

Unit-1.0 Basics of Engineering Drawing

1.1 Importance of engineering drawing.

1.2 Drawing instruments: Use of drawing board, mini drafter, compass, divider, protractor, drawing pencils, setsquares etc., drawing sheets, sheet layout, title block, folding of drawing sheets.

1.3 Lettering and numbering as per BIS 9609, importance, single stroke letters, slanting letters, upper case and lower-case letters, general procedure for lettering and numbering, height of letters.

1.4 Lines- Different types of lines. Scales - full scale, reduced scale and enlarged scale.

1.5 Dimensioning - terms and notations as per BIS, requirement of dimensioning - Dimension line, Extension lines and Leader lines, Dimensioning systems, Methods of dimensioning, important dimensioning rules.

1.5 Identification and representation of various symbols used in Mechanical and Electrical Drawings

1.7 Drawing Identification and representation of various symbols of building elements, materials and sanitary fittings

Unit-2.0 Projections of points, lines and planes

2.1 Projection of points: Concept of quadrant, first angle and third angle projection. Projection of points - points on different quadrants and on the reference planes.

2.2 Projection of straight lines: Projection of straight lines - Line in the first quadrant and on the reference Planes, perpendicular to one plane and parallel to other plane, inclined to one plane and parallel to the other plane, parallel to both the planes and inclined to both the planes.

2.3 Projection of Planes: Concept of planes,

a) Projection of planes parallel to one of the reference plane.

b) Projection of plane inclined to one reference plane and perpendicular to another.

Note: Triangle, Square/ rectangle and circle shape should be included in Various plane problems.

Introduction of Engineering Drawing:

Engineering Drawing is a type of **technical drawing** that is used to communicate **ideas, shapes, dimensions, and specifications** of an object. It is often called the **language of engineers**, because it provides a universal way of conveying complex information about machines, structures, and systems without using words.

Definition:

Engineering drawing is a **graphical representation** of physical objects and their dimensions, used to describe the size, shape, features, and construction details accurately.

Purpose:

- To communicate technical ideas clearly.
- To provide instructions for manufacturing or construction.
- To serve as a permanent record of a design.

Characteristics:

- Drawn using standard rules (like **BIS, ISO, or ASME standards**).
- Uses scales, symbols, notations, and conventions.
- Drawn with precision to avoid misunderstandings.

Types of Engineering Drawings:

1. **Freehand Sketches** – Rough representation of ideas.
2. **Orthographic Projections** – 2D views (front, top, side).
3. **Isometric Drawings** – 3D representation of an object.
4. **Assembly Drawings** – Shows how parts fit together.
5. **Detailed Drawings** – Shows exact dimensions of each part.

Importance of Engineering Drawing:

Engineering Drawing is often called the **backbone of engineering communication**. It plays a vital role in design, production, and maintenance. Its importance can be understood as follows:

1. Universal Language of Engineers

- It is a **graphical language** understood by engineers, technicians, and workers across the world.
- Removes language barriers in technical communication.

2. Accurate Representation of Objects

- Shows the exact **shape, size, and dimensions** of a product.
- Avoids confusion and misinterpretation.

3. Essential for Manufacturing and Construction

- Provides precise instructions for making machine parts, tools, buildings, or structures.
- Acts as a **guide for workers** during fabrication and assembly.

4. Saves Time and Cost

- Reduces errors in production by providing clear details.
- Helps in planning, reducing wastage of materials, and ensuring efficiency.

5. Documentation and Record

- Serves as a permanent record of design.
- Useful for **future reference, modifications, and maintenance**.

6. Standardization

- Based on **international standards (like ISO, BIS, ASME)**, which ensures uniformity and consistency in designs.

7. Visualization of Ideas

- Helps engineers convert **imagination into reality** by visualizing complex objects in 2D and 3D before actual production.

Basics drawing instruments are used in engineering drawing:

In engineering drawing, accuracy and neatness are very important. To achieve this, several basic drawing instruments are used. Here are the main ones:

1. **Drawing Board**
2. **T-Square**
3. **Mini Drafter**
4. **Set-Squares (Triangles)**
5. **Protractor**
6. **Compass**
7. **Dividers**
8. **Scales (Ruler/Engineering Scale)**
9. **French Curves / Flexible Curve**
10. **Pencils and Leads**
11. **Eraser & Erasing Shield**

Drawing Board

Introduction:

- A **drawing board** is the **fundamental instrument** used in engineering drawing.
- It is a flat, rectangular board made of **well-seasoned wood (like softwood, plywood)** or **laminated material**.
- Provides a **smooth and even surface** for drawing with precision.
- One edge (usually the left edge) is made **straight and smooth**, which acts as a guiding edge for **T-square** and **set-squares**.

Uses:

- To provide a **stable and smooth surface** for technical drawings.
- Used with **T-square, set-squares, scales, and compass** for drawing accurate lines, angles, and shapes.
- Essential for making **engineering diagrams, geometrical constructions, orthographic and isometric projections**.

Importance:

- A **primary base tool** in engineering drawing.
- Ensures **accuracy, neatness, and consistency** in drawings.
- Without a proper drawing board, instruments like **T-square and set-squares** cannot be used effectively.
- Acts as the **foundation** for all manual drafting work in engineering education and practice.

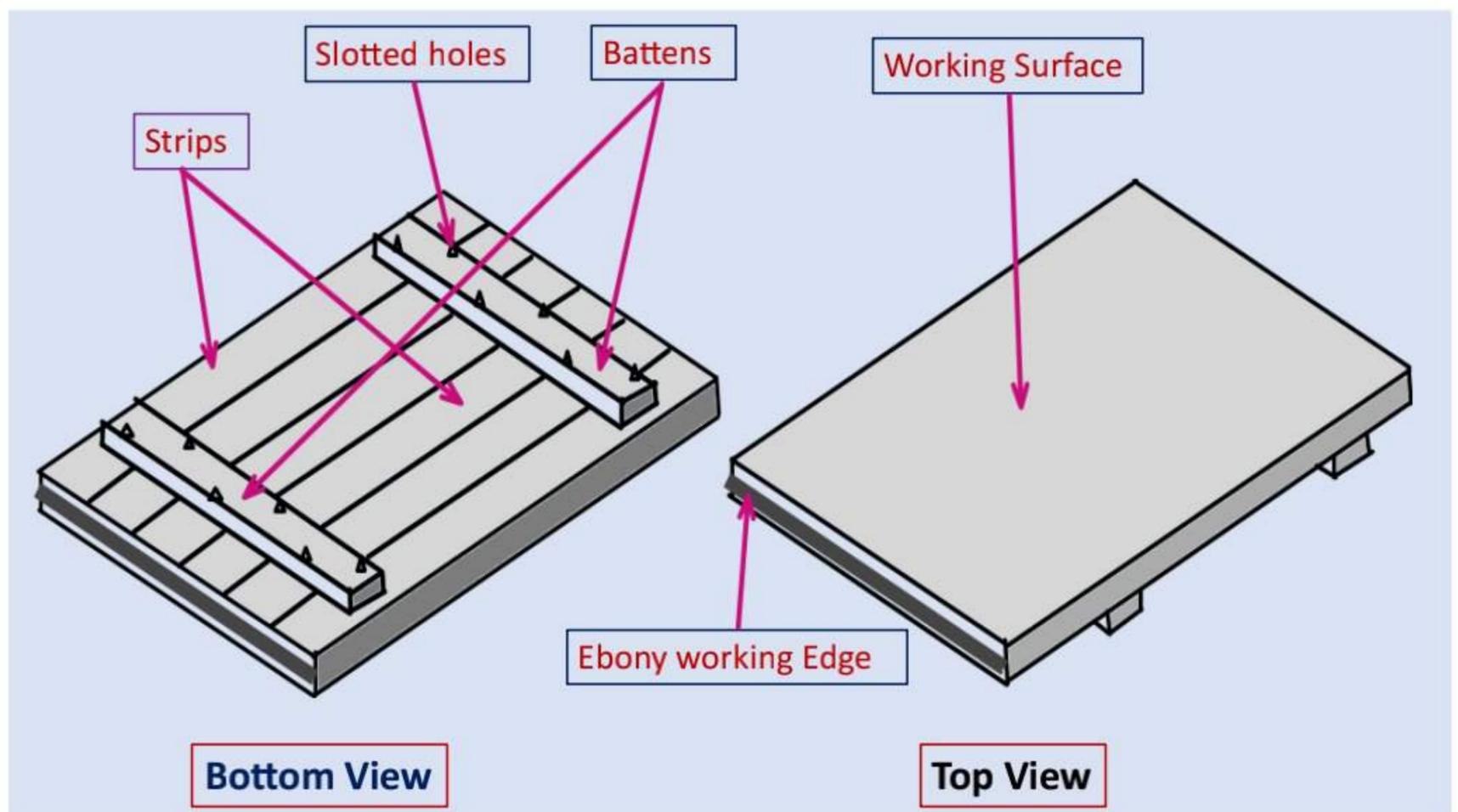


Fig: Drawing Board

Designation (Standard Sizes of Drawing Board as per IS:1444-1989)

Drawing boards are manufactured in **different sizes**, depending on the sheet size (A0, A1, A2, A3) to be used:

Board Designation	Board Size (mm) Length X Width X Thickness	Suitable for Sheet Size
D0	1500 × 1000 × 25	A0
D1	1000 × 700 × 25	A1
D2	700 × 500 × 15	A2
D3	500 × 350 × 15	A3

T-Square

Introduction

In engineering drawing, accuracy and neatness are very important. To achieve this, various drawing instruments are used, and one of the fundamental tools is the **T-Square**. It is primarily used on drawing boards to draw horizontal lines and to guide set squares or other instruments in producing vertical or inclined lines.

Definition

- A **T-Square** is a technical drawing instrument shaped like the letter "T". It consists of two main parts:
 1. **Head/Stock (shorter part, usually fixed at 90°)** – rests against the edge of the drawing board.
 2. **Blade (longer part)** – extends across the drawing board and is used as a guide for drawing.

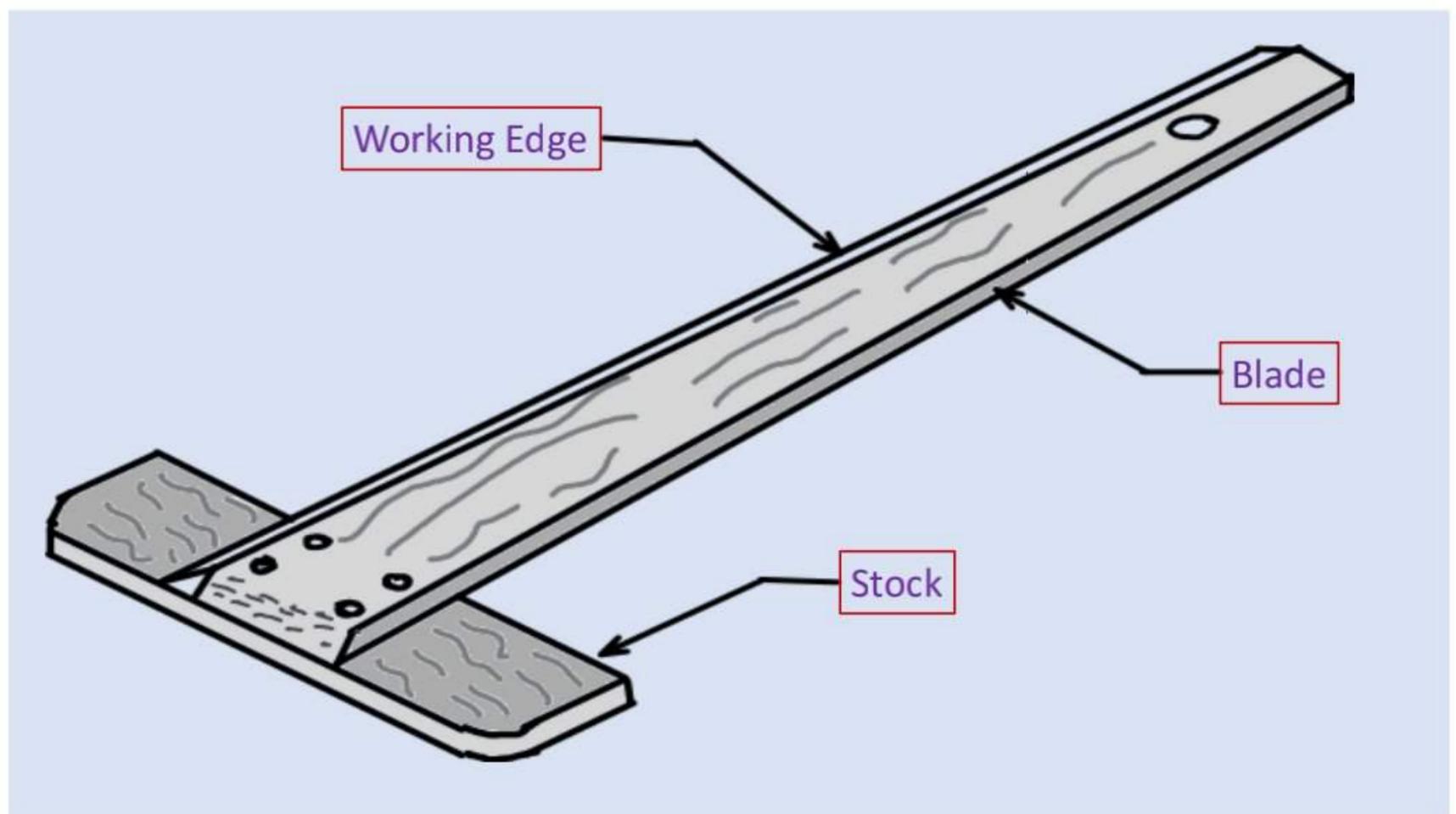


Fig: T – Square

Usages

- Drawing **horizontal lines** accurately on the drawing sheet.
- Serving as a **base or guide** for set squares, which are then used to draw vertical and inclined lines.
- Aligning and positioning the drawing sheet properly on the drawing board.
- Assisting in constructing **parallel lines** by sliding the instrument up and down.
- Used in combination with protractors or drafting machines for more complex constructions.

Importance

- Ensures **accuracy** and **consistency** in technical drawings.
- Helps in maintaining **proper orientation** (horizontal and vertical references).
- Saves time by making the drawing process faster and more efficient.
- Forms the **basis for precision**, since all other drawing instruments (like set squares and compasses) rely on its accuracy.
- It is an essential tool for students, architects, engineers, and draftsmen in producing clear, professional-quality drawings.

