to the trainer or classmates

4: Read the key readings 2.2.2

5: Perform the application of learning 2.2.

Key readings 2.2.2. Drawing geometrical figures and symbols

- **Steps for Drawing a Point**

✓ **Select Your Medium**:

Choose the appropriate tool for your drawing (e.g., pencil, pen, or digital stylus).

✓ **Prepare Your Drawing Surface**:

Ensure that your paper or digital canvas is clean and ready for drawing.

✓ **Identify the Location**:

Determine the exact coordinates or location where you want to place the point. This can be based on measurements or design requirements.

✓ Mark the Point:

- **For Traditional Drawing:**

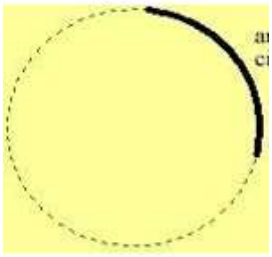
Use the tip of your pencil or pen to make a small dot at the identified location. Press gently to avoid smudging.

✓ **Drawing lines**

Horizontal

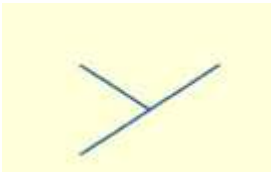
vertical

Oblique



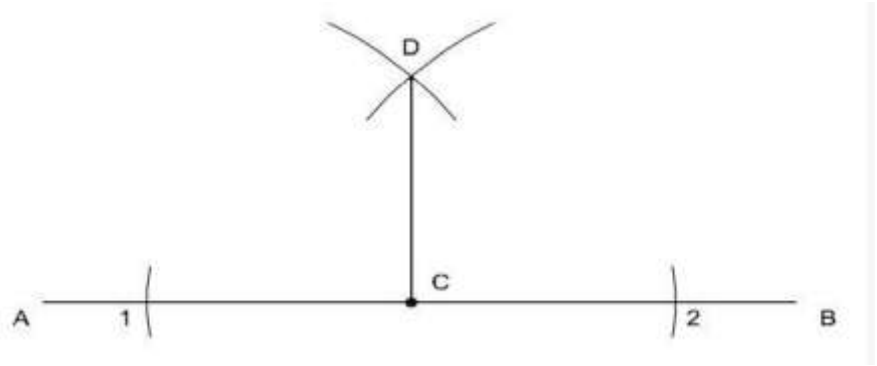
curved

parallel

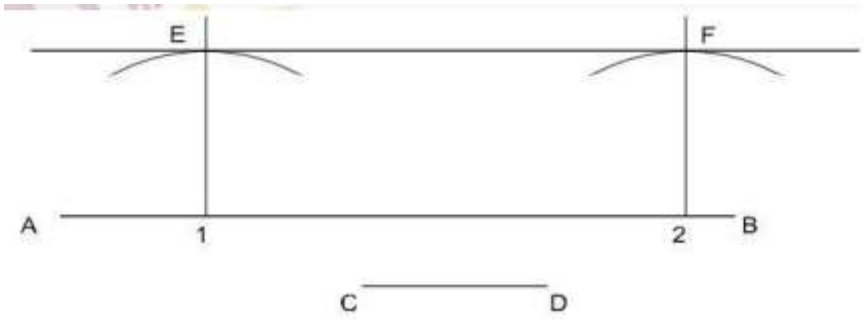


Perpendicular

- **Draw a Perpendicular to a Straight Lines**:
  - Draw a perpendicular to a given straight line, from a given point in it
  - `C' is the point on the line AB.
  - `C' as centre draw arcs on the line AB at 1 & 2.
  - 1 and 2 are centres draw arcs. The arcs intersect at D.
  - Join DC.
  - CD is the perpendicular line from the point `C'.



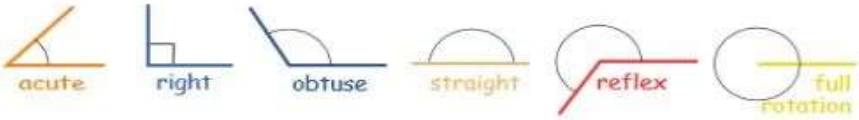
- **Draw Parallel Lines:**
  - Draw a line parallel to a given line at a given distance:
  - Draw a line AB to a convenient length (say 60 mm).
  - Draw a line CD (40 mm) is the given distance.
  - Mark points 1 & 2 near A & B respectively.
  - With 1 & 2 as centres CD as radius draw arcs.
  - At 1 & 2 erect perpendiculars by using setsquares, meeting at E & F respectively.
  - Join the points E & F.
  - EF is parallel to AB at the given distance of CD.



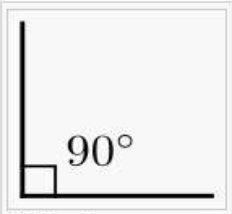
- **Drawing Angles**

The main angles used are described below:

As the Angle Increases, the Name Changes:

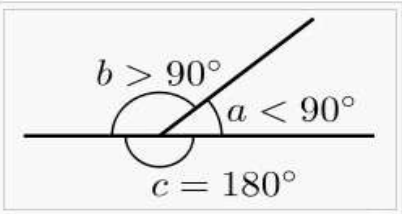


Type of Angle	Description
Acute Angle	is less than 90°
Right Angle	is 90° exactly
Obtuse Angle	is greater than 90° but less than 180°
Straight Angle	is 180° exactly
Reflex Angle	is greater than 180°
Full Rotation	is 360° exactly



Right angle.

Reflex angle.



Acute (*a*), obtuse (*b*), and straight (*c*) angles.

- **Draw triangles**

Draw a straight line to make the first side of your triangle. Use a protractor to measure a 60° angle at one end of the line, then draw another straight line from that point that's equal in length to the first. Use the straight edge of the protractor to draw the final side of the triangle and connect all the points.

- **Draw Quadrilateral**

Use a ruler to draw two connected straight lines for the first two sides of the quadrilateral

Locate the Remaining Vertices:

Calculate where the remaining two vertices of the quadrilateral will be based on the type of quadrilateral:

Square: Ensure all sides are equal and all angles are right angles (90 degrees).

Rectangle: Ensure opposite sides are equal and all angles are right angles.

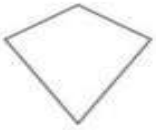
Trapezoid: Ensure one pair of opposite sides are not equal.

Rhombus: Ensure all sides are equal, but not all angles are right angles.

- **Draw the Remaining Sides:**

Use your ruler to draw lines from the last vertex of the second side to the first vertex, and from the first vertex to the last vertex of the first side, ensuring the lines meet at the vertices to form the quadrilateral.

Quadrilateral Types & Their Properties

Quadrilateral Type	Shape	Properties
Square		1. All the sides of the square are of equal measure. 2. The opposite sides are parallel to each other. 3. All the interior angles of a square are at 90 degrees (i.e., right angle). 4. The diagonals of a square are equal and perpendicular to each other. 5. The diagonals bisect each other. 6. The ratio of the area of incircle and circumcircle of a square is 1:2.
Rectangle		1. The opposite sides of a rectangle are of equal length. 2. The opposite sides are parallel to each other. 3. All the interior angles of a rectangle are at 90 degrees. 4. The diagonals of a rectangle are equal and bisect each other. 5. The diameter of the circumcircle of a rectangle is equal to the length of its diagonal.
Rhombus		1. All the four sides of a rhombus are of the same measure. 2. The opposite sides of the rhombus are parallel to each other. 3. The opposite angles are of the same measure. 4. The sum of any two adjacent angles of a rhombus is equal to 180 degrees. 5. The diagonals perpendicularly bisect each other. 6. The diagonals bisect the internal angles of a rhombus.
Parallelogram		1. The opposite sides of a parallelogram are of the same length. 2. The opposite sides are parallel to each other. 3. The diagonals of a parallelogram bisect each other. 4. The opposite angles are of equal measure. 5. The sum of two adjacent angles of a parallelogram is equal to 180 degrees.
Trapezium		1. A trapezium has two parallel sides and two non-parallel sides 2. The two adjacent sides of a trapezium are supplementary (180 degrees). 3. The diagonals of regular trapezium bisect each other. The ratio of bisection of diagonals is the same for both the diagonals. 4. The length of the mid-segment is equal to half the sum of the parallel bases, in a trapezium. 5. The sum of two pairs of adjacent angles of a trapezium formed between the parallel sides and one of the non-parallel sides is 180 degrees.
Kite		1. The pair of adjacent sides of a kite are of the same length. 2. The larger diagonal of a kite bisect the smaller diagonal. 3. Only one pair of opposite angles are of the same measure.

- **Draw solids**

Sketch the Basic Shape: Lightly sketch the basic shape of the solid using simple shapes (e.g., squares, triangles, or circles).

Add Depth and Dimension:

Add lines and shapes to create depth and dimension:

Lines: Use lines to indicate the edges and contours of the solid.

Shading: Add shading to create the illusion of depth and volume.

Texture: Add texture to give the solid a more realistic appearance.

Define the Edges and Corners:

Use lines and curves to define the edges and corners of the solid:

Sharp Edges: Use sharp lines to create crisp edges.