Mini Drafter

Introduction

In engineering drawing, precision and accuracy are essential. Engineers and draftsmen often need tools that help them create neat, scaled, and accurate drawings. One such important instrument is the **mini drafter**, which combines the functions of a protractor, ruler, set squares, and compass into a single compact device. It is widely used by engineering students, architects, and professionals for technical drawing and design work.

Definition

A **mini drafter** is a portable drafting instrument used in engineering drawing for drawing straight lines, parallel lines, angles, and geometrical figures directly on a drawing sheet. It consists of:

- A **drawing board clamp** for attaching to the board,
- An **arm** (usually adjustable),
- A **protractor head** with two scales (one horizontal, one vertical) that can rotate to any angle.

This allows easy and accurate construction of engineering drawings without the need for multiple separate instruments.

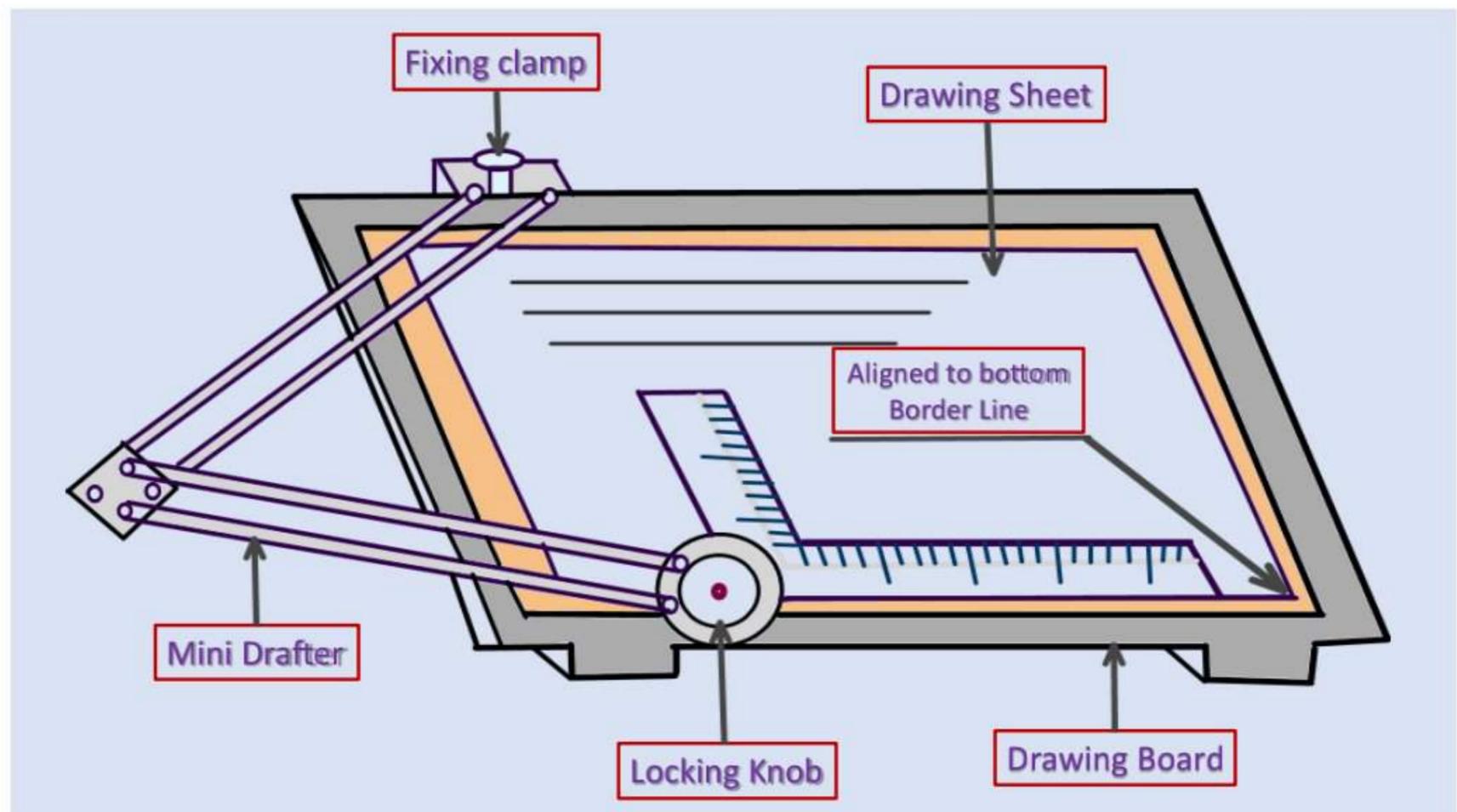


Fig: Mini Drafter

Usages

The mini drafter serves many purposes in engineering drawing, such as:

- **Drawing straight and parallel lines** quickly and accurately.
- **Constructing angles** using the protractor head.
- **Drawing perpendiculars and inclined lines** without shifting set squares.
- **Creating projections** in orthographic and isometric drawings.
- **Reducing drawing time** by combining functions of different tools.
- **Maintaining accuracy and neatness** in engineering sketches and technical diagrams.

Importance

- **Time-saving:** Eliminates repeated use of separate set squares and protractors.
- **Accuracy:** Provides high precision in drawing angles, parallel lines, and projections.
- **Convenience:** Compact and easy to use, especially for students and professionals.
- **Versatility:** Suitable for civil, mechanical, electrical, and architectural drawings.
- **Essential for learning:** Helps engineering students practice accurate drafting before moving to CAD software.

Set-square

Introduction

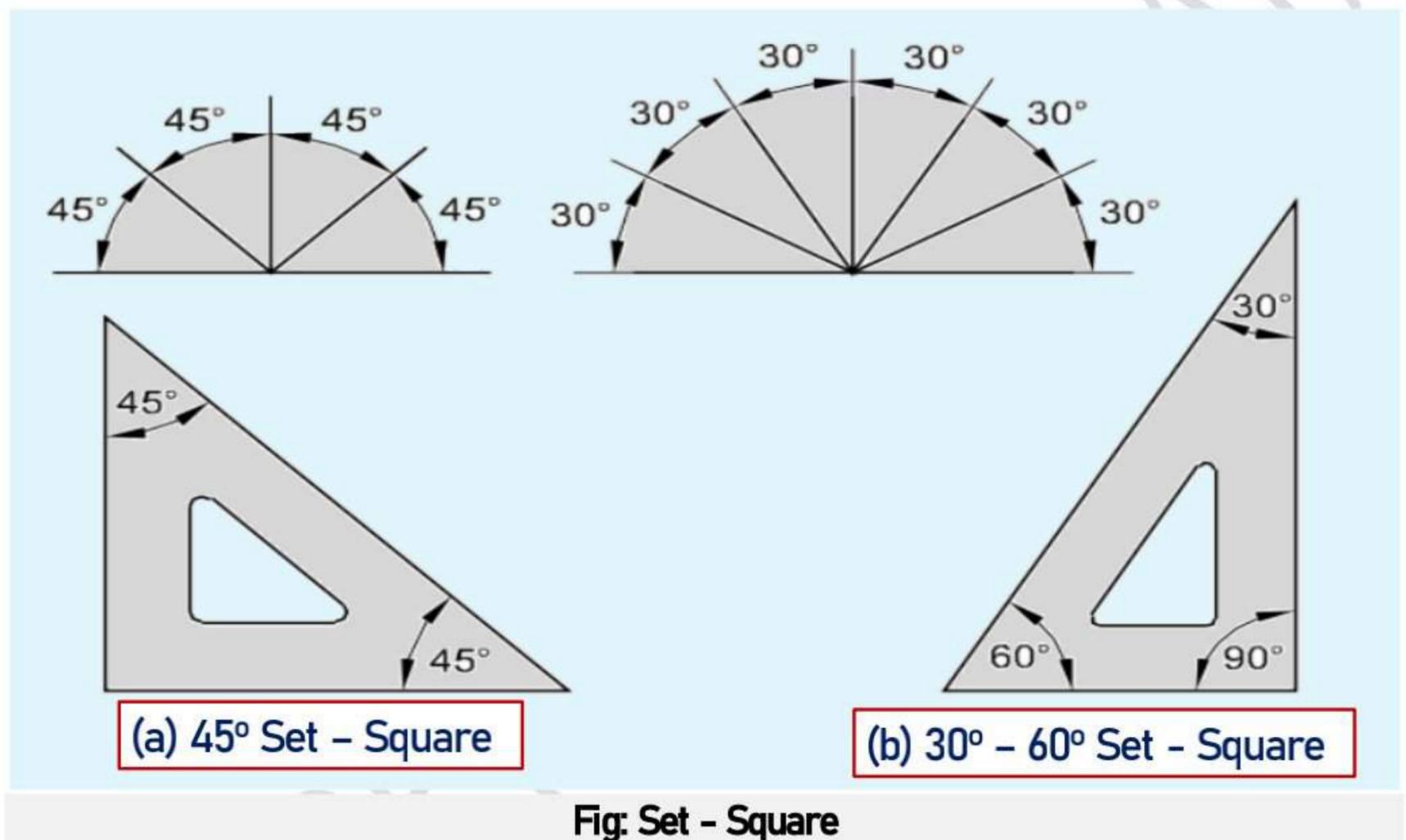
In engineering drawing, accuracy and neatness are essential because technical drawings serve as the universal language of engineers, architects, and designers. To achieve precision, various drawing instruments are used, and one of the most common and important is the **set-square**. It is a triangular-shaped tool that allows the drafter to draw lines at specific angles quickly and accurately.

Definition

A **set-square** is a flat, triangular drafting instrument, usually made of transparent plastic, wood, or metal, used in engineering and technical drawing. It is designed with specific angles—typically:

- **45°–45°–90°** triangle
- **30°–60°–90°** triangle

To help draw straight lines, perpendiculars, and angled lines without the need for protractors.



Usages

- Set-squares are widely used in drawing and drafting for:
- **Drawing perpendicular lines:** To the baseline or T-square edge.
- **Drawing parallel lines:** By sliding the set-square along a ruler or T-square.
- **Drawing inclined lines:** At standard angles like 30°, 45°, 60°, 75° and 90° (15° multiple)
- **Constructing geometric figures:** Such as triangles, hexagons, and other polygons requiring standard angles.
- **Checking right angles:** As a measuring and verification tool.
- **Supporting lettering:** Keeping vertical and slanted letters aligned neatly.

Importance

- **Accuracy:** Ensures precise angles and lines, which is critical in technical drawings.
- **Speed:** Provides quick ways to draw commonly used angles without measurement.
- **Simplicity:** Easy to handle, lightweight, and portable.
- **Versatility:** Useful in combination with T-square, compasses, and scales.

- **Foundation for CAD:** Understanding manual instruments like set-squares builds the fundamentals of computer-aided drafting.

Protractor

Introduction

In engineering drawing, accurate measurement and construction of angles is crucial for producing precise technical designs. One of the simplest and most essential instruments used for this purpose is the **protractor**. It is widely used by engineers, architects, and draftsmen to measure and draw angles on technical drawings.

Definition

A **protractor** is a semicircular or circular drawing instrument, usually made of transparent plastic or metal, that is used to **measure and construct angles in degrees**. Standard protractors are divided into 180° or 360° and marked with degree graduations.

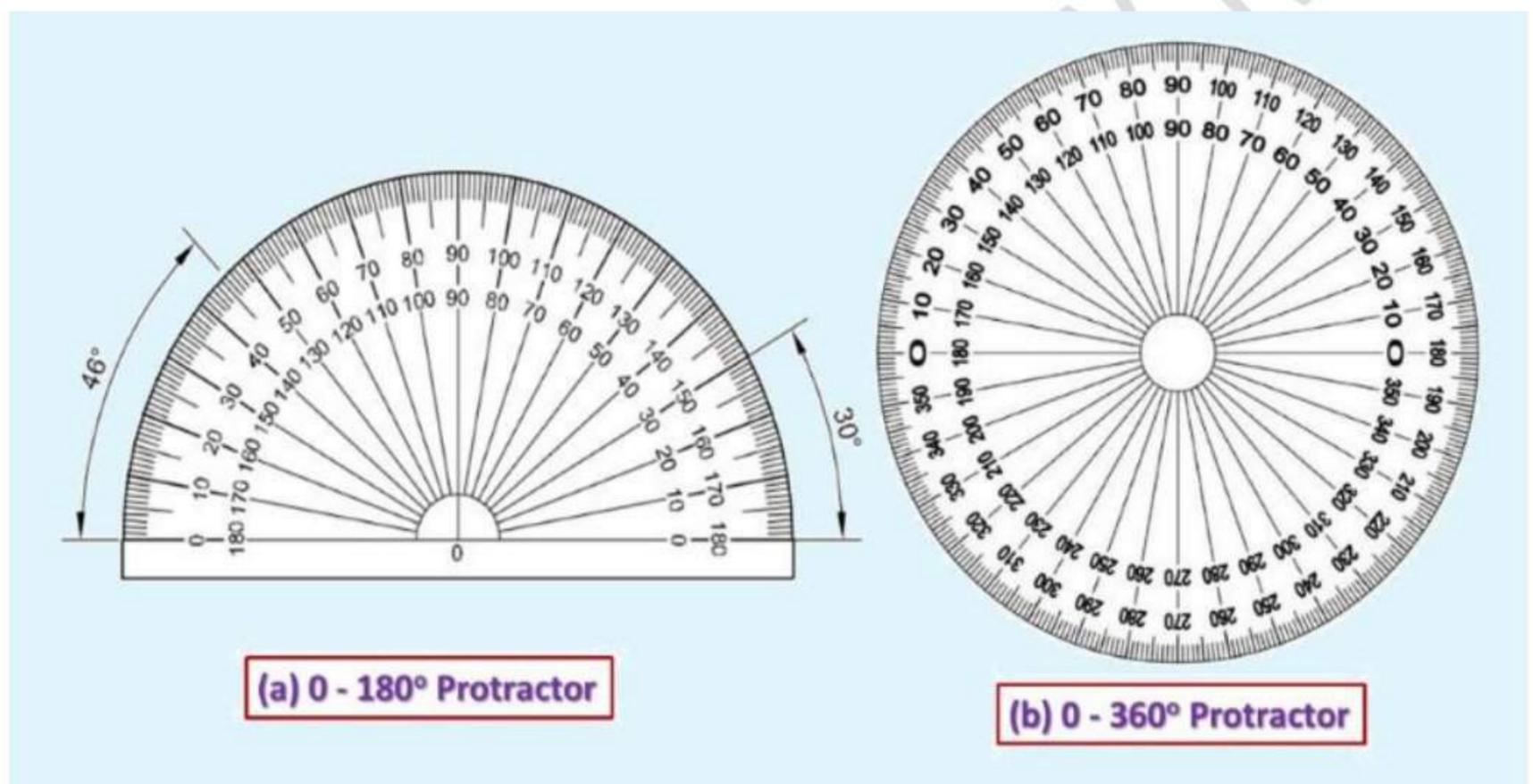


Fig: Protractor

Usages

- **Measuring Angles** – To determine the size of an existing angle on a drawing.
- **Constructing Angles** – To draw specific angles such as 30° , 45° , 60° , 90° , etc.
- **Checking Angles** – To verify whether drawn angles are correct and accurate.
- **Creating Geometrical Constructions** – Useful in bisecting, transferring, or dividing angles.
- **Technical Drawings** – Applied in mechanical, civil, and architectural drawings for layouts and designs.
- **Navigation and Surveying** – Circular protractors are also used in fields like surveying, mapping, and navigation to plot directions.

Importance

- **Ensures Accuracy:** Precision in angles is vital for the correctness of machine parts, structures, and technical layouts.
- **Saves Time:** Provides a quick and efficient way to draw or measure angles.

- **Fundamental Tool:** Serves as a basic but indispensable instrument in engineering graphics and drafting education.
- **Error Reduction:** Helps avoid human error when estimating or constructing angles manually.
- **Versatile Application:** Useful across multiple disciplines—mechanical engineering, architecture, civil engineering, and surveying.

Compass

Introduction

In engineering drawing, accuracy and neatness are essential for communicating technical ideas. A **compass** is one of the most commonly used drawing instruments, designed to draw circles, arcs, and transfer measurements with precision. It helps engineers, architects, and draftsmen create geometrical constructions that are fundamental in design and drafting.

Definition

A **compass** is a drawing instrument consisting of two legs joined at a pivot.

- One leg is fitted with a **needle point** to hold the center.
- The other leg holds a **pencil, lead, or pen attachment** for drawing.

By adjusting the angle between the legs, circles and arcs of various radii can be drawn accurately.

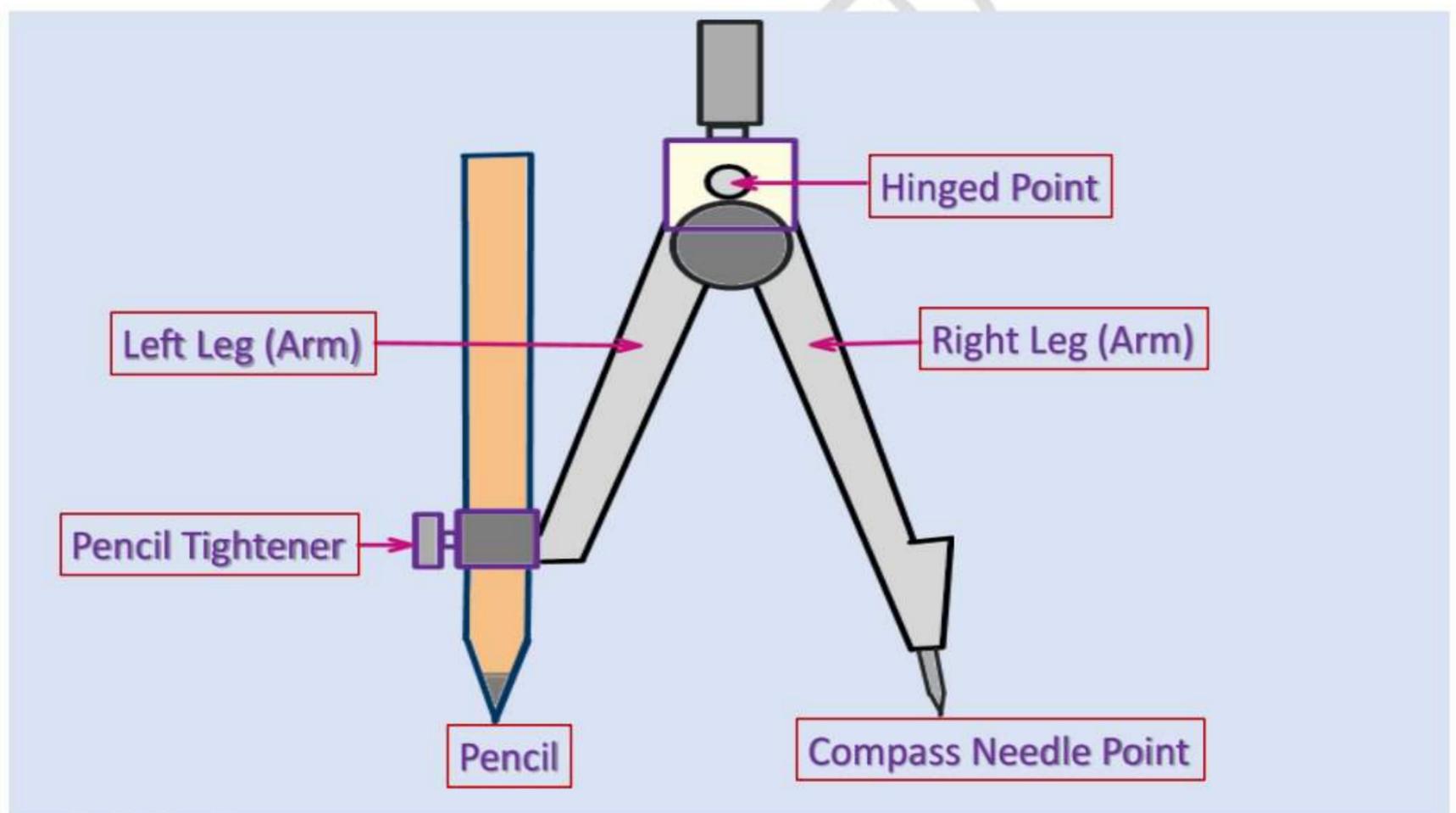


Fig: Compass

Usages

A compass is used for:

- **Drawing circles** of required radii.
- **Drawing arcs** for geometrical constructions.
- **Marking equal distances** by stepping off a radius multiple time.
- **Transferring measurements** from a scale to a drawing.
- **Bisecting lines and angles** in geometric constructions.
- **Drawing polygons** by stepping the compass around a circle.

Importance

- **Accuracy:** Ensures precise construction of circles, arcs, and curves.
- **Standardization:** Helps maintain uniformity in technical drawings.
- **Versatility:** Useful in various geometrical constructions required in design.
- **Foundation Tool:** Essential for beginners as well as professionals in technical drawing.
- **Time-saving:** Simplifies repetitive tasks like dividing circles or transferring distances.

Divider

Introduction

In engineering drawing and drafting, precision is essential. Instruments such as compasses, dividers, rulers, and protractors help achieve accuracy. Among them, the **divider** is a fundamental tool used for transferring, comparing, and marking distances. It is one of the oldest instruments in technical drawing, geometry, and navigation, and continues to play a key role in both manual drafting and workshop practices.

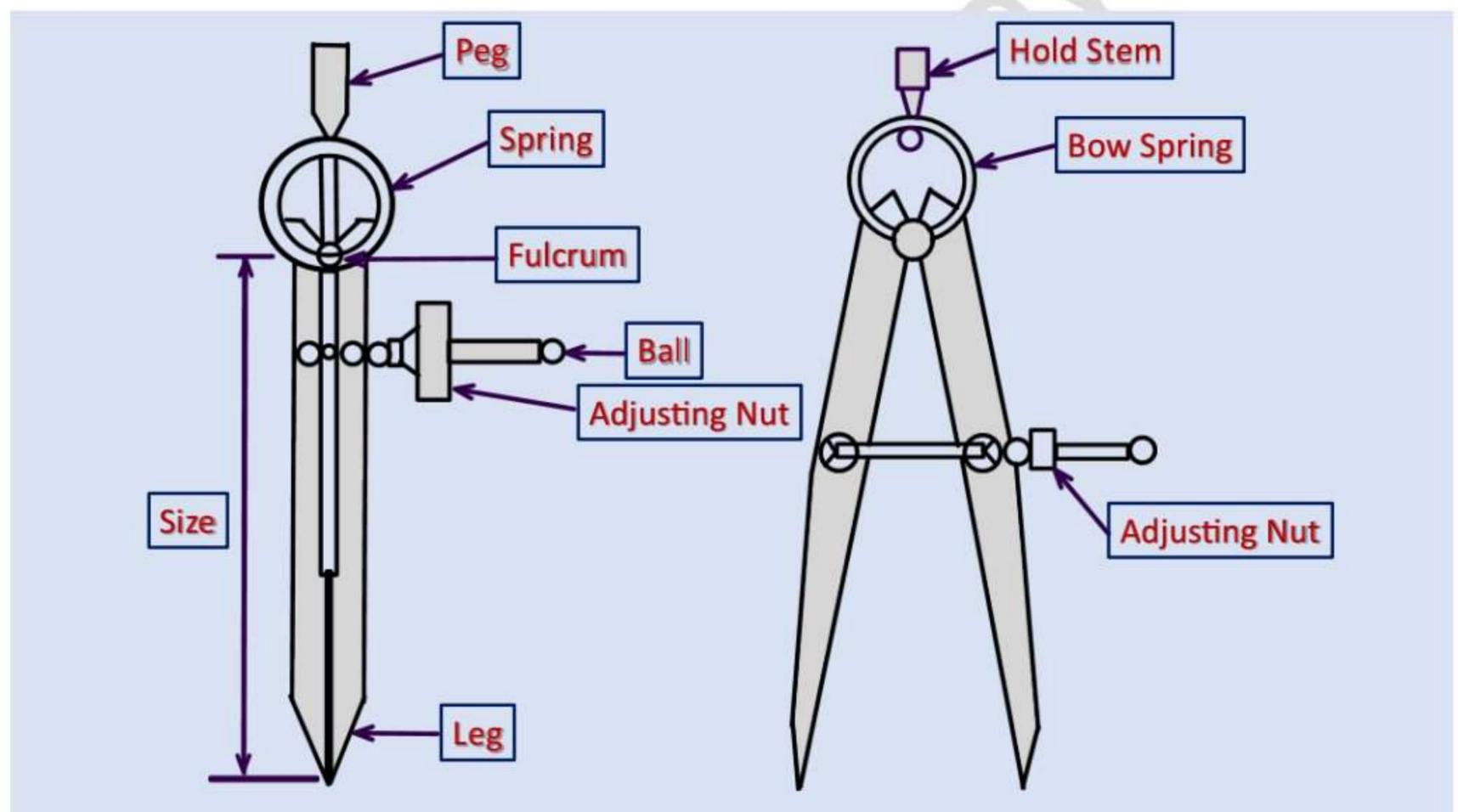


Fig: Divider

Definition

A **divider** is a precision instrument with two pointed legs joined at a pivot. Unlike a compass, which holds a pencil in one leg, a divider has two sharp points. It is mainly used to **measure or transfer distances from one part of a drawing to another or from a scale to a drawing.**

Usages

Dividers have multiple applications in engineering drawing and related fields:

- **Transferring distances:** Carrying a specific length from a scale and marking it on the drawing.
- **Measuring distances:** Comparing two lengths or checking dimensions on drawings.
- **Dividing lines:** Splitting a line into equal or proportional parts.
- **Locating points:** Accurately marking points on circles, arcs, or lines.

- **Drawing circles/arcs (with compass attachment):** In some cases, modified dividers can be used with attachments to draw arcs.
- **Workshop use:** In mechanical and civil fields, dividers are used to scribe marks directly on metal, wood, or other materials before machining or cutting.

Importance

- **Accuracy:** Ensures precise measurement transfer, which is essential in engineering.
- **Consistency:** Helps in reproducing equal distances and divisions.
- **Versatility:** Can be used on paper, scales, and even directly on materials in workshops.
- **Fundamental learning tool:** Helps students and engineers develop accuracy in manual drafting before using advanced digital tools like CAD.
- **Supports design and manufacturing:** Acts as a bridge between drawing (design) and practical application (fabrication).

Scales (Rulers or Engineering Scales)

Introduction

In engineering drawing, accurate representation of objects is essential. However, many real-world objects are either too large (like buildings, bridges, and machines) or too small (like machine components or electronic parts) to be drawn at their actual size on standard drawing sheets. To solve this, engineers use **scales** (rulers or engineering scales) that allow them to draw objects proportionally, either reduced, enlarged, or actual size.

Definition

A scale in engineering drawing is a **measuring instrument or tool used to represent dimensions of an object proportionally on a drawing sheet**. It may be a simple ruler marked in units or a specialized **engineering scale** (triangular scale, diagonal scale, vernier scale, etc.) designed to show measurements in different ratios.

In simple terms: A scale is a device that helps to draw or measure objects at a specific ratio between the drawing size and actual size.