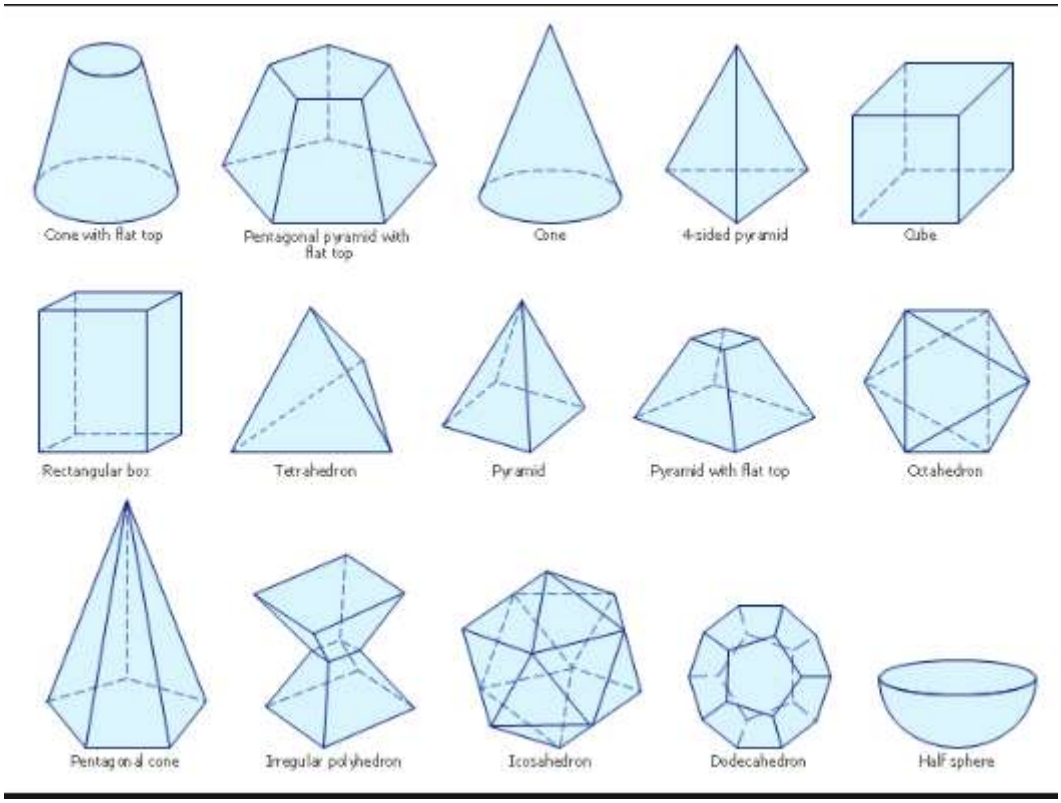
Rounded Corners: Use curved lines to create rounded corners.

Add Additional Details:

Add additional details to enhance the solid:

Shading and Lighting: Add shading and lighting effects to create depth and atmosphere.

Patterns and Textures: Add patterns and textures to give the solid a more realistic appearance.



- **Draw symbols**

✓ **Understand the Standards**:

Familiarize yourself with the specific engineering drawing standards relevant to your field (e.g., ISO, ANSI, ASME).

Review the symbols commonly used in your discipline (e.g., mechanical, electrical, civil).

✓ **Gather Tools and Materials**:

Use appropriate drawing tools such as:

Pencils: For sketching and detailing.

Rulers and T-squares: For straight lines and precise angles.

Compass: For drawing circles and arcs.

Templates: For standard shapes and symbols.

✓ **Choose the Symbol**:

Identify the specific engineering symbol you need to draw (e.g., valves, pumps,

✓ **Sketch the Basic Shape:**

Lightly sketch the outline of the symbol using a pencil:

Use geometric shapes (e.g., circles, rectangles) to establish the basic form.

Ensure the proportions align with standard dimensions

Points to Remember

- While describing geometric figures Consider the main key points: Point, Types of lines and their uses, Angles and their types, Triangles and their types, Quadrilaterals and their proprieties
- While drawing Geometric figures pay attention to the relationships between angles, and how they interact with each other. And Use lines to define the form of the symbol, including its edges, contours, and surfaces.

Application of learning 2.2.

By using lines, rectangles, squares, circle and semi-circle, try to Draw a door of Networ king Workshop which comprises all of the geometrical figures listed above.

Indicative content 2.3: Drawing Lettering

Duration: 4 hrs

Theoretical Activity 2.3.1: Description of lettering drawing

Tasks:

1: Answer the following questions:

i What do you understand by the term drawing lettering?

ii What are the features of Lettering in Technical drawing

iii Identify the application of Lettering in Technical drawing

iv Give three types of lettering in Technical drawing

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary.

5: Read the key readings 2.3.1.

Key readings 2.3. 1: Description of lettering drawing

- **Definition of lettering**

Lettering: The writing of alphabets and numerals such as A, B, C, D…….Z and 1, 2, 3……9, 0 respectively is called Lettering.

✓ **Feature of lettering**

- Legibility: Shape, Space between letters and words
- Uniformity: Size, Line thickness
- Neatness
- Rapidity

- **Classification of lettering**

Gothic Lettering: Lettering having all the alphabets or numerals of uniform thickness is called Gothic Lettering.

Roman Lettering: The lettering in which all the letters are formed by thick and thin elements is called Roman

Free Hand Lettering: The writing of alphabets without the use of drawing instruments and in free hand is called Free Hand Lettering.

- **Common applications of drawing lettering:**

✓ **Architecture and Building Design**

Used for: Labels, titles, and annotations on architectural plans and drawings

Purpose: To provide clear and concise information about building designs and layouts

✓ **Engineering and Technical Drawings**

Used for: Labels, captions, and annotations on technical drawings and diagrams

Purpose: To provide detailed information about mechanical, electrical, and other technical systems

✓ **Graphic Design and Illustration**

Used for: Titles, headings, and decorative elements in graphic designs and illustrations

Purpose: To add visual appeal and convey messages in a creative and engaging way

- ✓ **Product Design and Packaging**

Used for: Labels, logos, and branding elements on product designs and packaging

Purpose: To provide product information, create brand identity, and enhance visual appeal

- ✓ **Cartography and Mapmaking**

Used for: Labels, titles, and annotations on maps and cartographic designs

Purpose: To provide geographic information, navigate, and understand spatial relationships

- ✓ **Fashion and Textile Design**

Used for: Labels, logos, and branding elements on fashion designs and textiles

Purpose: To provide product information, create brand identity, and enhance visual appeal

- ✓ **Signage and Wayfinding**

Used for: Signs, labels, and directional elements in public spaces and wayfinding systems

Purpose: To provide clear and concise information, navigate, and enhance user experience

- ✓ **Publishing and Print Media**

Used for: Titles, headings, and body text in publications, such as books, magazines, and newspapers

Purpose: To convey information, tell stories, and engage readers

Practical Activity 2.3.2: Application of drawing lettering

Task:

1: Do the task described below:

i. You are requested to go to the workshop and draw lettering according to the a ssigned task.

2: Present the step for drawing lettering

3: Referring to the presented in step 2, draw lettering drawing

4: Present the lettering drawing to the trainer or classmates

5: Read the key readings 2.3.2

6: Perform the application of learning 2.3.

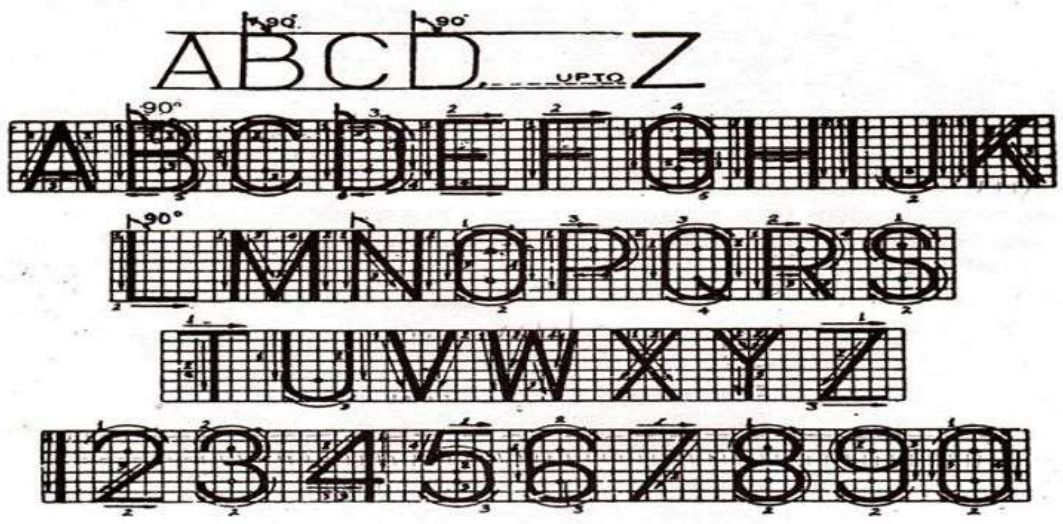
Key readings 2.3.2 Application of lettering drawing

- **Classification of lettering by drawing**

Gothic Lettering: Lettering having all the alphabets or numerals of uniform thickness called gothic lettering which include vertical gothic lettering and italic or inclined gothic lettering.

- ✓ **Single Stroke Vertical Gothic Lettering:**

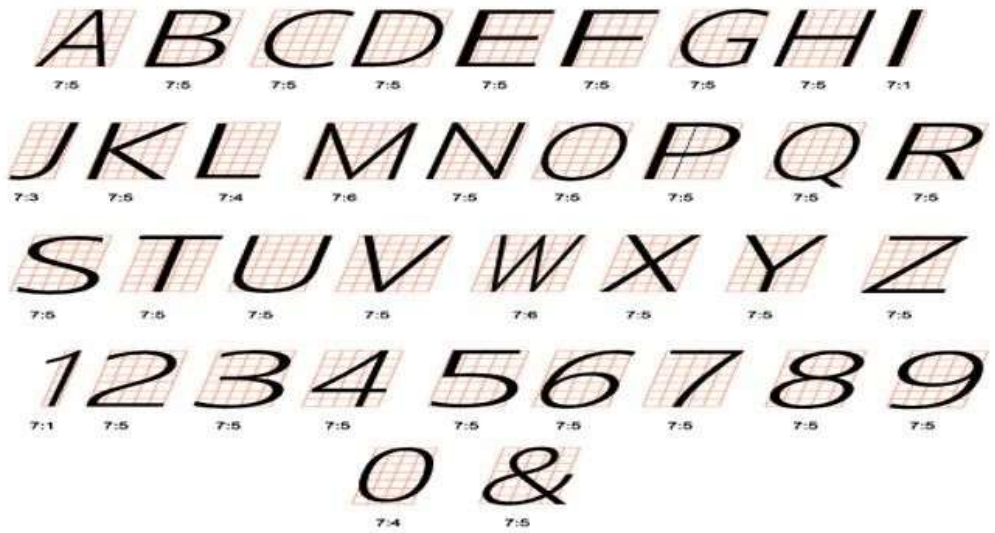
These are vertical letter having thickness of each line of alphabet or numerals etc. Same as the single stroke of a pencil. Since Stroke means that the letter is written with one more stems or curves and each made with single stroke.



Single Stroke Vertical Gothic Lettering

- ✓ **Single stroke inclined gothic lettering:**

These are single stroke letter inclined at 75' to the Horizontal.