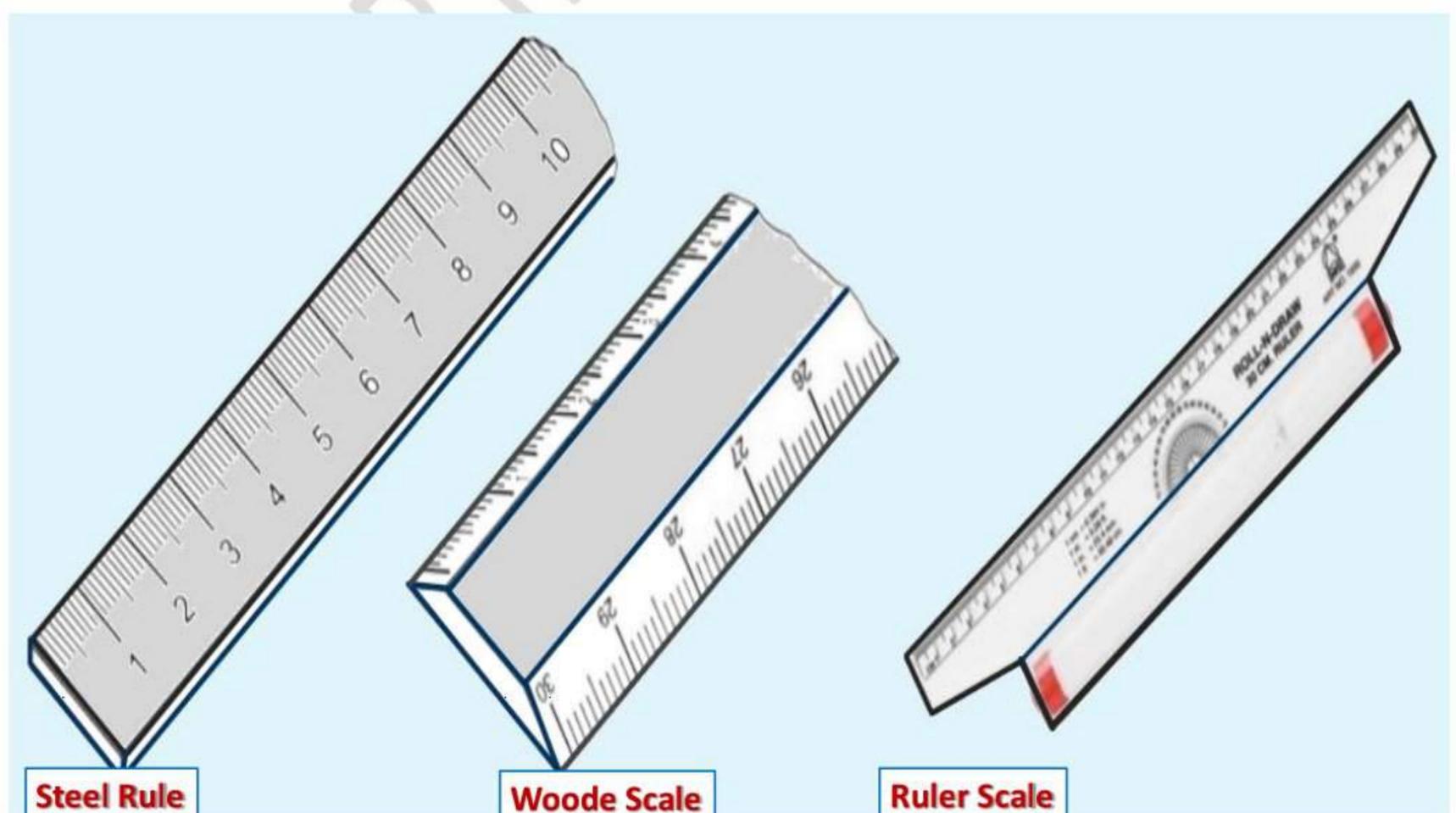


Fig: Scales

Usages

Scales are widely used in technical drawings for the following purposes:

- **Drawing to Scale** – To represent large objects (buildings, bridges, machines) in reduced size or small objects (nuts, bolts, ICs) in enlarged size.
- **Measurement** – To measure distances directly from a drawing using the chosen ratio.
- **Representation** – To present complex objects clearly on a limited drawing sheet.
- **Standardization** – To maintain uniformity and precision in technical drawings across industries.
- **Types of Uses:**
 - **Reducing scale** → e.g., 1:50 (a building plan).
 - **Enlarging scale** → e.g., 10:1 (a microchip layout).
 - **Full scale (1:1)** → when the object fits the sheet size.

Importance

Scales are essential in engineering drawings because:

- They allow **accurate communication** of dimensions between engineers, architects, and manufacturers.
- They help to **fit real-world objects** on standard drawing sheets without losing proportion.
- They ensure **consistency** and prevent errors in design, measurement, and construction.
- They make drawings **readable and practical**, especially for large projects like roads, railways, and machines.
- They form the **basis of design interpretation**, ensuring that what is drawn can be correctly manufactured or built.

French curve

Introduction

In engineering drawing and drafting, it is often necessary to draw smooth, irregular curves that cannot be drawn accurately using simple tools like a compass or protractor. To solve this, a **French curve** is used. It is a drafting instrument made of transparent plastic, shaped with a variety of complex curves that allow a drafter to draw smooth arcs and transitions.

Definition

A **French curve** is a **drawing instrument consisting of curved edges of varying radii**, used to draw non-circular and irregular curves in engineering drawing. It is typically made from plastic or celluloid and comes in different shapes, though the most common set consists of three curves.

Usages

- **Drawing irregular curves** – Helps in drawing curves that are not circular or elliptical.
- **Connecting points smoothly** – Used to join a series of plotted points into a continuous, smooth curve.
- **Designing machine parts** – Helpful in drafting irregular profiles such as cams, turbine blades, or automobile parts.
- **Geometrical constructions** – Used where arcs of different radii need to merge smoothly.
- **Graphical work** – Commonly applied in plotting graphs, curves of best fit, and mathematical function representation.
- **Art and architecture** – Assist in making ornamental designs, patterns, and smooth artistic outlines.

- **Soft leads (B, 2B, 3B...):**
 - Used for shading, freehand sketches, and artistic rendering.
 - They produce darker, thicker lines but may smudge.

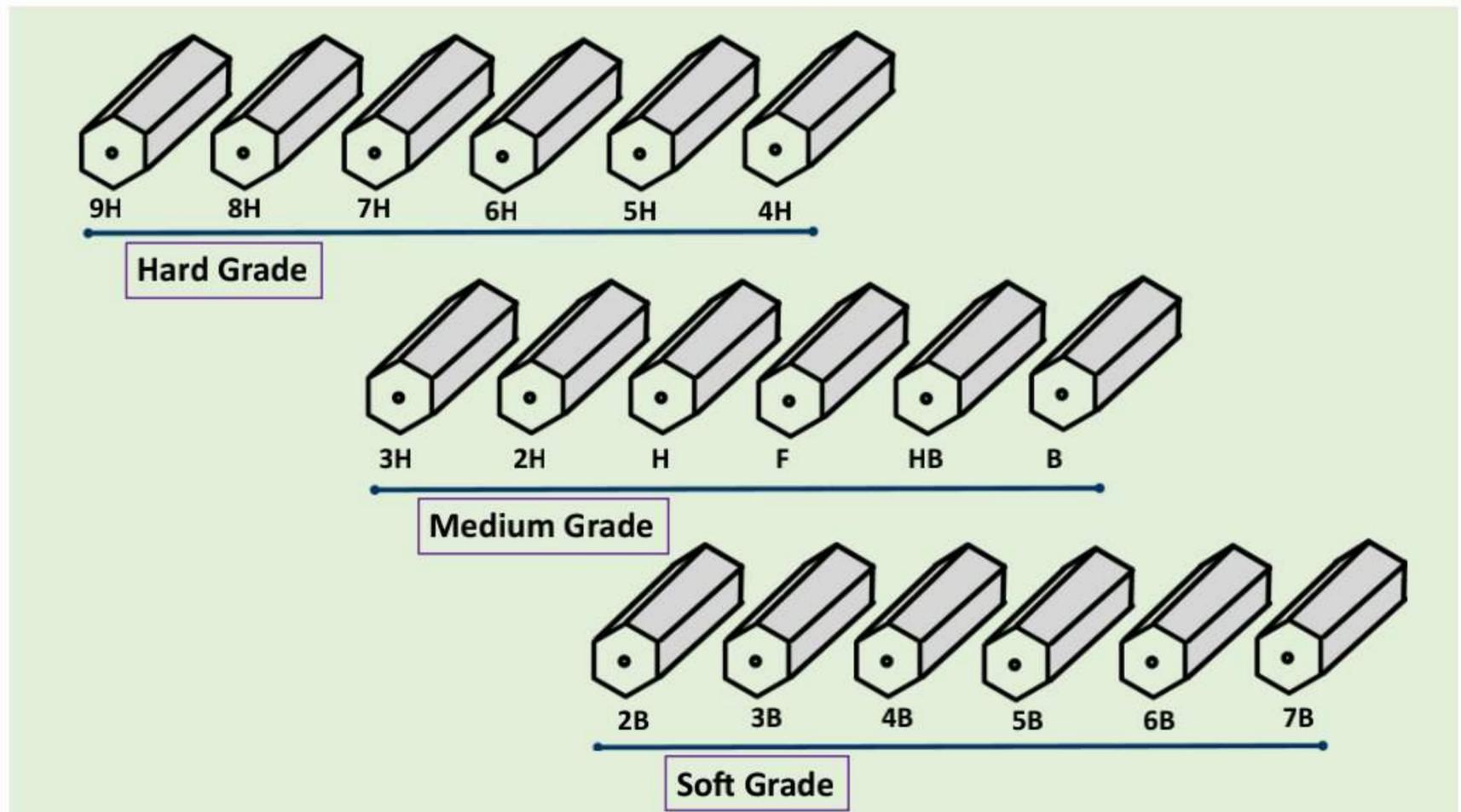


Fig: Pencils and Leads

Importance

- **Accuracy:** Proper selection of lead hardness ensures uniform and precise lines, which is critical for technical drawings.
- **Clarity:** Different types of lines (construction, object, hidden, dimension, etc.) require distinct appearances, achieved through proper pencil grades.
- **Durability:** Hard leads prevent smudging and maintain sharpness, keeping the drawing neat.
- **Communication:** Engineering drawings are universal languages; clear lines and neat presentation help avoid misinterpretation.
- **Professional Standards:** Correct use of pencils and leads ensures drawings conform to engineering standards (e.g., BIS, ISO, ASME).

Erasers and Erasing Shields

Introduction

In engineering drawing, accuracy and neatness are very important. While creating or modifying drawings, mistakes can occur. To correct these mistakes without damaging the drawing sheet or affecting other lines, special drawing instruments such as **erasers** and **erasing shields** are used. These tools help maintain the professional quality, precision, and clarity of engineering drawings.

Definition

- **Eraser:**
An eraser is a soft block, usually made of rubber, vinyl, or plastic, used to remove unwanted

pencil or ink marks from a drawing sheet. Different types of erasers are used depending on the medium (pencil or ink).

- **Erasing Shield:**

An erasing shield is a thin sheet of metal (usually stainless steel) or plastic with small cut-out shapes such as circles, slots, and rectangles. It is placed over the drawing to expose only the area that needs to be erased, protecting the surrounding lines and preventing accidental removal of important details.

Usages

Eraser

- Removing pencil lines, construction lines, or mistakes from a drawing.
- Cleaning smudges or light marks for a neat appearance.
- Correcting freehand sketches before final inking.
- Preparing the sheet for redrawing over erased portions.

Erasing Shield

- Erasing only a specific portion of a line without disturbing adjacent lines.
- Correcting fine details such as dimensions, lettering, or small parts of a figure.
- Ensuring neatness while modifying complex drawings.
- Maintaining the accuracy of final inked drawings by controlling the erased area.

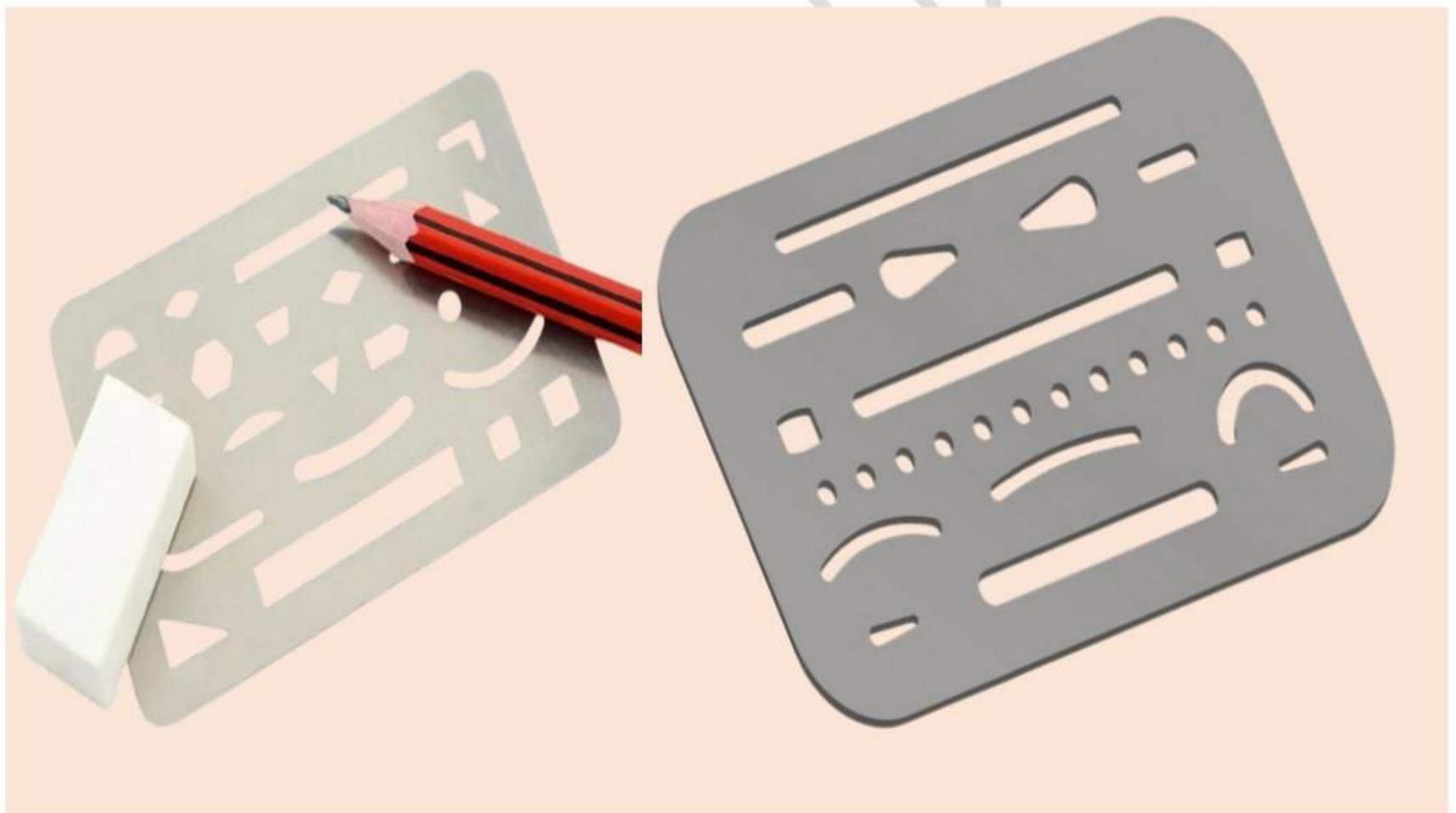


Fig: erasers and erasing shields

Importance

- **Accuracy:** Prevents accidental removal of correct lines while erasing mistakes.
- **Neatness:** Helps produce clean, professional-quality drawings without smudges.
- **Efficiency:** Saves time by allowing selective erasing instead of redrawing the entire figure.
- **Durability:** Protects the drawing sheet from excessive rubbing and tearing.
- **Professional Standard:** Essential in technical fields where precision and clarity of drawings are critical for communication and manufacturing.

Drawing Sheet in Engineering Drawing

Introduction

A **drawing sheet** is a rectangular piece of paper used for **technical drawings** in engineering. All objects, whether mechanical, civil, or electrical, are represented on a drawing sheet using standardized methods.

To ensure **uniformity and clarity**, the **size, layout, title block, margins, and scale** of drawing sheets are standardized by **BIS (Bureau of Indian Standards)** and **ISO (International Organization for Standardization)**.

Standard Drawing Sheet Sizes (As per BIS – IS:10711 / ISO 5457)

Drawing sheets are standardized in the **A-series** (A0 to A4).