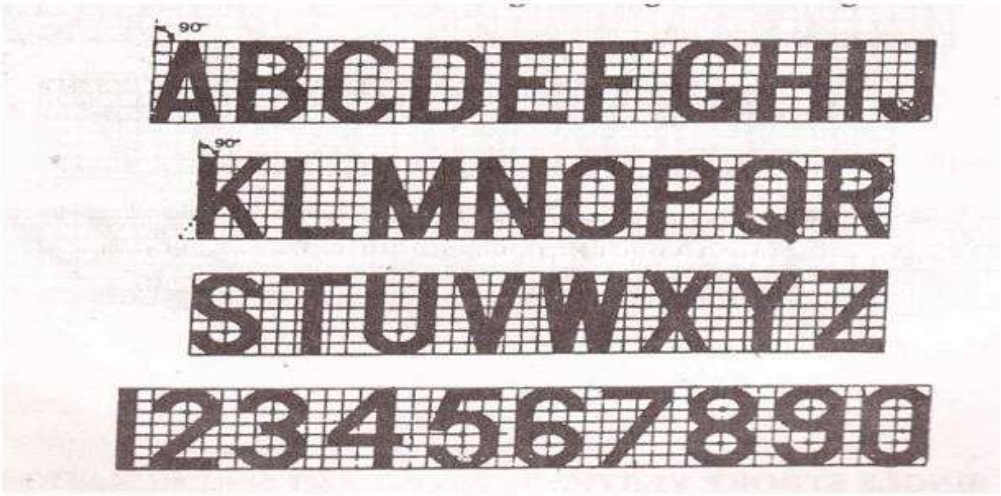


SINGLE STROKE INCLINED LETTERS

Single Stroke Inclined Gothic Lettering

- ✓ **Double stroke vertical gothic lettering:**

Vertical letter drawn by double Stroke of pencil with uniform thickness between these strokes are called Double Stroke Vertical Gothic Lettering.

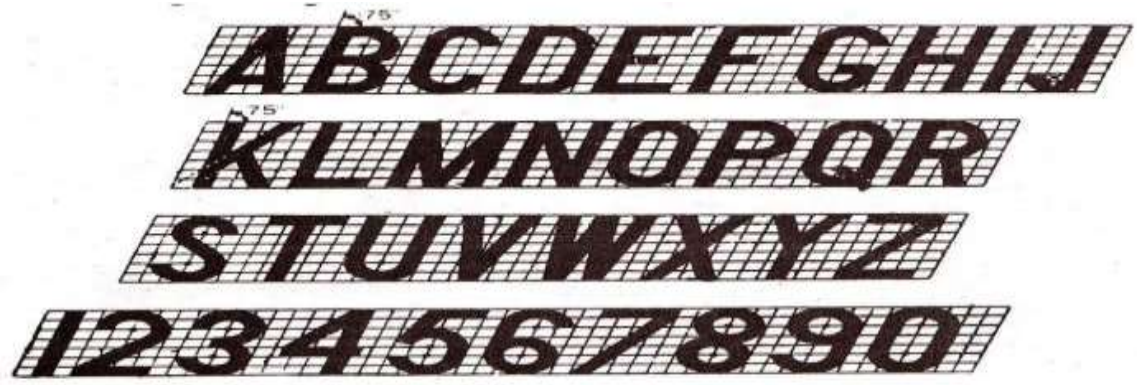


Double Stroke Vertical Gothic Lettering

Double Stroke Vertical Gothic Lettering

- **Double stroke inclined gothic lettering:**

Double stroke gothic when inclined at an angle of 75' is called Double Stroke Inclined Gothic Lettering.



Double Stroke Inclined Gothic Lettering

✓ **Lower case vertical single stroke gothic lettering:**

Lower case vertical gothic lettering is shown along with its sizes.

- **Steps for drawing lettering**

Drawing lettering involves a series of steps that help you create clear, legible, and visually appealing text. Here's a step-by-step guide to drawing lettering:

Step 1: Plan and Sketch

- Determine the purpose and context of the lettering
- Choose a font style or create a custom design
- Sketch the lettering lightly with a pencil, considering the size, spacing, and layout

Step 2: Measure and Grid

- Measure the width and height of the lettering area
- Create a grid or guidelines to help you draw the letters evenly
- Use a ruler or other straightedge to draw the grid lines

Step 3: Draw Guidelines

- Draw guidelines for the lettering, including:
- Baseline: the line that the letters sit on
- X-height: the height of the lowercase letters
- Cap height: the height of the uppercase letters
- Ascender and descender lines: the lines that the letters extend above and below the baseline

Step 4: Draw Letterforms

- Draw the letterforms, using the guidelines and grid to help you:
- Start with the basic shape of the letter
- Add details, such as serifs, flourishes, and connections
- Pay attention to letter spacing and kerning

Step 5: Refine and Edit

- Refine the lettering, paying attention to:
- Proportion and balance
- Line quality and consistency
- Spacing and kerning

- Edit the lettering, making adjustments as needed

Step 6: Ink and Finalize

- Ink the lettering, using a pen or other drawing tool:
- Use a consistent line width and style
- Pay attention to details, such as serifs and flourishes
- Finalize the lettering, adding any finishing touches:
- Erase guidelines and grid lines
- Add color or other visual effects, if desired

Points to Remember

- While describing drawing lettering make sure you keep in mind the key points like: Features of lettering, Classification of lettering and Style of freehand lettering
- While applying lettering in drawing remember to use style of lettering that is created by hand, using a variety of techniques and tools and maintain a consistent line width throughout the lettering to create a cohesive look.

Application of learning 2.3.

ABC Network Business Company wants to advertise its products and services by marketing with wallpaper letterings on their building. It wishes to use this word: "NETWORKING ". Draw that name by using double stroke vertical gothic lettering. The height of capital letter must be 20mm

Indicative content 2.4: Application of Drawing Scale

Duration: 4 hrs

Theoretical Activity 2.4.1: Description of drawing scale

Tasks:

1: Answer the following questions:

i. What do you understand by the term drawing scale?
ii. Why scale is important in technical drawing?
iii. Identify the types of drawing scale.

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary.

5: Read the key readings 2.4.1.

Key readings 2.4. 1: Description of drawing scale

- **Definition of scale**

Scale is he proportion by which we either reduce or increase the actual size of the object on a drawing is known as drawing to scale or simple scale.

- **Types of scale**

✓ **Full size scale**

The scale in which the actually measurements of the object are drawn to the same sizes on the drawing is known as full size scale. It is written on the stick as under

✓ **Reading the standard scale**

1:1 – drawing made to actual size

✓ **Reducing scale**:

The scale in which the actual measurements of the object are reduced to some proportion is known as reducing scale.

Examples of:

- The standard Reduction scales: 1:2, 1:5, 1:10, 1:20, 1:50, 1:100, …..

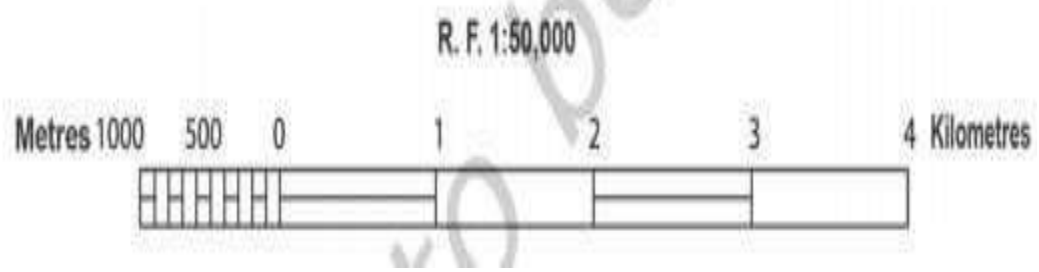
- The standard Enlarging scales: 2:1, 5:1, 10:1, 100:1, …..

- **Scale representation**
  - ✓ **Representation by Statement of Scale:**

The scale of a map may be indicated in the form of a written statement. For example, if on a map a written statement appears stating 1 cm represents 10 km, it means that on that map a distance of 1 cm is representing 10 km of the corresponding ground distance.

- ✓ **Representation by Graphical or Bar Scale:**

The second type of scale shows map distances and the corresponding ground distances using a line bar with primary and secondary divisions marked on it.



- ✓ **Representation by Fraction (R . F.):**

The third type of scale is R. F. It shows the relationship between the map distance and the corresponding ground distance in units of length. The use of units to express the scale makes it the most versatile method. R. F.

- **Importance of scale in drawing**
  - ✓ **Accuracy**:

Scale ensures that objects are drawn in proportion to each other and to the actual object

- ✓ **Proportion:**

Scale helps maintain the correct proportions of objects, making them appear realistic and believable

- ✓ **Communication:**

Scale enables artists to effectively communicate their ideas and designs to others

- ✓ **Visualization:**

Scale allows artists to visualize and explore different designs and layouts

Practical Activity 2.4.2: Applying drawing scale

Task:

1: Do the task described below:

i. You are requested to go to the workshop and calculate scale to be applied o n drawing according to the drawing standard

2: Present the steps for calculating scale

3: Referring to the presented steps in task 2, calculate the scale

4: Present the scale drawing to the trainer or classmates

4: Read the key readings 2.4.2

5: Perform the application of learning 2.4.

Key readings 2.4.2 Applying drawing scale

- ✓ **Steps for calculating scale**

Calculating scale is essential for accurately representing objects in drawings, models, or plans. Here's a step-by-step guide to help you calculate scale effectively:

Step 1: Determine the Actual Size

Measure the Object: Obtain the actual dimensions of the object you want to represent. Use a ruler or measuring tape for accuracy.

Record the Dimensions: Note down the length, width, and height (if applicable) of the object.

Step 2: Decide on the Scale

Choose a Scale Ratio: Determine the scale ratio you want to use. Common scale

- ✓ **Finding distance from map and scale**

Example1: suppose we have a map with a scale of 1:50.000. We measure the distance along a property boundary as 1.7cm. What is the length in real world?

As an example, suppose we have a map with a scale of 1:50.000. We measure the distance along a properly boundary as 1.7cm. What is the length in the real world?