Each smaller sheet is obtained by cutting the previous size in half **parallel to the shorter side**.

SHEET DESIGNATION	SHEET SIZE DIMENSIONS (mm x mm)	AREA (mm ²)	Aspect Ratio
A0	841 × 1189	1.00	1 : √2
A1	594 × 841	0.50	1 : √2
A2	420 × 594	0.25	1 : √2
A3	297 × 420	0.125	1 : √2
A4	210 × 297	0.0625	1 : √2
A5	148 × 210	0.0310	1 : √2

Note:

- The **aspect ratio** (length to breadth) of all sheets is $1 : \sqrt{2}$ ($\approx 1 : 1.414$).
- This ratio allows enlargement or reduction of drawings **without distortion**.

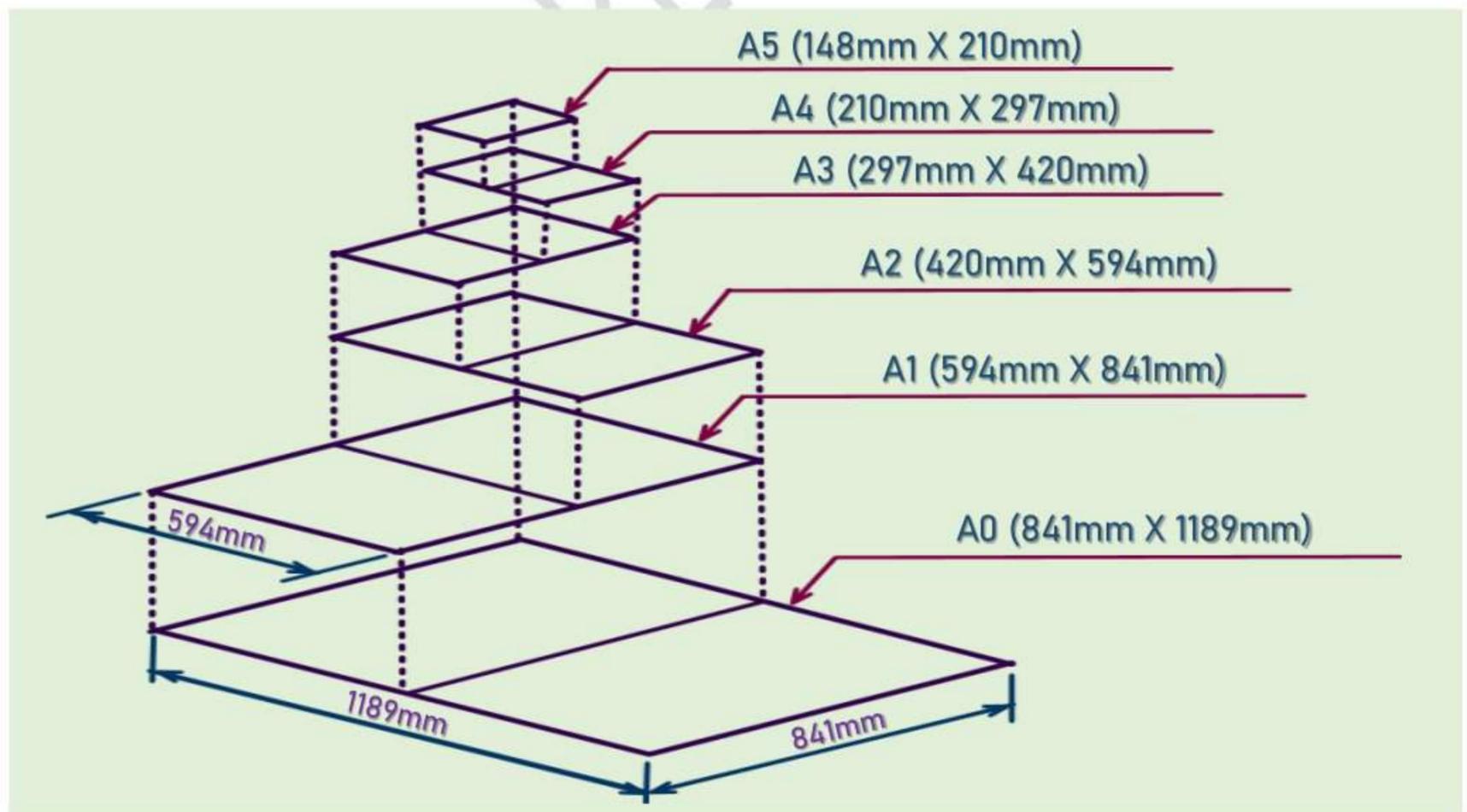


Fig: Sheet Dimensions

BIS / ISO Recommendations for Use

Sheet Size	Recommended Use
A0	General assembly or large machine drawings
A1	Large component drawings
A2	Medium-sized machine parts
A3	Small machine parts or civil details
A4	Simple sketches, part lists, or lab drawings

Sheet Layout Margins (Border Lines)

Every drawing sheet must have a **margin (border)** drawn inside the outer edges. Margins ensure neatness and protect the drawing area.

Margin Type	Thickness of Line	Distance from Edge
Left side (for binding)	Thick	25 mm
Other three sides	Thick	10 mm

Note:

- For **A2 size**, the left margin is **25 mm**, and all others are **10 mm** top/right/bottom margin,
- The border line is drawn **with a thick continuous line**.
- Title block in bottom-right corner.

Standard Layout of Drawing Sheet

The **layout** of a standard drawing sheet generally includes:

1. **Border (margin)**
2. **Title block** (bottom right)
3. **Revision table** (top right)
4. **Graph or notes space** (optional)
5. **Projection symbol**
6. **Company / Institution logo**

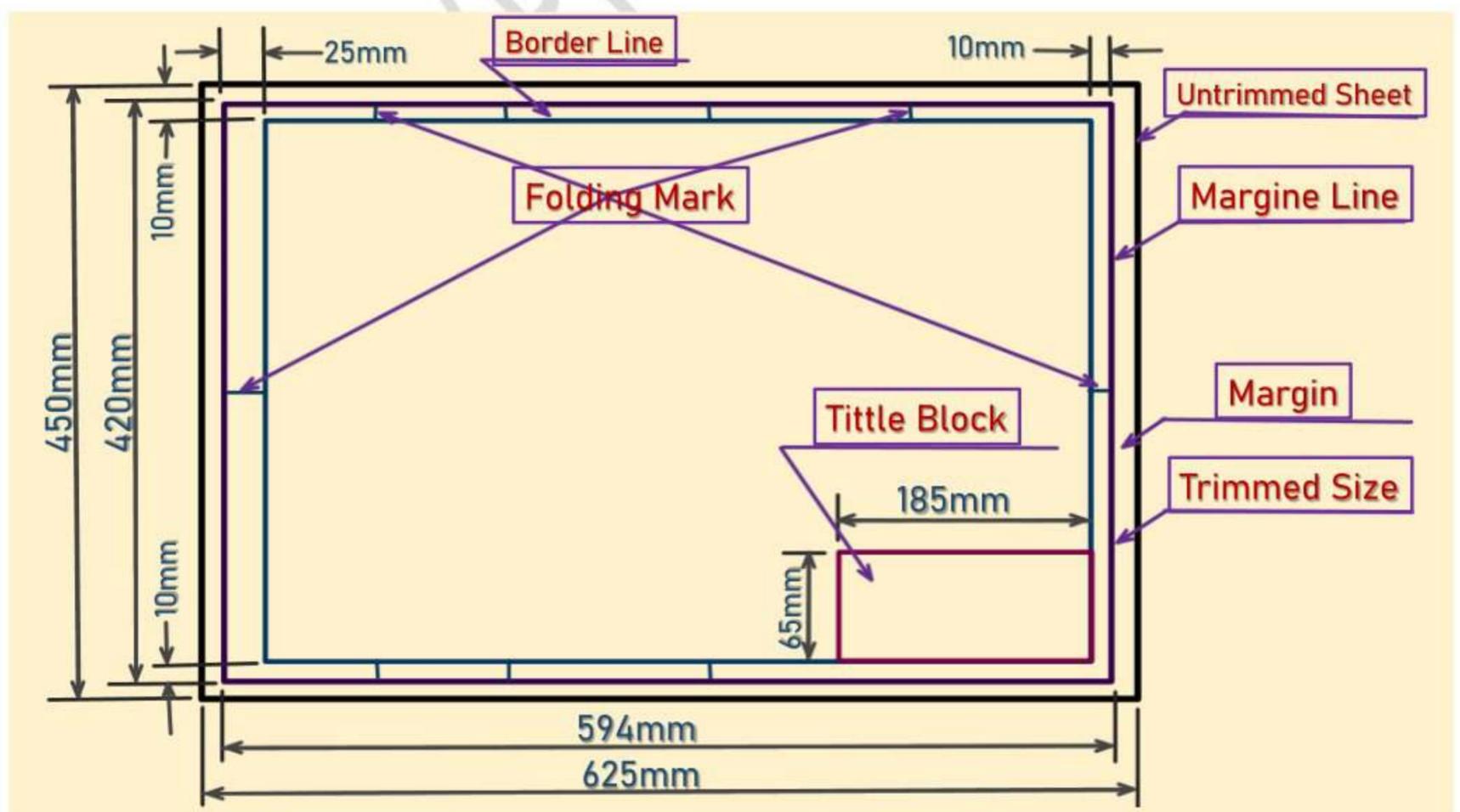


Fig: Sheet Layout

Title Block

The **title block** is placed at the **bottom-right corner** of the drawing sheet. It provides all necessary information about the drawing and the drafter.

Contents of Title Block

1. **Title of the drawing** (e.g., "Flange Coupling Assembly")
2. **Drawing number** (unique identification)
3. **Name of the drafter, checker, and approver**
4. **Scale used**
5. **Date of drawing**
6. **Sheet number and total number of sheets**
7. **Projection method** used (First angle / Third angle)
8. **Organization / College / Company name**

Note:

- Title block size: Usually **185 mm × 65 mm** (for A2 sheet and above).
- The **projection symbol** is used to indicate the **method of projection**.

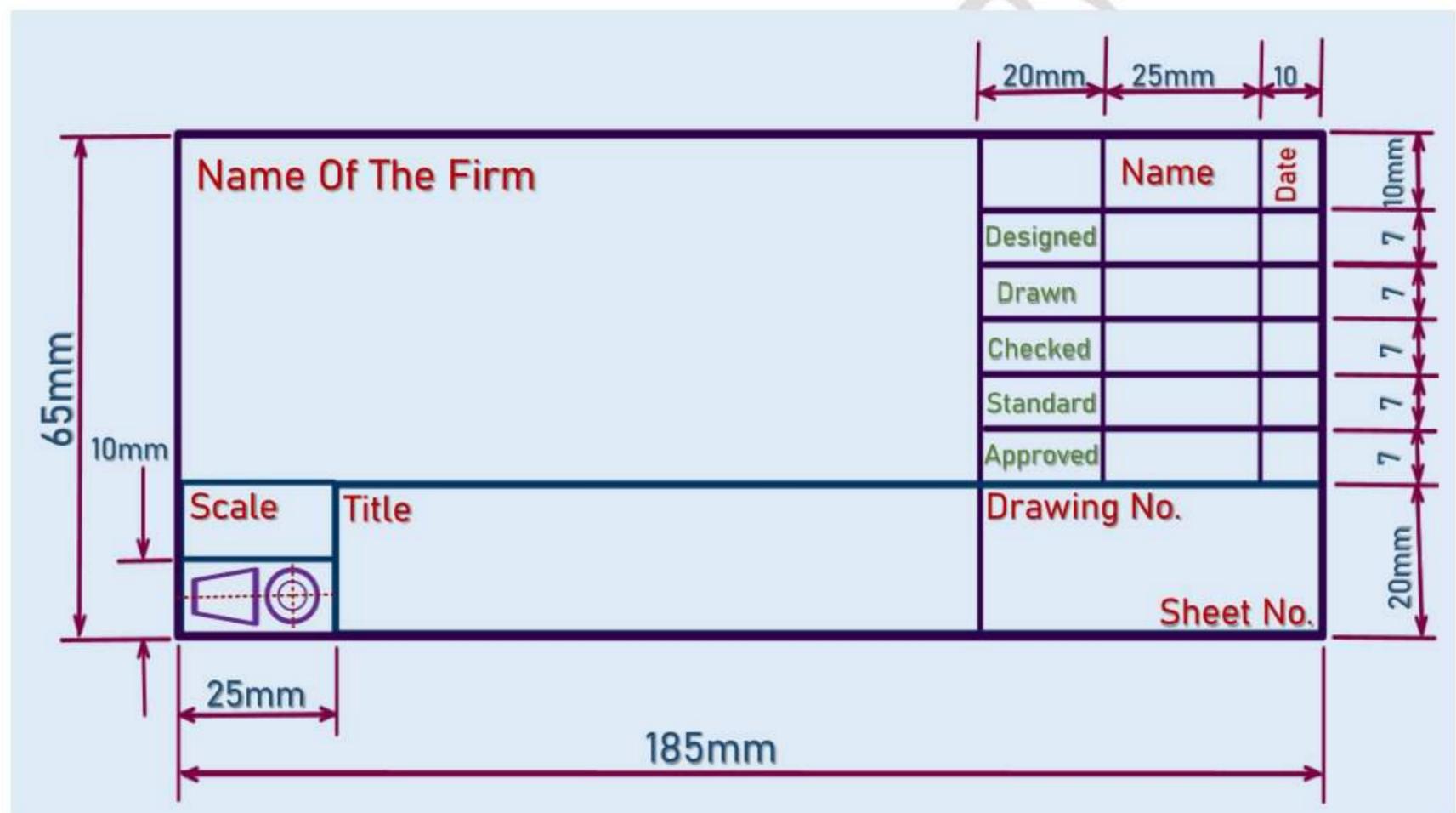


Fig: Title Block

Folding of Drawing Sheet in Engineering Drawing

Introduction

In engineering drawing, **folding of drawing sheets** is an important part of maintaining, storing, and handling large-size drawings. Since sheets like A0, A1, and A2 are quite large, they are folded into a compact size (usually A4) for easy filing, storing, and reading without damaging the drawing.

Large sheets (A0, A1, A2) are folded to fit into standard **A4 size (210 × 297 mm)** files. Folding must be done such that:

- The **title block remains visible** on top when folded.
- Creases should be **parallel to shorter sides**.

Purpose of Folding

1. To make large sheets easy to **handle, carry, and store**.
2. To **fit the sheets into standard files** (A4 size – 210 mm × 297 mm).
3. To allow the **title block** to remain **visible and readable** even after folding.
4. To **protect the drawing surface** from damage, dust, and folding marks.