1.7cm$_{map}$ x $\frac{50{,}000\ ground}{1map}$ x $\frac{1km}{100{,}000}$ = 1.7x $\frac{50{,}000}{100{,}000cm}$ **km $_{ground}$=0.85km**

- ✓ **Finding area measurement**

Area must be expressed in a real unit which are usually distance units squared-cm^2, mi^{2}and so on. We must there for used squared conversion factors when finding area from map measurements.

Example 2: suppose we measure a rectangular piece of property that is 3cm by 4cm on map. The map is at a scale of 1:24,000. What is the area of the parcel? The area of the parcel on the map is expressed in hectare.

The area of the parcel on the map is 3cmx4cm=12cm^2

3cm$_{map}$x4cm$_{map}$=12cm$^2{}_{map^2}$x(24,000ground^{1}map)^{2}x(1m/100cm)^2

=12cm^{2}map^{2}x $\frac{576{,}000map}{1map}$ x $(1m^2)/(10{,}000cm^2)$

= $\frac{12x576{,}000{,}000}{10{,}000}$ m^2 ground2=691,200m^2

Since this is a large number. We might want to translate to other units. There are 1000square meter per hectare. So the area is 69 hectares (ha).

Example3: calculate the true scale used to draw on object which has 50mm on drawing and 10m as it's real dimension?

Data: dimension real:10m=10000mm

Drawing on paper=50mm

scale= $\frac{drawing\ on\ paper}{real\ size}$

scale= $\frac{50}{10000} = \frac{1}{200}$

The side of the building on paper was 12cm at the scale of 1/50; calculate the real length of the same building?

Data

Drawing on paper:12cm

Scale=1/50

Question: calculate real length

Formula

Real = $\frac{drawing\ on\ paper}{scale}$

$=\frac{12cmx50}{1}$ =600cm=6m

Points to Remember

- In description of scale used in drawing take into consideration of the following key points: Types of Scale such as full scale, Enlarging scale, and reducing scale In addition Scale Representation
- While Applying Scale on Drawing ensure that the drawing is accurate, precise and check the proportions of the drawing regularly to ensure its consistent

Application of learning 2.4.

A model car is made using the model to an actual distance of 1:40 the height of the

Car is 170cm. Calculate the height of the model car.

Indicative content 2.5: Application of Drawing Dimensioning

Duration: 4 hrs

Theoretical Activity 2.5.1: Description of drawing dimensioning

Tasks:

1: Answer the following questions:

i. What do you understand by the term drawing dimensioning?
ii. Why is dimensioning drawing important in technical drawing?
iii. Identify the arrangement of dimensioning.
iv. What are the element of drawing dimensioning?

2: Write your findings on papers or flipcharts

3: Present the findings to your trainer or classmates

4: Ask questions for clarification where necessary.

5: Read the key readings 2.5.1.

Key readings 2.5. 1: Description of dimensioning drawing

Dimensioning is a process of clarifying an object by means of notes, number, symbols, lines etc. Indicating on a drawing, the size of the object other details essential for its construction and function, using lines, numerals, symbols, notes, etc.

- ✓ **Types of dimensions**
- **Size Dimensions:**

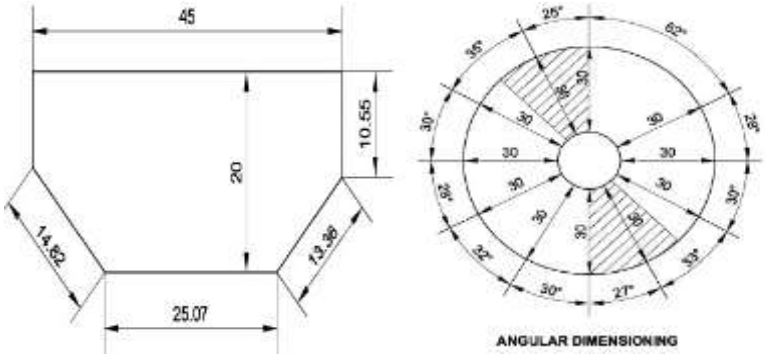
How big or small is something? For example, what is the size of the circle being drilled through the block? How big is that block, what is its size is? The dimensions which indicate various sizes of the object such as length, breadth, diameter, etc. are known as **size dimensions.** These dimensions are represented by the letter "S"

- **Location Dimensions:**

Where that hole should be drilled through the block?

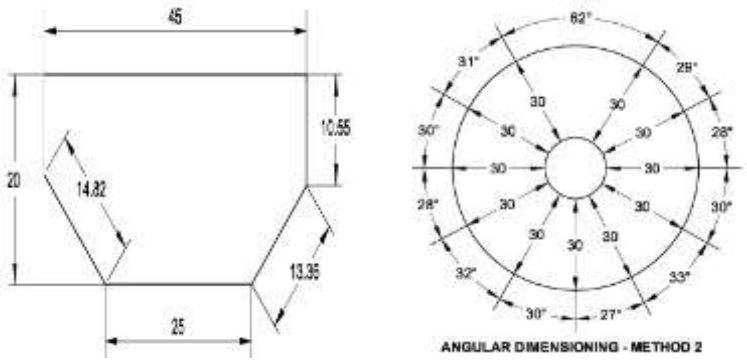
- ✓ **Methods of dimensioning**
- **Aligned method**:

Place the numerals for the dimension values so that they are readable from the bottom and right sides of the drawing.



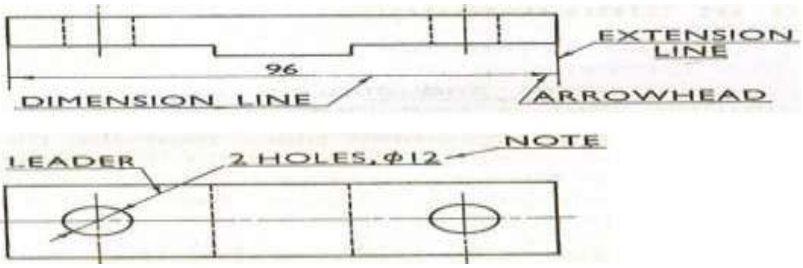
✓ **Unidirectional method**:

Place the numerals for the dimension values so that they can be read from the bottom of the drawing only.



✓ **Elements of dimensioning**

- Dimension lines
- Extension lines
- leaders
- arrowheads
- dimension value



✓ **Function of dimensions**

- Dimensions provide clear instructions for manufacturers, builders, and assemblers, ensuring that the final product meets the design specifications.
- Dimensions provide precise measurements, ensuring that the final product meets the required specifications.

- Dimensions promote consistency in design, manufacturing, and construction, ensuring that products meet industry standards

✓ **Rules of dimensioning**

- Dimensions should be clear, concise, and easy to read.
- Use consistent units throughout the drawing, such as inches or millimetres
- Place dimensions in a location that provides clear visibility, avoiding clutter and overlap.
- Dimensions should be oriented horizontally or vertically
- Align dimensions with the feature being measured, ensuring consistency and clarity.

Practical Activity 2.5.2: Applying drawing dimensioning

Task:

1: Do the task described below:

i. You are requested to go to the workshop and apply dimensions on a drawin g according to the task assigned.

2: Present the steps for dimensioning

3: Referring to the presented steps in task 2, draw dimensions

4: Present the dimensions to the trainer or classmates

4: Read the key readings 2.5.2

5: Perform the application of learning 2.5.

Key readings 2.5.2 Applying drawing dimensioning

- **Steps for applying dimensioning**

When applying dimensions to a drawing, it's essential to follow a structured approach to ensure accuracy, clarity, and consistency. Here are the steps to follow:

Step 1: Review the Drawing

Verify the design: Review the design to ensure it is complete and accurate.

Step 2: Determine the Dimensioning Standard

Select the standard: Determine the applicable dimensioning standard, such as ASME or ISO.

Step 3: Identify the Features to be Dimensioned

Identify the critical features that require dimensioning, such as holes, slots, or surfaces.

Prioritize dimensions: Prioritize dimensions based on importance and complexity.

Step 4: Choose the Dimensioning Method

Select the method: Choose the appropriate dimensioning method, such as linear, ordinate, or chain dimensioning.

Consider the feature: Consider the feature being dimensioned and select the method that best suits its geometry.

Step 5: Apply Dimensions

Start with overall dimensions: Begin with overall dimensions, such as length, width, and height.

Add detail dimensions: Add detail dimensions, such as hole diameters, slot widths, and surface tolerances.

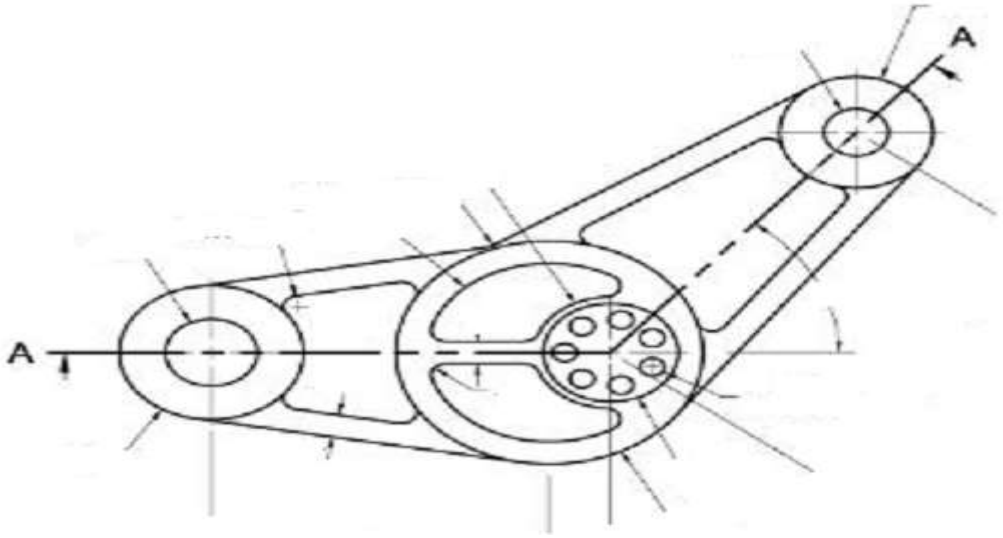
Use leader lines: Use leader lines to connect dimensions to the relevant feature

Points to Remember

- In description of drawing dimensioning consider the main key points like: types of dimensions, method of dimensioning, elements of dimensioning, function of dimensions and rules of dimensioning
- While applying Dimension on drawing ensure that the unit of measurement is clearly indicated on the drawing and use standard dimensioning symbols, abbreviations, and notation.

Application of learning 2.5.

Suppose that the following figure is a spiral part needed to be attached on a machine. As a designer in drawing, try to put dimensions on it in order to help mechanical technicians



Learning outcome 2 end assessment

Theoretical assessment

Q1. From the following questions, answer by TRUE if the statement is correct or by FALSE if it the statement is incorrect.

i. A drawing that is twice as large as the original object is said to be drawn to scale.

ii. A scale drawing is always smaller than the original object.

iii. A line is a continuous mark made on a surface by a drawing tool.

iv. All lines in drawing are straight.

Q2. Match the following technical drawing lines (column B) with their corresponding uses/description (Column C). Write the letter of the correct answer in the provided blank space (column A)

Column A	Column B	Column C
Answers	**Lines**	**Uses**
1	1) object lines	a) These lines are thin, alternating long dashes separated by two short dashes used to show alternate positions for moving parts and the positions of related or adjacent parts, and to eliminate repeated details
2	2) center lines	b) line is a dashed line that represents an edge or outline of an object that is not visible from the current viewpoint.
3	3) phantom lines	c) These lines are thick, solid lines used to show the visible edges, corners, and surfaces of an object.
		d) line is a solid line with arrowheads at both ends that represents the size of an object or a feature.

		e) These lines are thin, alternating long and short dashes used to show hole center and center positions of rounded features, such as arcs and radii.

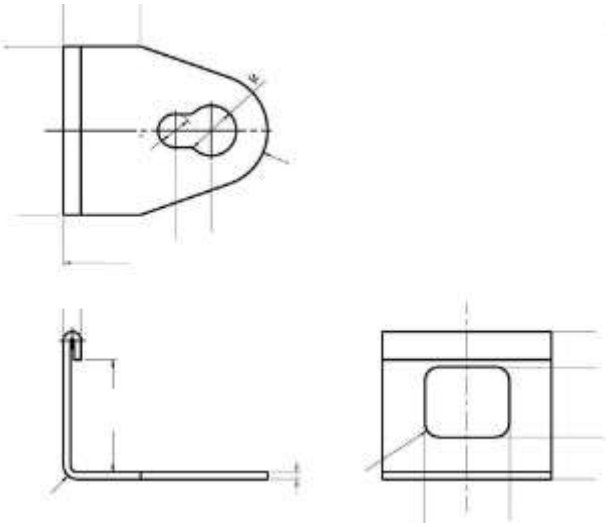
Q3. Read and answer the following questions:

i. What are some common mistakes to avoid in lettering?
ii. What are the different types of angles in drawing?

Practical assessment

The drawings below are the spiral parts of networking objects. As a technician, you are hired to draw the following:

a) Drawing sheet layout needed for aforementioned drawing.
b) the aforementioned drawing by respecting the geometrical figures shape
c) dimensions
d) title block
e) lettering of the names in title block



END

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Web Links

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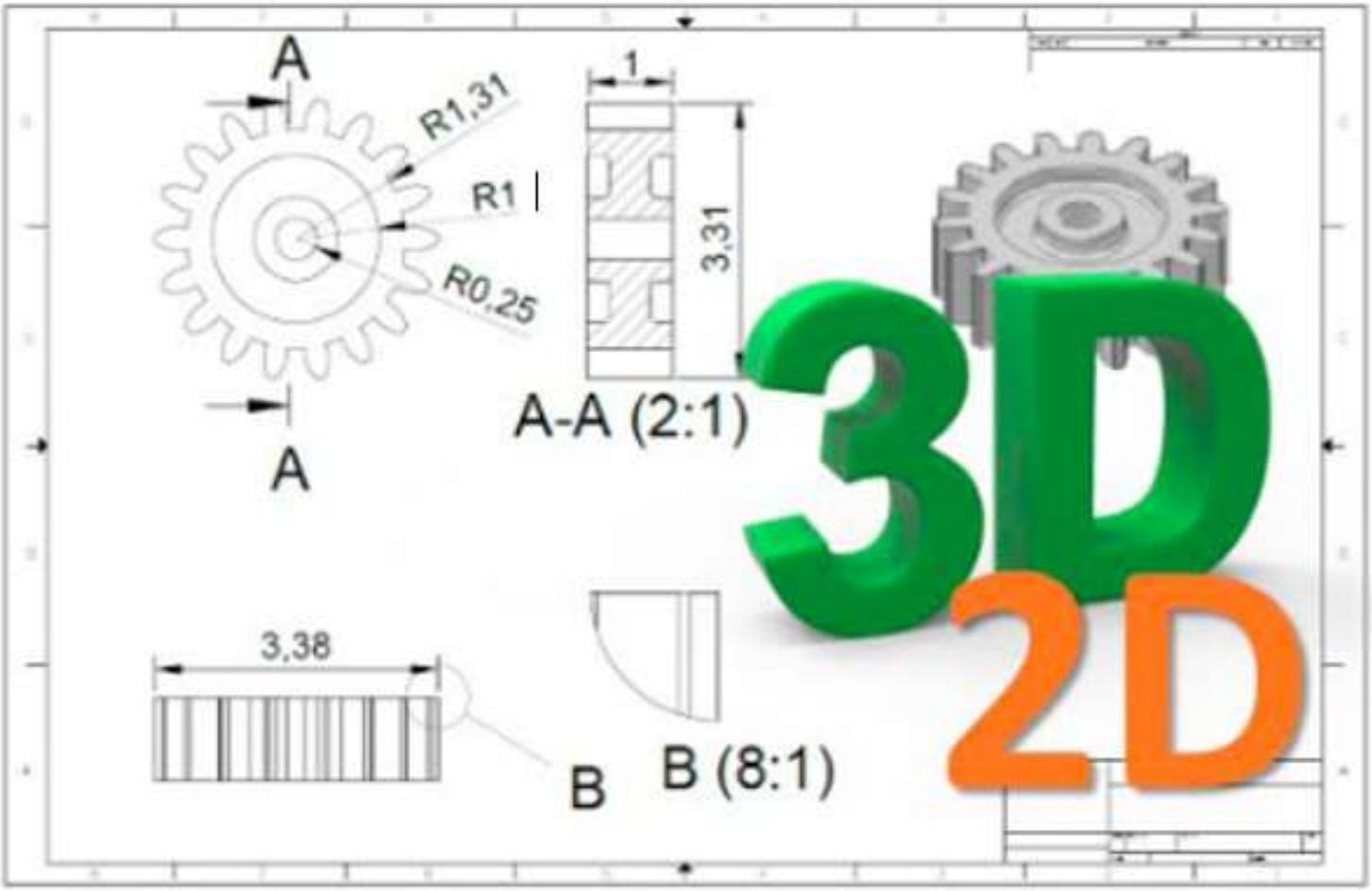
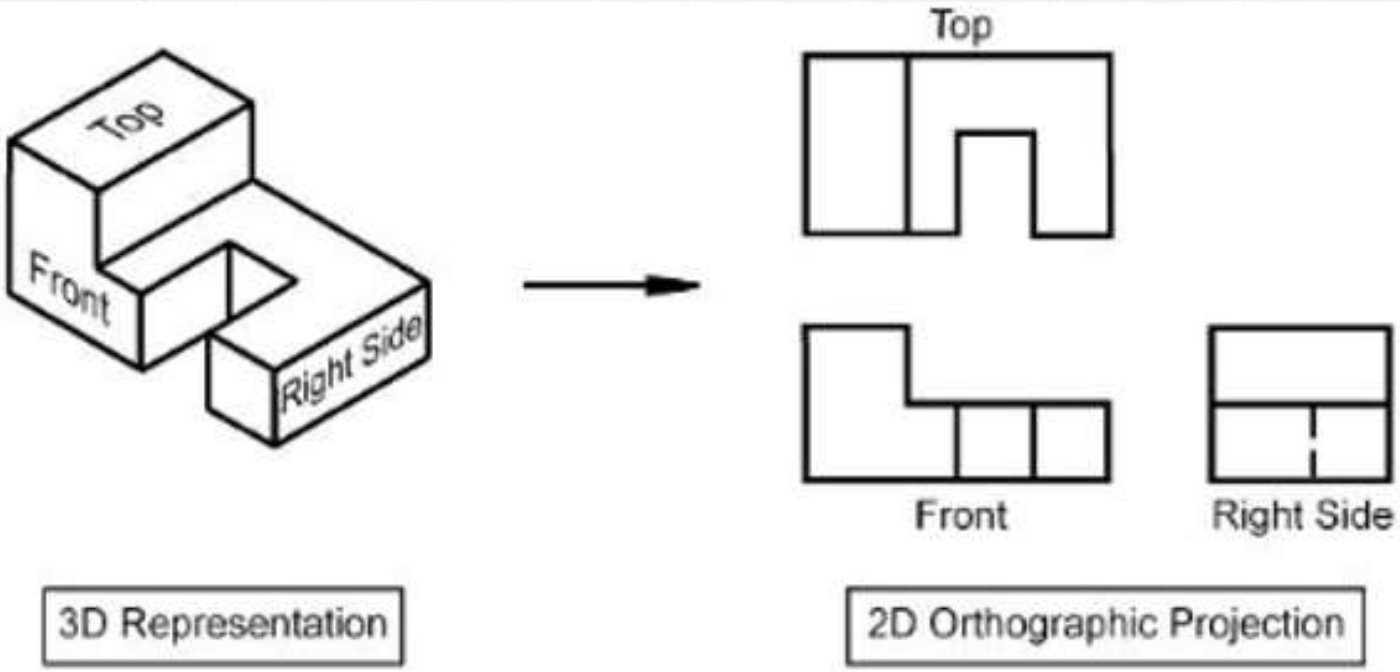
https://www.google.com/search?q=Apply+lines+and+symbols+used+in+drawing
https://www.google.com/search?q=Perform+dimensional+drawing





3D Representation

2D Orthographic Projection

Indicative contents

3.1 Description of 2D and 3D
3.2 Types of projections
3.3 Views and sections of objects

Key Competencies for Learning Outcome 3: Apply 2 and 3 Dimensions

Knowledge	Skills	Attitudes
● Description of 2 and 3 dimensions. ● Differentiation of various types of projections. ● Interpretation of views and sections of an object.	● Drawing projection of an object. ● Creating views of the object ● Creating sections of the object.	● Having curiosity and willingness to learn how 2D and 3D objects in real-world are designed ● Adaptability to new drawing tools and techniques

Duration: 20 hrs

Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly 2D and 3D based on the object.
2. Differentiate properly the types of projections based on their standards
3. Draw properly the projection of the object based on the type.
4. Create correctly views and sections according to the object.