General Principles of Folding

1. Folding should be **along pre-decided lines** so that the **title block** is visible.
2. **First folds** are made **parallel to the shorter side** (vertical folds).
3. **Subsequent folds** are made **parallel to the longer side** (horizontal folds).
4. Fold lines should be **sharp and neat**; no tearing or wrinkling.
5. The **title block** must always appear **on the top right corner** when folded.

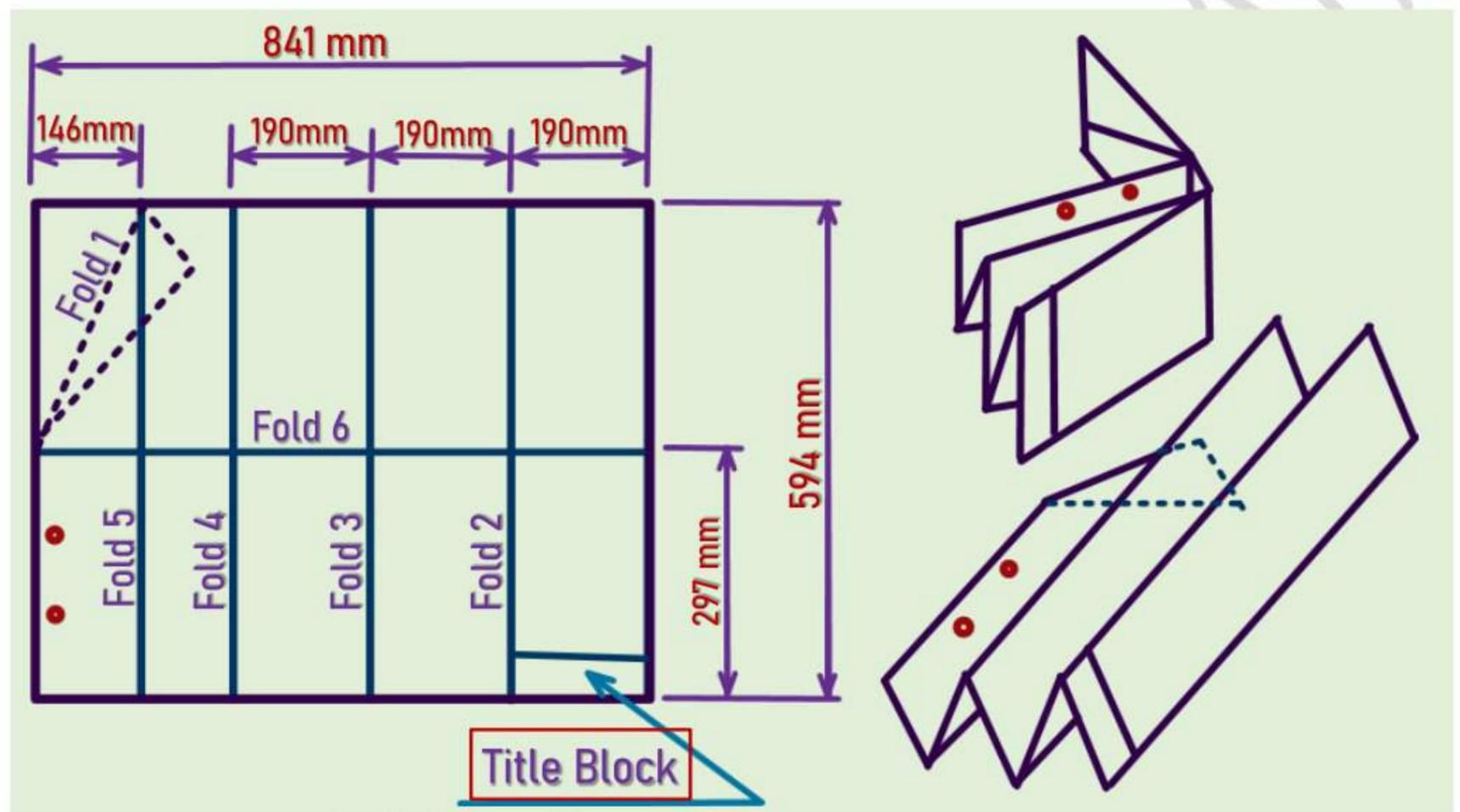


Fig: Sheet Folding

The method of folding sheets is standardized according to **Bureau of Indian Standards (BIS): IS 1847 (Part I): 1971** and **IS 10711: 2001** – (Technical drawings – Sizes and layout of drawing sheets).

Step-by-Step Folding Method

For A1 Sheet (594 × 841 mm):

Folding to A4 (210 × 297 mm):

1. **Step 1:** Fold from **right to left** vertically into 4 parts of 210 mm each (leaving about 1 cm extra for binding edge).
2. **Step 2:** Then fold **horizontally from bottom to top** into 2 parts of 297 mm each.
3. **Result:** Title block should appear on the **front side, lower right corner**.

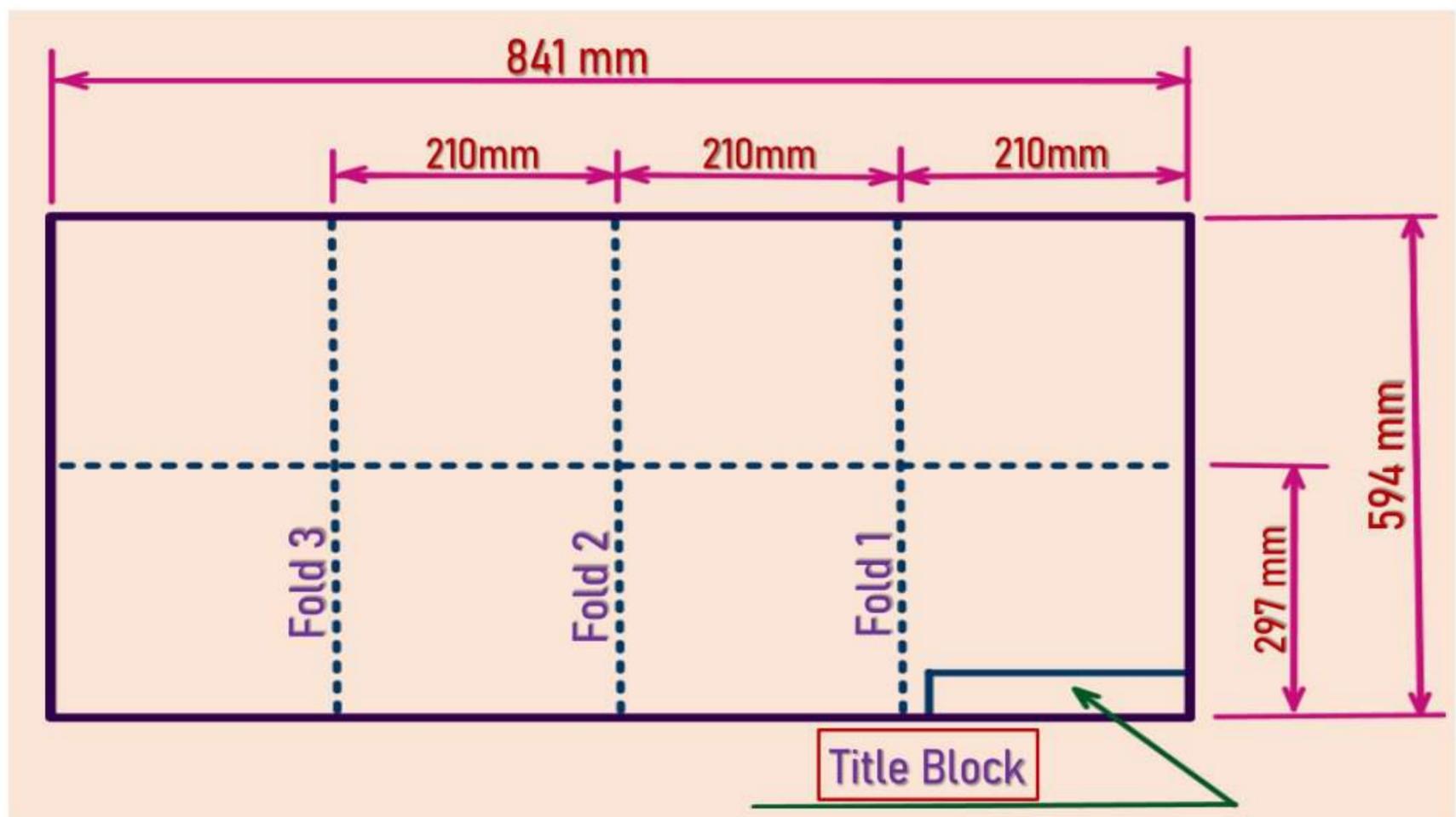


Fig: Sheet Folding

For A2 Sheet (420 × 594 mm):

Folding to A4 (210 × 297 mm):

1. **Step 1:** Fold from **right to left** vertically into one 210 mm parts and one 180 mm part. (leaving about 1 cm extra for binding edge).
2. **Step 2:** Then fold **horizontally from bottom to top** once into 297 mm height.
3. **Result:** Title block should appear on the **front side, lower right corner**.

Different Types of Lines in Engineering Drawing

Introduction

Lines are the most fundamental element in engineering drawing. They represent the **shape, size, form, and details** of an object. Every engineering drawing is made up of different types of lines, each having a specific meaning and purpose.

To ensure uniformity and clarity, **different line types, thicknesses, and styles** are standardized according to **BIS (Bureau of Indian Standards)** or **ISO standards**.

Types of Lines

Lines are the most basic and important element in engineering drawing. They are used to represent **shapes, features, edges, and details** of an object accurately.

Each line type has a **specific meaning, thickness, and purpose**, standardized by **BIS (Bureau of Indian Standards) – IS:10714 and IS:962**.

Lines in engineering drawing are mainly classified by.

1. **Type of line (appearance)** – solid, dashed, chain, etc.
2. **Thickness** – thick, medium, or thin.

1. Continuous Thick Line (Visible or Object Line)

Appearance: Continuous and thick.

Thickness: 0.5 mm to 0.7 mm (thickest line).

Purpose:

- Represents **visible edges** and **outlines** of objects.
- Used to show the **shape and boundary** that can be seen from a given view.

Example: Outer edges of a mechanical part.

2. Continuous Thin Line

Appearance: Continuous and thin.

Thickness: 0.25 mm or less.

Purpose:

- For **dimension lines, extension lines, projection lines, leader lines, and hatching.**
- Used in **construction lines** (light lines drawn temporarily).

Example: Dimension and projection lines in an orthographic drawing.

3. Continuous Thin Freehand Line

Appearance: Thin, irregular (drawn freehand).

Purpose:

- Represents **short break lines** — used to show a break in a part to reveal interior details without drawing the whole object.

Example: Showing broken portions of shafts or pipes.

4. Dashed Thick Line (Hidden Line)

Appearance: Short dashes of uniform length and spacing.

Thickness: Same as visible line (thick).

Purpose:

- Shows **edges, surfaces, and features that are not visible** in a particular view.
- Always drawn behind visible edges.

Example: Hidden holes or internal parts.

5. Chain Thin Line (Center Line)

Appearance: Long dash followed by a short dash.

Thickness: Thin (same as dimension line).

Purpose:

- Represents **axes of symmetry, center of circles, paths of motion, etc.**

Example: Axis of holes, cylinders, or symmetrical objects.

6. Chain Thin Line with Thick Ends (Cutting Plane Line)

Appearance: Long and short dashes, thick at ends or where it turns.

Purpose:

- Indicates the **location of a sectional plane** (where an object is imagined to be cut to show internal details).
- Ends are labeled (e.g., **A-A, B-B**).

Example: Sectional view in machine drawing.

7. Chain Thin Double-Dashed Line (Pitch or Alternate Position Line)

Appearance: Long dash, two short dashes, repeating.

Purpose:

- Used to show **adjacent positions of moving parts** or **alternate outlines**.
- Also used to indicate **pitch circles** in gears. **Example:** Showing the rotation path of a lever.

8. Continuous Thin Zigzag Line (Long Break Line)

Appearance: Thin zigzag (or sometimes ruled wavy line).

Purpose:

- Used to show a **long break** in an object where the central portion is omitted.

Example: Long pipes, rods, or beams drawn shortened.

9. Chain Thick Line (Indication of Surfaces or Limits)

Appearance: Long dash and short dash pattern, thick.

Purpose:

- Used for **indicating special surfaces** such as those to be finished, machined, or treated.

Example: Surface to be machined in a part drawing.

10. Phantom Line (Reference or Imaginary Line)

Appearance: Alternating long and two short dashes.

Purpose:

- Shows **repeated details, paths of motion, or positions of related parts.**

Example: Open and closed positions of a valve or door.

Types of Lines in Engineering Drawing (with Explanation)

S.NO.	TYPES OF LINE	REPRESENTATION	PURPOSE/NAME/ USE	DESCRIPTION & APPLICATION
1	Continuous Thick Line		Visible or Object Line	Used for all visible outlines and edges of an object. It shows the shape of the component.
2	Continuous Thin Line		Projection Line, Dimension Line, Leader Line, Hatching Line	Used for dimensioning, projection, extension, and for section lining (hatching).
3	Continuous Thin Freehand Line		Short Break Line	Used to show a short break where the object continues but the detail is not necessary.
4	Continuous Thin Zig-Zag Line		Short Break Line	Used to show a short break where the object continues but the detail is not necessary.
5	Dashed Thin Line		Hidden Line or Invisible Line	Represents hidden edges and features not directly visible in that view
6	Chain Thin Dash - Dot Line		Center Line	Represents the axis of symmetry, center of circles, arcs, and cylindrical parts.
7	Chain Thin Double Dashed - Dot Line		Ghost Line / Pitch Circle Line	Used to represent paths of motion, adjacent positions of parts, or pitch circles in gears.
8	Chain Thick Ends Double Dash - Dot Line		Cutting Plane Line	Indicates the location where an imaginary section is taken to show the interior details.

Line Thickness Classification (by BIS)

TYPE OF LINE	THICKNESS	EXAMPLE USE
Thick Line	0.5 mm - 0.7 mm	Visible outline, cutting plane
Medium Line	0.35 mm - 0.5 mm	Hidden edges
Thin Line	0.18 mm - 0.25 mm	Dimensions, hatching, center lines

Note: The ratio of thick to thin line should be approximately 2:1.