Resources

Equipment	Tools	Materials
• Drawing board • Drawing table	• White boards • Marker pens • Calculator • Scale rulers • Rubber • Drawing Compass • T square • Protractor • Pencil sharpener • Mathematical set instruments	• Paper • Rubber • Pencils

Indicative content 3.1: Description of 2D and 3D

Duration: 6 hrs

Theoretical Activity 3.1.1: Description of 2D and 3D

Tasks:

1: Answer the following questions:

i. Describe the following terms:

a. 2D shape

b. 3D shape

2: Write your answers on papers, blackboard, flipcharts or whiteboard.

3: Present your findings/answers to your trainer and/or classmates

4: Pay attention to the trainer's clarifications and ask questions where necessary

5: Read the key readings 3.1.1.

Key readings 3.1.1.: Description of 2D and 3D

- **Definition**

2D Shapes: A two-dimensional (2D) shape has only two dimensions: length and width. It is flat and lies on a plane.

3D Shapes: A three-dimensional (3D) shape has three dimensions: length, width, and height (or depth). These shapes occupy physical space.

- **Differences between 2D and 3D Shapes**

Feature	2D Shapes	3D Shapes
Dimensions	Two (Length and Width)	Three (Length, Width, Height/Depth)
Representation	Flat	Solid/Volumetric
Examples	Circle, Square, Triangle, Rectangle	Cube, Sphere, Cylinder, Pyramid
Surface	Area (measured in square units)	Volume (measured in cubic units)
Edges and Faces	No Faces, Only Edges (Lines)	Has Faces (Flat Surfaces) and Edges

Visualization	Only seen from a single perspective	Can be viewed from multiple perspectives

- **Applications of 2D and 3D Shapes**

✓ **2D Shapes Applications:**

- **Art and Design**: Used in illustrations, logos, graphics, and animations.
- **Architecture**: Floor plans, maps, blueprints are created using 2D shapes.
- **Mathematics**: Geometry, algebra, and calculus problems often involve 2D shapes.
- **Printing and Signage**: Designs are usually printed in 2D format.

✓ **3D Shapes Applications:**

- **Architecture and Engineering**: Used in the design of buildings, vehicles, bridges, etc.
- **Computer Graphics**: 3D modeling for video games, movies, virtual reality.
- **Product Design**: Physical product prototypes and models.
- **Medical Imaging**: 3D models of body parts for diagnostics and surgery (e.g., MRI scans).
- **Manufacturing**: 3D shapes are essential in product assembly and part creation.

Practical Activity 3.1.2: Using formula of 2D and 3D shape

Task:

1: Perform the task described below:

i. You are requested to go to the workshop and use the formulas of 2D and 3D sha pes according to the assigned task.

2: Present the formula of 2D and 3D shape.

3: Referring to the formula presented in step 2, use the formula according to the task assigned.

4: Present the task to the trainer or classmates

4: Read the key readings 3.1.2

5: Perform the application of learning 3.1.

Key readings 3.1.2: Using formula of 2D and 3D shape

- **Formula of 2D and 3D Shapes**

✓ **Common 2D Shapes Formula:**

Shape	Area	Terms
Circle	$\pi \times r^2$	r = radius of the circle
Triangle	½ × b × h	b = base h = height
Square	a^2	a = length of side
Rectangle	l × w	l = length w = width
Parallelogram	b × h	b=base h=vertical height
Trapezium	½(a+b) × h	a and b are the length of parallel sides h = height
Ellipse	πab	a = ½ minor axis b = ½ major axis

✓ **Common 3D Shapes Formula:**

Shape	Surface area	Terms
Cube	$6a^2$	a = length of the edge
Rectangular prism	2(wl+hl+hw)	l = length w = width h = height
Cylinder	$2\pi r(r + h)$	r = radius of circular base h = height of the cylinder
Cone	$\pi r(r + l)$	r = radius of circular base l = slant height
Sphere	$4\pi r^2$	r = radius of sphere
Hemisphere	$3\pi r^2$	r = radius of hemisphere

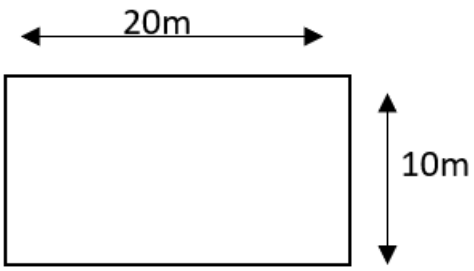
Points to Remember

- In description of 2D and 3D ensure that 2D shapes have only length and width, while 3D shapes have length, width, and height (or depth).
- While using the formula of 2D shape, be familiar with specific area formulas, know how to calculate the perimeter and always pay attention to units.
- While using the formula of 3D shape, understand the surface area calculations and the volume formula.

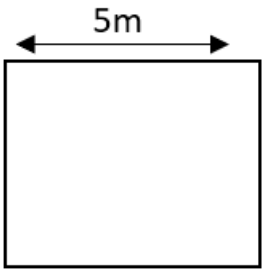
Application of learning 3.1.

Kamana is a business man who wants to build a new restaurant in your area. Based on the key reading 3.1.2, help Kamana to calculate the area of the restaurant with the shapes below:

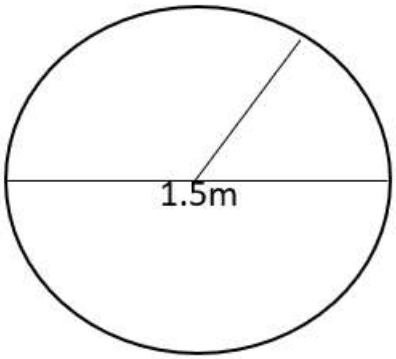
1. **Dining Area (Rectangular):** Length = 20 m, Width = 10 m



2. **Kitchen (Square):** Side = 5 m



3. **Bathroom (Circular):** Diameter = 3 m (Radius = 1.5 m)



Indicative content 3.2: Identification of Types of Projections

Duration: 7 hrs

Theoretical Activity 3.2.1: Description of the types of projections

Tasks:

1: Answer the following questions:

i. What do you understand about the following terms?

a) Perspective projection

b) Axonometric projection

c) Oblique projection

ii. Explain the three types of perspective projections.

2: Write your answers on papers or flipcharts.

3: Present your findings/answers to your trainer and/or classmates

4: Pay attention to the trainer's clarifications and ask questions where necessary

5: Read the key readings 3.2.1.

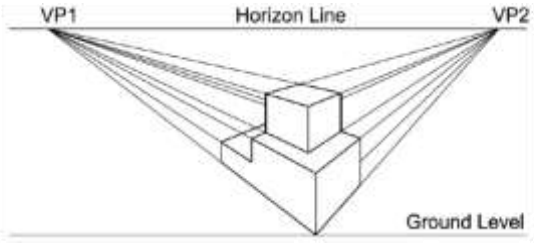
Key readings 3.2.1. Description of the types of projections

- **Different types of projections**

✓ **Pictorial projection**

Pictorial projections offer a more realistic view of an object by portraying all three dimensions in one image. They are widely used in technical drawings and illustrations.

Perspective projection



Definition: A type of projection where the lines of sight converge at a single point (vanishing point), creating a realistic view of how objects appear to the human eye.

Key Features:

Distant objects appear smaller than nearer ones.

Types:

One-point perspective: A single vanishing point (e.g., looking down a straight road).

Two-point perspective: Two vanishing points, used for viewing objects from a corner.

Three-point perspective: Three vanishing points, often used for tall structures viewed from above or below.

- **Axonometric projection**

Definition: A type of projection where the object is rotated along one or more of its axes, and the projection lines remain parallel, not converging to a vanishing point.

Key Features:

Proportions are maintained (no foreshortening).

Types:

Isometric projection: The object is rotated such that the angle between any two axes is 120°. All three axes are equally foreshortened.

Dimetric projection: Two axes are equally foreshortened, while the third axis has a different scale.

Trimetric projection: All three axes have different scales, so each axis is foreshortened differently.

- **Oblique projection**

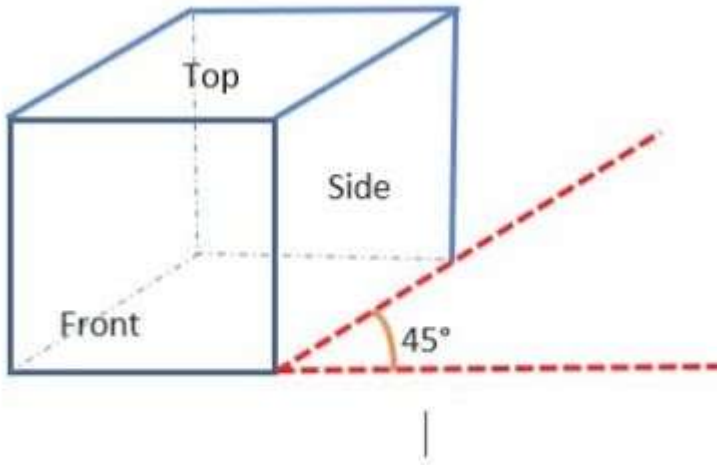


Figure:1

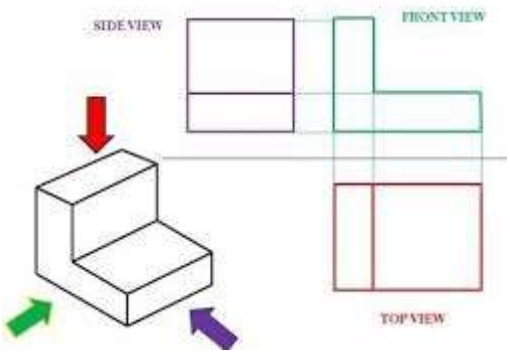
Oblique Drawing

Definition: A projection where the front face of the object is drawn in true shape, and the third dimension (depth) is projected at an angle, typically 30° or 45°.

Key Features:

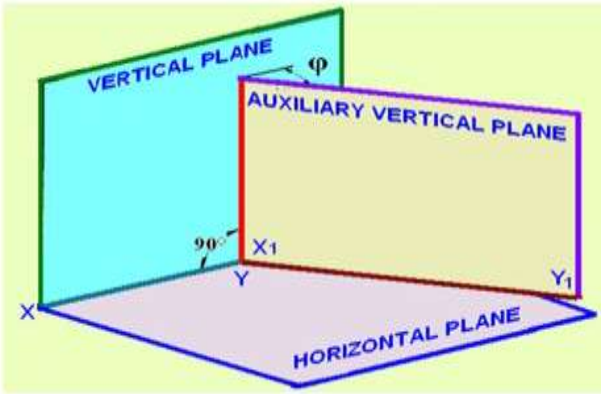
Used for simple and quick visualization.
The front face is undistorted, while depth is scaled.
Types:
Cavalier projection: The depth axis is represented at full scale.
Cabinet projection: The depth axis is scaled to half its true length to give a more realistic appearance.

- ✓ **Orthographic projection**



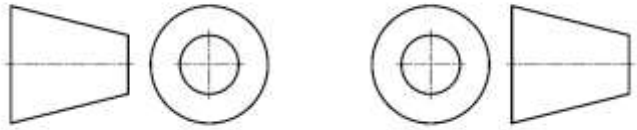
Orthographic projection is a method of representing a 3D object in two dimensions by projecting its views onto a series of planes, without perspective distortion.

- **Plane of projection**



Definition: A plane onto which the object is projected. There are three primary planes used in orthographic projection:
Horizontal Plane (HP): For the top view.
Frontal Plane (FP): For the front view.
Profile Plane (PP): For the side view.

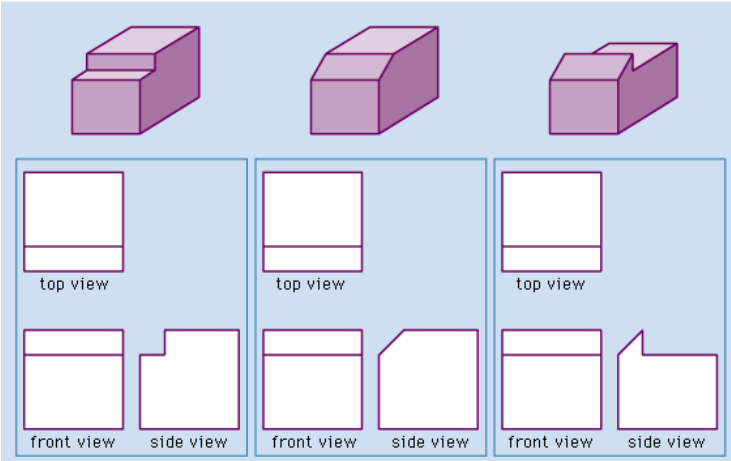
- **Angles of projections**



Third Angle Projection First Angle Projection

First Angle projection (used primarily in Europe and Asia):
The object is placed in the first quadrant, meaning the object is between the viewer and the plane of projection.
The views are arranged such that the top view is below the front view, and the side view is on the opposite side of the front view.
Third Angle projection (used in the United States and Canada):
The object is placed in the third quadrant, meaning the projection plane is between the object and the viewer.
The views are arranged so that the top view is above the front view, and the side view is on the same side as the front view.

- **Dimensions of object views**



Top View: This is the projection of the object onto the horizontal plane, showing the width and depth.
Front View: This is the projection of the object onto the frontal plane, showing the height and width.
Side View: This is the projection of the object onto the profile plane, showing the height and depth.
Additional Views: For complex objects, auxiliary views may be used to show surfaces that are inclined or not parallel to any of the primary planes.

Practical Activity 3.2.2: Drawing a projection of an object

Task:

1: Perform the task described below:

i. You are requested to go to the workshop and draw the projection of an object a ccording to the assigned task.

2: Present the steps to draw a projection of an object.

3: Referring to the steps presented in step 2, draw the projection of an object according to the task assigned.

4: Present the drawing to the trainer or classmates

4: Read the key readings 3.2.2

5: Perform the application of learning 3.2.

Key readings 3.2.2: Drawing a projection of an object

- **Steps for drawing a projection of an object**

✓ **Understand the Object**:

- Analyze the object's dimensions, shape, and features.
- Gather necessary measurements and reference images.

✓ **Choose the Projection Type**:

- Decide whether to use orthographic, isometric, perspective, or another type of projection based on your needs.

✓ **Establish a Coordinate System**:

- Set up a 2D grid or coordinate system to maintain accuracy in dimensions.

✓ **Determine Projection Views**:

- Identify which views are necessary (e.g., front, top,

side).

- For orthographic projection, typically three views are drawn: front, top, and side.

✓ **Draw the Front View**:

- Start with the front view, placing the object in the center.
- Use horizontal and vertical lines to outline the shape, indicating key features and dimensions.

✓ **Draw the Top and Side Views**:

- Project the features from the front view to the top and side views.
- Ensure alignment of corresponding points across views for accuracy.

✓ **Add Dimensions and Annotations**:

- Clearly label each view and add dimensions to indicate size and scale.
- Use arrows and leader lines for clarity.

✓ **Check for Accuracy**:

- Review all views to ensure consistency and correct proportions.
- Adjust any discrepancies.

✓ **Finalize the Drawing**:

- Darken the lines for final presentation.
- Consider adding shading or textures if necessary.

- **Criteria for drawing a projection of an object**

Accuracy: All measurements and angles should be precise.

Clarity: The drawing should be easy to read, with clear labels and annotations.

Consistency: Features should align correctly between

different views.

Proportionality: The size relationship between different parts of the object must be maintained.

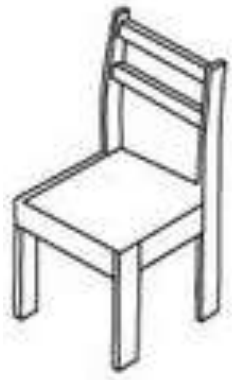
Simplicity: Avoid unnecessary details that may clutter the drawing.

Points to Remember

- While describing the types of projections know that in orthographic and isometric projections, lines are parallel, while in perspective projections, lines converge.
- While drawing the projection of an object, you have to be familiar with the specific characteristics of the projection type you are using (orthographic, isometric, axonometric, oblique, or perspective).

Application of learning 3.2.

AXZ School wants to make chairs for its workshop. Help the school to obtain an orthographic drawing for the sample of the chair shown in the image below:



Indicative content 3.3: Description of Views and Sections of Objects

Duration: 7 hrs

Theoretical Activity 3.3.1: Descriptions of views and sections of objects

Tasks:

1: Answer the following questions:

i. What is front view?

ii. Differentiate real view from side view

iii. What is the difference between longitudinal section and transversal section?

2: Write your answers on papers or flipcharts.

3: Present your findings/answers to your trainer and/or classmates

4: Pay attention to the trainer's clarifications and ask questions where necessary

5: Read the key readings 3.3.1.

Key readings 3.3.1.: Descriptions of views and sections of objects

- **Views of objects**

✓ **Front view (elevation view):**

Description: The front view is the projection of the object as seen from directly in front. It shows the height and width but not the depth. This view is often the primary reference, as it displays the main features of the object.

Use: Provides an overall understanding of the shape and structure of an object from the front.

✓ **Side view (lateral view):**

Description: This is the view of an object as seen from its left or right side. It shows the height and depth, offering a different perspective than the front view.

Use: Useful for visualizing features not apparent in the front view, such as the thickness or depth of the object.

✓ **Top view (plan view):**

Description: The top view is the projection of the object as seen from above. It shows the width and depth but not the height. This view provides a horizontal layout of the object.

Use: Typically used in architectural drawings to show floor plans or in engineering to display the layout of components.

- ✓ **Rear view (back view)**:

Description: The rear view is the projection of the object as seen from the back. It shows the height and width but not the depth.

Use: Offers a view of the object's backside, providing details that are not visible in the front view.

- ✓ **Bottom view**:

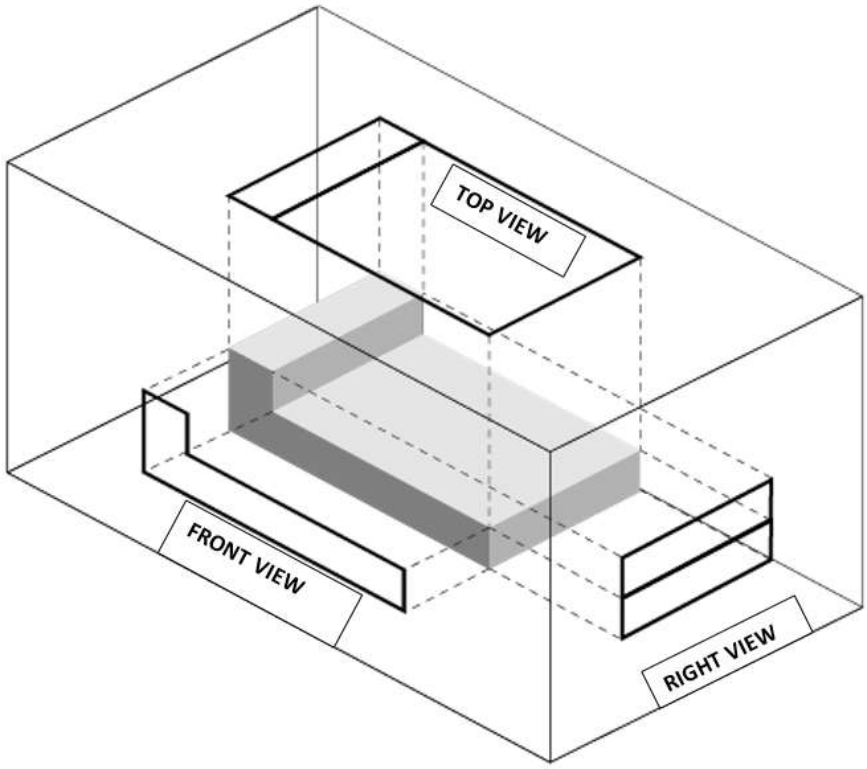
Description: The bottom view is the projection of the object as seen from below. It shows the width and depth but not the height.