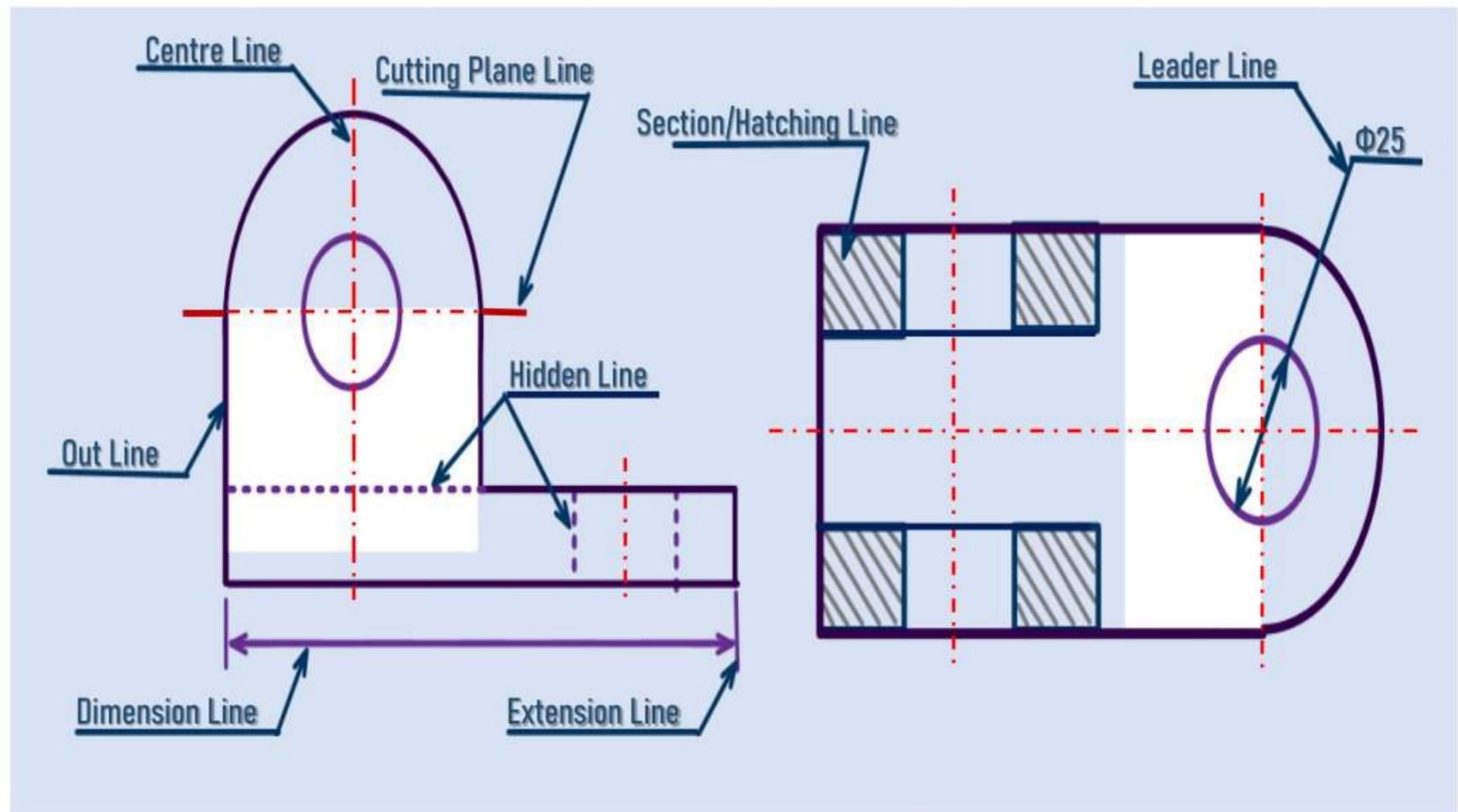


Fig: Different Types of Lines

General Guidelines

- Always maintain **line hierarchy**: visible > hidden > center.
- Lines should be **clearly distinguishable** in a drawing.
- Line spacing and dashes should be **uniform and consistent**.
- Avoid overcrowding — clarity is more important than decoration.
- Brings **clarity** and **uniformity** to drawings.
- Helps avoid **misinterpretation** of details.
- Makes drawings **readable** and **professional**.
- Essential for **communication** in technical and industrial environments.

Purpose of Using Different Lines

- To show **visible edges and outlines**.
- To represent **hidden or invisible edges**.
- To indicate **center lines, cutting planes, and sections**.
- To mark **dimensions, projections, and construction lines**.
- To make the **drawing easy to read and interpret**.

type of line used in Engineering Drawing:

1. Out Line (Visible Line)

- **Definition:** Thick and dark continuous line used to represent the visible edges and boundaries of an object.
- **Purpose:** Shows the shape and main features of an object that can be seen from a particular view.
- **Line type:** Continuous thick line.

2. Margin Line

- **Definition:** A line drawn parallel to the edges of the drawing sheet, usually on the left-hand side, to keep space for binding and notes.
- **Purpose:** Separates the drawing area from the margin (used for title block, notes, or numbering).
- **Line type:** Continuous thin line.

3. Dimension Line

- **Definition:** Thin continuous line with arrowheads at both ends, used to indicate the **extent and direction of a dimension**.
- **Purpose:** Shows the actual size of the object (length, width, height, diameter, etc.).
- **Line type:** Continuous thin line with arrowheads.

4. Extension (Projection) Line

- **Definition:** Thin continuous line drawn from the object to define the limits of a dimension.
- **Purpose:** Extends from the object outline to the dimension line to indicate the points between which the dimension applies.
- **Line type:** Continuous thin line, slightly beyond the dimension line.

5. Construction Line

- **Definition:** Very light and thin continuous line used as a guide for drawing or locating other lines and features.
- **Purpose:** Helps in constructing drawings accurately, usually erased after final lines are drawn.
- **Line type:** Continuous very thin line.

6. Hatching (Section) Line

- **Definition:** Thin and equally spaced inclined lines used on sectional views to represent the cut surface of an object.
- **Purpose:** Indicates material that has been cut in a sectional view.
- **Line type:** Continuous thin lines drawn at 45° angle.

7. Leader (Pointer) Line

- **Definition:** Thin continuous line with an arrowhead at one end and a note or dimension at the other.
- **Purpose:** Used to point out a specific feature or give a note, dimension, or part name.
- **Line type:** Continuous thin line ending with an arrow or dot.

8. Border Line

- **Definition:** Thick continuous line drawn close to the edges of the drawing sheet.
- **Purpose:** Forms the boundary of the usable drawing space.
- **Line type:** Continuous thick line (thicker than outline).

9. Short Break Line

- **Definition:** Thick, wavy, freehand line used to show that a part of the object is removed or not drawn completely.
- **Purpose:** Represents a break in an object where details are not needed.
- **Line type:** Freehand thick wavy line.

10. Long Break Line

- **Definition:** Thin straight line with zigzag or jagged interruptions.
- **Purpose:** Used to indicate a long uniform part that is broken in the middle to shorten the view.
- **Line type:** Thin line with zigzag breaks.

11. Hidden (Dotted) Line

- **Definition:** Medium thick line made of short dashes.
- **Purpose:** Represents edges, surfaces, or features **not visible** in the current view.
- **Line type:** Short dashed line (--- --- ---).

12. Centre Line

- **Definition:** Thin line made up of long and short dashes alternately (— · — · —).
- **Purpose:** Indicates the **axis of symmetry, centre of holes, cylindrical parts, or paths of motion.**
- **Line type:** Alternating long and short dashes, thin line.

DIMENSIONING IN ENGINEERING DRAWING

Introduction

In engineering drawing, **dimensioning** is the process of indicating the **size, shape, and other details** of an object on a drawing. It provides all the necessary measurements (length, width, height, diameter, angle, etc.) required to manufacture or inspect a component accurately.

Without proper dimensioning, a drawing cannot be interpreted or used for production.

Definition

Dimensioning is the process of adding numerical values (called dimensions) and symbols on a drawing to define the size, form, and position of different features of an object.

In simple words:

Dimensioning means writing the measurements and directions on a drawing using specific lines and symbols.

Dimensioning = Size + Location + Notes + Symbols (All in a clear and standardized form)

Purpose of Dimensioning

- To communicate **exact size and shape** of an object.
- To show **location and relationship** between different parts.
- To ensure **accuracy** in manufacturing and inspection.
- To maintain **standardization** of technical drawings.

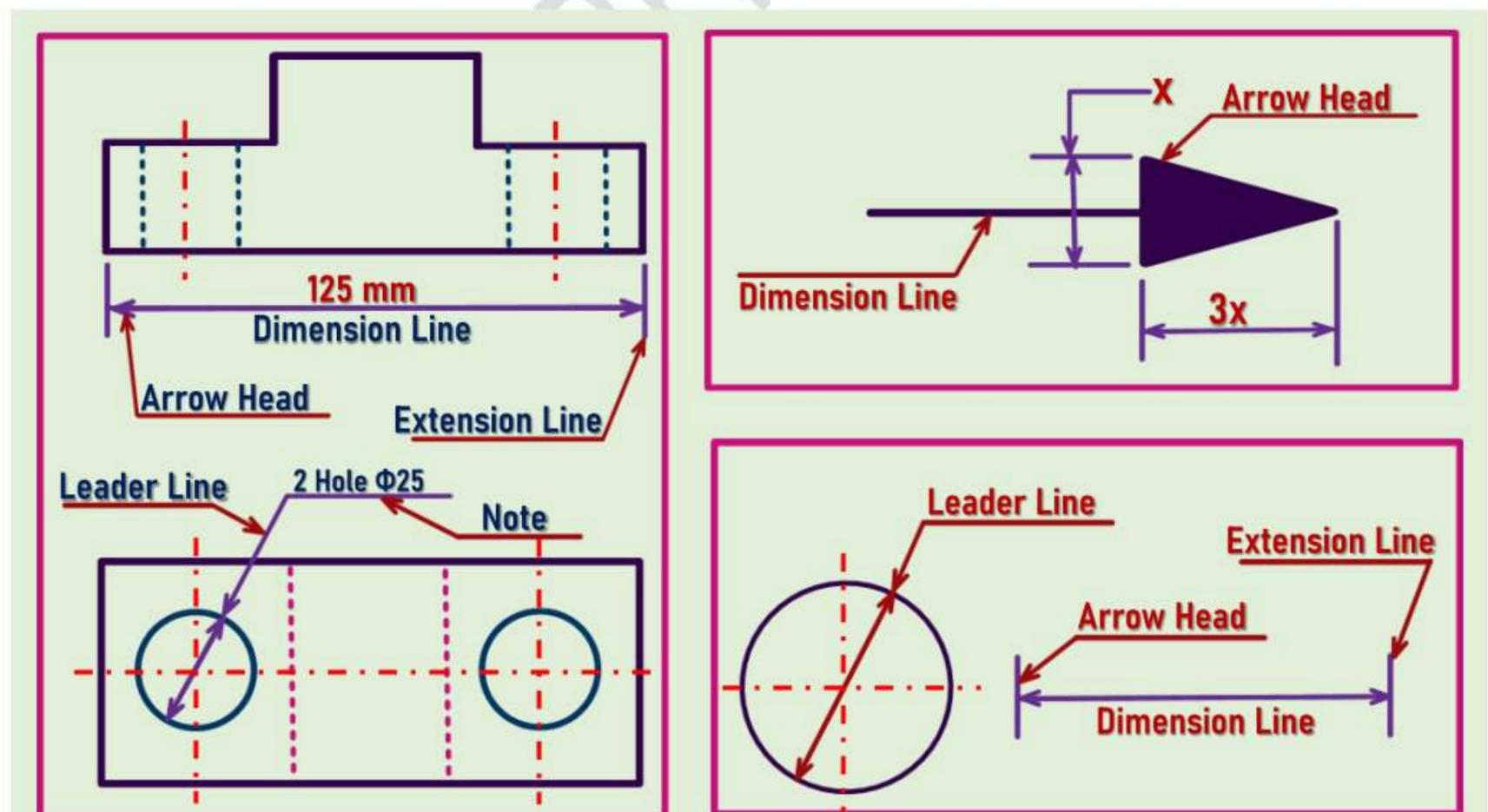


Fig: Dimensioning Lines

Dimensioning Lines

There are several lines used in dimensioning. The most important are:

TYPE OF LINE	DESCRIPTION / FUNCTION
Dimension Line	Shows the distance being measured. Arrows are placed at both ends, and the dimension value is written above the line.
Extension (Projection) Line	Extends from the object to define the limits of the dimension line. It should not touch the object line.
Leader or Pointer Line	Used to indicate a note, radius, or diameter. It ends with an arrowhead pointing to the feature.

Types of Dimensioning

Dimensioning can be classified based on the way measurements are arranged on the drawing.

(A) Chain Dimensioning

- All dimensions are placed one after another in a straight line.
- Used when **overall accuracy is not very critical**.
- Example: Used in machining small parts.

(B) Parallel Dimensioning / Progressive Dimensioning (Baseline Dimensioning)

- All dimensions are taken from a **common reference line or datum line**.
- Used when **accuracy** is important.
- Dimensions are measured **from one end** of an object successively.
- Commonly used in **architectural drawings**.

(C) Combined Dimensioning

- It is a **combination of chain and parallel** dimensioning for complex shapes.

(E) Coordinate Dimensioning

- Used in **CNC or CAD drawings** where every feature is defined by **X and Y coordinates** from a fixed reference.