Use: Used to display the underside features or components of an object, which are not visible in other views.

- ✓ **Isometric view**:

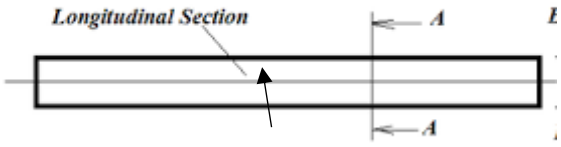
Description: This is a type of axonometric projection that shows three faces of the object in a single view, with all three axes (height, width, depth) equally inclined to the drawing plane.

Use: Provides a 3D representation of the object, giving a clearer understanding of its shape and proportions.



- **Sections of objects**

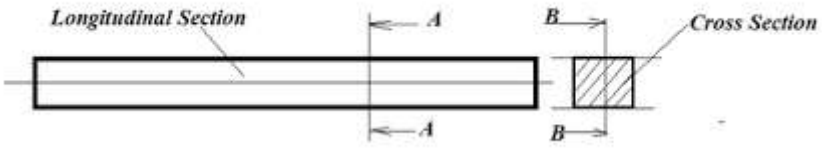
✓ **Longitudinal section**:



Description: A longitudinal section is a vertical cut through the object along its longest axis. It reveals the internal features that run along the length of the object.

Use: Commonly used to show the interior layout of elongated structures like buildings, bridges, or pipes.

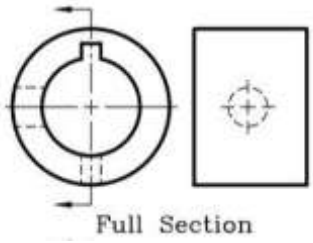
✓ **Transversal Section (Cross Section)**:



Description: A transversal section is a cut across the object, perpendicular to its longest axis. It reveals the internal features along the object's width or cross-section.

Use: Provides insight into the internal components or structures that are not visible in standard views, useful in engineering and architecture.

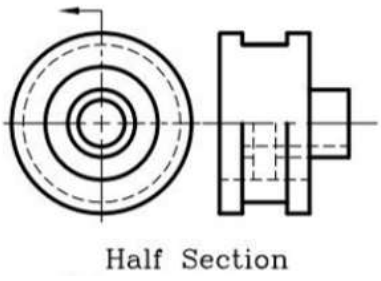
- ✓ **Full Section**:



Description: A full section cuts through the entire object, typically along a straight plane, showing the interior features along the whole length or width.

Use: Used when a detailed internal view of the entire object is needed.

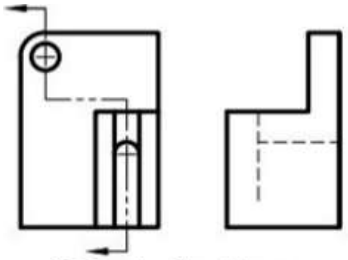
- ✓ **Half Section**:



Description: A half section cuts through only half of the object, leaving the other half intact. It shows one part of the interior while retaining the external features on the other side.

Use: Used when it's necessary to display both internal and external features of an object in a single drawing.

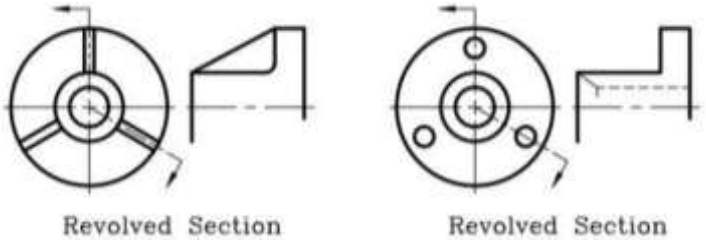
- ✓ **Offset Section**:



Description: In an offset section, the cutting plane is shifted or bent to pass through important features that are not aligned in a straight line.

Use: Allows for the display of important features that would otherwise not be visible in a straight section.

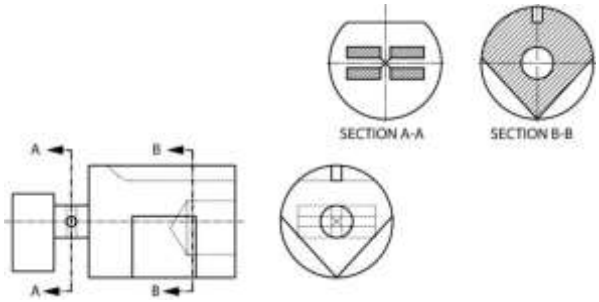
- ✓ **Revolved Section**:



Description: A revolved section takes a portion of the object, rotates it 90 degrees, and projects it onto the drawing. This section type shows the cross-sectional shape of circular or cylindrical objects.

Use: Commonly used in mechanical engineering to show the profile of round objects like pipes or shafts.

- ✓ **Removed Section**:



Description: A removed section shows the internal details of the object at a different location on the drawing, away from the object itself.

Use: Used to provide detailed information on specific internal features without cluttering the main views.

Practical Activity 3.3.2: Creating views and sections of the object

Task:

1: Do the task described below:

i. You are requested to go to the workshop and create orthographic views of an object according to the assigned task

2: Present the steps of creating orthographic views of an object.

3: Referring to the steps presented in task 2, create orthographic views of an object according to the task assigned.

4: Present the work results to the trainer or classmates.

4: Read the key readings 3.3.2

5: Perform the application of learning 3.3.

Key readings 3.3.2. Creating views and sections of the object

- **Steps to Create Orthographic Views**

✓ **Gather Information**

Analyze the Object: Study its dimensions, features, and shape.

Collect Measurements: Use a ruler or caliper to obtain accurate dimensions.

✓ **Choose the Projection Plane**

Select Views: Common views include:

Front View: Shows the height and width.

Top View: Displays the width and depth.

Side View: Illustrates height and depth (usually the right side).

✓ **Establish a Coordinate System**

Grid Setup: Use graph paper or a drawing software to create a grid.

Determine Origin: Establish a reference point (usually at the bottom left).

✓ **Draw the Front View**

Outline Shape: Start with the object's main outline using measured dimensions.

Indicate Features: Mark doors, windows, or other significant details.

✓ **Draw the Top View**

Project Features: From the front view, transfer dimensions to create the top view directly above.

Maintain Proportions: Ensure alignment with the front view.

✓ **Draw the Side View**

Project Dimensions: Transfer relevant dimensions from the front view to create the side view (usually to the right).

Ensure Consistency: Check that corresponding features match across all views.

- ✓ **Add Dimensions and Annotations**

Label Each View: Clearly mark which view is which (Front, Top, Side).

Dimension Lines: Use arrows and leader lines to indicate measurements.

- **Steps to Create Section Views**

✓ **Determine Section Plan**

Identify Section Location: Decide where to cut the object for the section view (often through complex features).

Use Cutting Plane Lines: Indicate the plane of the cut with a dashed line on the orthographic views.

- ✓ **Draw the Section View**

Project Section Lines: Draw the section view based on the cutting plane.

Show Internal Features: Represent the internal details as they would appear in the cut view.

- ✓ **Indicate Material and Texture**

Hatching: Use different patterns or shading techniques to denote different materials in the section view.

Label Materials: Clearly indicate materials used for various components.

- ✓ **Add Dimensions and Annotations**

Dimension the Section View: Provide measurements for clarity.

Label Important Features: Include notes on specific parts or materials as necessary.

- ✓ **Finalize the Drawing**

Check for Consistency: Ensure all views and sections align correctly.

Review Annotations: Confirm that labels and dimensions are clear and accurate.

Clean Up: Erase any unnecessary construction lines and smudges.

Points to Remember

- While describing section and views of objects in technical drawing it is essential to know different types of views and sections of objects.
- Before creating views of object, you should know different types of views and section of objects

Application of learning 3.3.

Suppose that there is a local Networking workshop located in your area that needs to create detailed orthographic views of a new machine part. Refer to the key readings 3.3.2 and create the orthographic views of a new machine part to show its internal components.

Learning outcome 3 end assessment

Theoretical assessment

Q1. From the following questions, answer by TRUE if the statement is Correct or by False if the statement is incorrect.

i. In a 2D view, all objects are represented using width and height only.

ii. A 3D view allows you to see the depth of an object, in addition to its height and width.

iii. Orthographic projections are a type of 3D representation.

iv. 3D models provide more information about the internal structure of an object than 2D drawings.

Q2. Match the types of views (in column B) with their descriptions (in column C). Write the letter of the correct answer in the provided blank space (in column A)

Column A	Column B	Column C
Answers	**Types of view**	**Descriptions**
…….	1. Isometric view	A. A view from one side or angle, usually showing width and height
…….	2. Perspective view	B. A 3D drawing where lines converge to a point in the distance
…….	3. Plan view	C. A 4D drawing where lines converge
		D. A 2D drawing representing a horizontal cut through an object

Q3. Fill in the blanks with the appropriate words. Select from the given choices in the box

width and height, shape and structure, internal features

i. In a 2D projection, an object's dimensions are shown as _____.

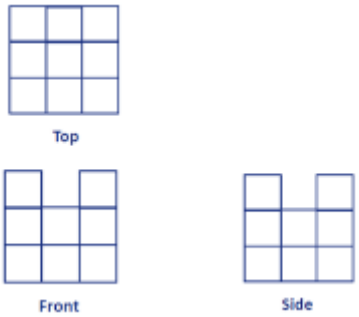
ii. 3D models are commonly used in design because they provide a complete view of an object's _____.

iii. A sectional view is used in 2D drawings to display _____ of an object.

Practical assessment

Q1. Suppose that TXY network company wishes to upgrade its network infrastructure by installing custom server racks. You are tasked to prepare detailed orthographic views of the racks including sectional views to show internal cable routing, power distribution units, and airflow management.

Q2. Given the 2D drawings below:



Draw a 3D corresponding to the above mentioned drawing.

END

References

Books

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Madsen, D. A., & Madsen, D. P. (2016). Engineering Drawing and Design (6th ed.). Cengage Learning.

Simmons, C. H., & Maguire, D. E. (2012). Manual of Engineering Drawing (4th ed.). Elsevier.

Web Links

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