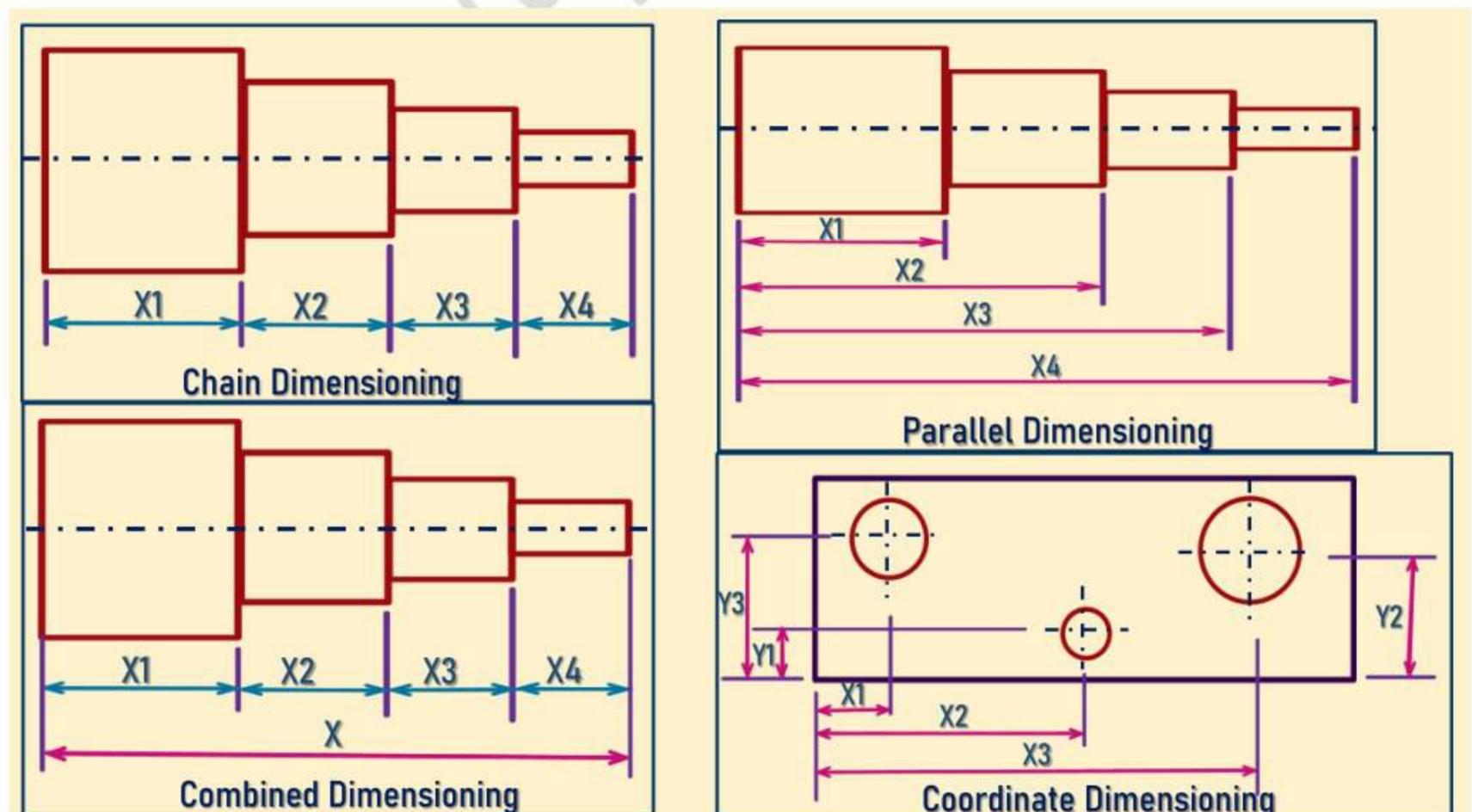


Fig: Types Of Dimensioning

Arrowhead

Introduction:

In engineering drawing, an **arrowhead** is a small pointed mark used at the end of **dimension lines**, **leader lines**, or **extension lines** to show the **limit or direction of a dimension**. It helps to clearly indicate **where a dimension starts and ends** on a drawing.

Definition:

An **arrowhead** is a **narrow, pointed symbol** placed at each end of a **dimension line or leader line** to indicate the **extent or direction** of the dimension.

Proportions (as per BIS SP:46 – 2003):

- **Length of arrowhead (L):** about **3 times** the thickness of the dimension line.
- **Width of arrowhead (W):** about **1/3** of its length.
- The included angle at the tip is usually **15° to 20°**.

Example:

If the line thickness = 0.3 mm →

then arrowhead length = 0.9 mm, width = 0.3 mm.

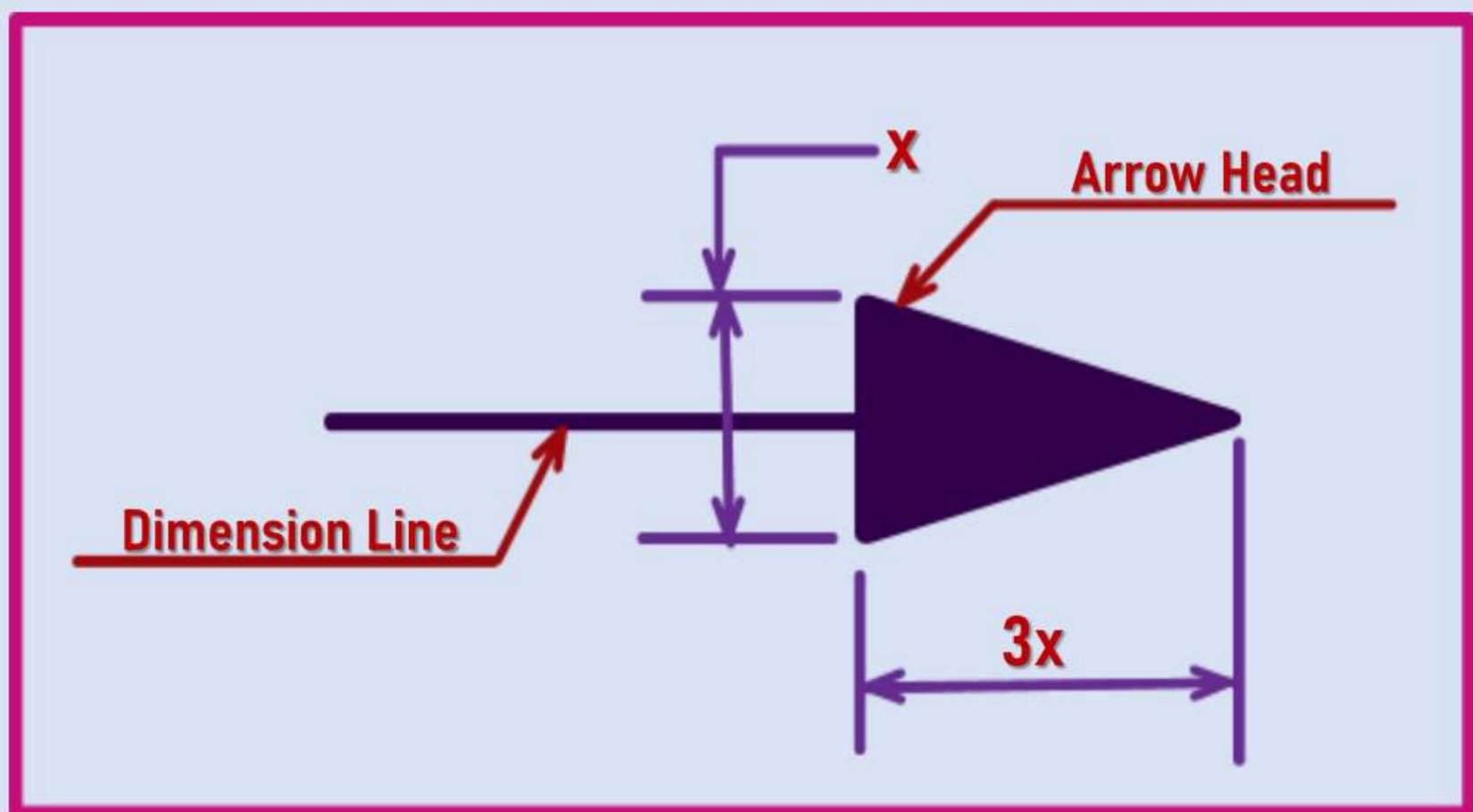


Fig: Arrow Head

Shape of Arrowheads:

Arrowheads can be of various shapes depending on the drawing style, such as:

1. **Closed and filled (solid) arrowhead** – Commonly used in most engineering drawings.
2. **Open arrowhead** – Outline only, not filled.
3. **Slash (oblique stroke)** – A simple angled line used when space is limited.

System of Placing Dimensioning

The **System of Dimensioning** refers to how the **numbers (values)** are written on a drawing.

System of Dimensioning is the method or standard used for **placing and reading dimension values** (numerical measurements) on a drawing.

In simple words:

It means the **way or direction** in which the dimension numbers (sizes) are written on a technical drawing.

Purpose of Dimensioning System

The main purpose of using a proper dimensioning system is:

- To make the drawing **clear and easy to read**.
- To maintain **uniformity and standardization** in engineering drawings.
- To **avoid confusion** during manufacturing or inspection.
- To ensure that **all engineers, machinists, and designers** can interpret the drawing correctly.

Placement of Dimensions (General Rules)

- Avoid crowding of dimensions.
- Place dimensions **outside** the view if possible.
- Dimensions should **not be repeated**.
- Write dimensions **clearly** and **neatly**.
- Do not dimension hidden lines.
- Maintain uniform **font size and line thickness**.

Types of Dimensioning Systems

There are **two main systems** of dimensioning used in engineering drawing:

(1) Unidirectional System

Definition:

In this system, **all dimensions are written in one direction only**, generally **horizontal**, so that they can be read from the **bottom of the drawing sheet**.

- All dimensions are written **in one direction**, usually **horizontal**.
- Easy to read on machine drawings.
- Commonly used in modern engineering drawings.
- Dimension always written in between mid of dimension line.

Explanation:

- All dimension figures face **one direction** (usually left to right).
- The **dimension lines** may be at any angle, but the **numbers** are always horizontal.
- Most commonly used in **mechanical and industrial drawings**.

Advantages:

- Easy to read and write.
- Neat and uniform appearance.
- Reduces chances of reading errors.
- Recommended by **BIS (Bureau of Indian Standards)** and **ISO**.

(2) Aligned System

Definition:

In this system, **dimensions are written parallel to their dimension lines**, and can be read from the **bottom or right-hand side** of the drawing sheet.

- Dimensions are written **parallel to the dimension line**.
- They are read from the **bottom or right-hand side** of the drawing.
- Commonly used in architectural drawings.

Explanation:

- The **dimension figures are aligned** (tilted) with the **dimension lines**.
- If the line is **horizontal**, the number is read from the **bottom**.
- If the line is **vertical or inclined**, the number is read from the **right side**.
- Commonly used in **architectural and civil drawings**.

Advantages:

- Looks natural and aesthetic.
- Convenient for freehand and architectural sketches.
- Easy to read from multiple directions.

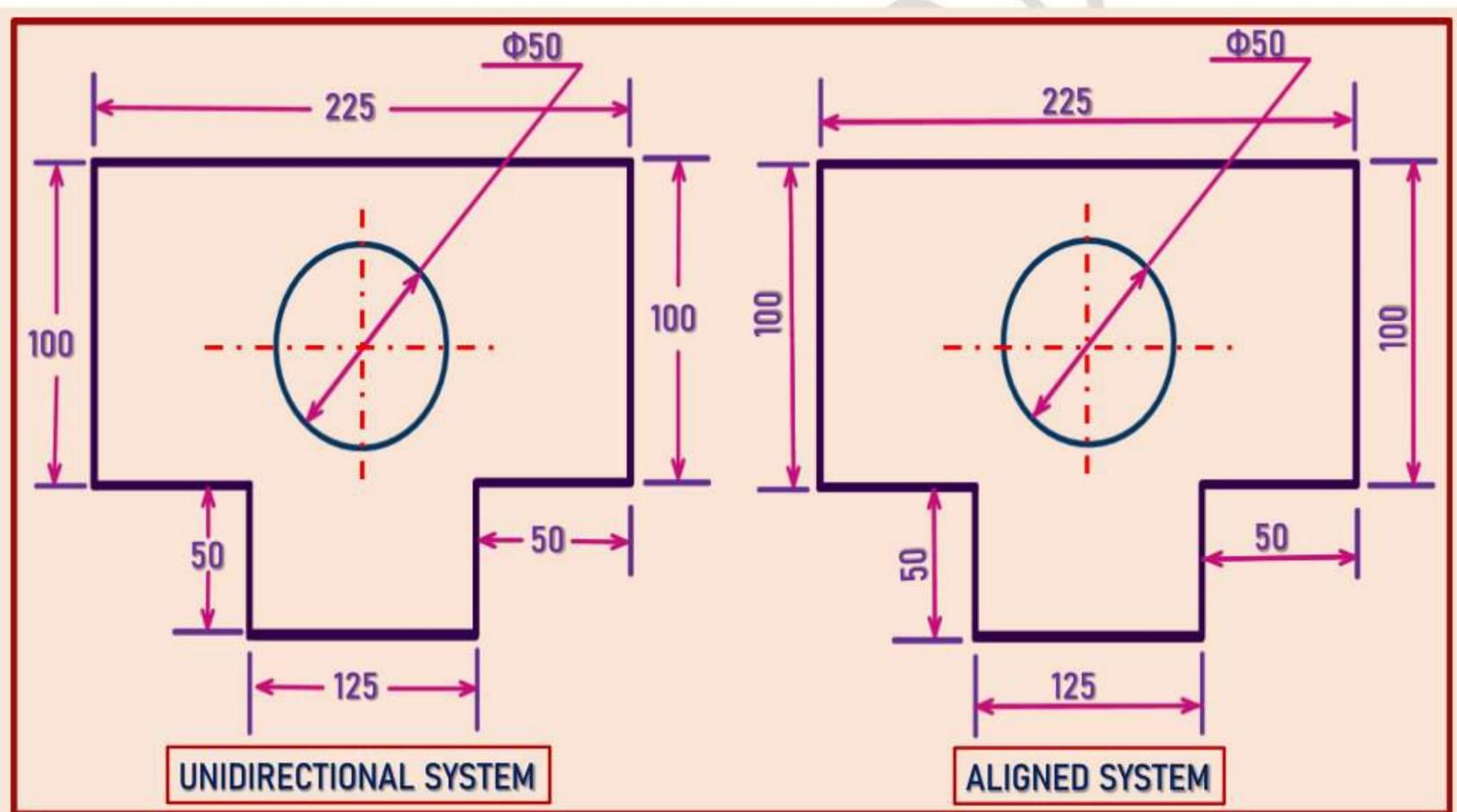


Fig: System Of Dimensioning

Difference between Unidirectional and Aligned Systems

Point of Difference	Unidirectional System	Aligned System
Direction of Dimensions	All numbers written in one (horizontal) direction	Numbers written parallel to their dimension lines
Reading	Always from bottom of sheet	From bottom or right-hand side
Appearance	Neat, uniform, easy to read	Looks natural and artistic
Commonly Used In	Mechanical and industrial drawings	Architectural and civil drawings
Standardization	Recommended by BS & ISO	Used for illustrative sketches

Projection in Engineering Drawing

Introduction

Projection is one of the most important concepts in **Engineering Drawing**.

It is a **method of representing a three-dimensional object** on a **two-dimensional object** or a **Plane (paper or screen)** by using **imaginary lines called projectors**.

In engineering, projection is used to **accurately visualize, draw, and communicate** the shape and size of an object.

Definition

Projection is defined as:

The representation of an object on a plane (called the plane of projection) by means of projectors drawn from the object to the plane.

In simple terms:

Projection is the **shadow or image** of an object formed on a plane when light (or imaginary rays) is projected from the object.

Basic Concept of Projection

The basic concept involves three main elements:

1. **Object** – The item to be projected or represented.
2. **Projectors or Projection Line** – The imaginary straight lines drawn from every point on the object to the plane of projection.
3. **Plane of Projection** – The surface (usually a paper or screen) on which the projection or image of the object is obtained.

When projectors from the object meet the plane, they form the **projection of the object**.

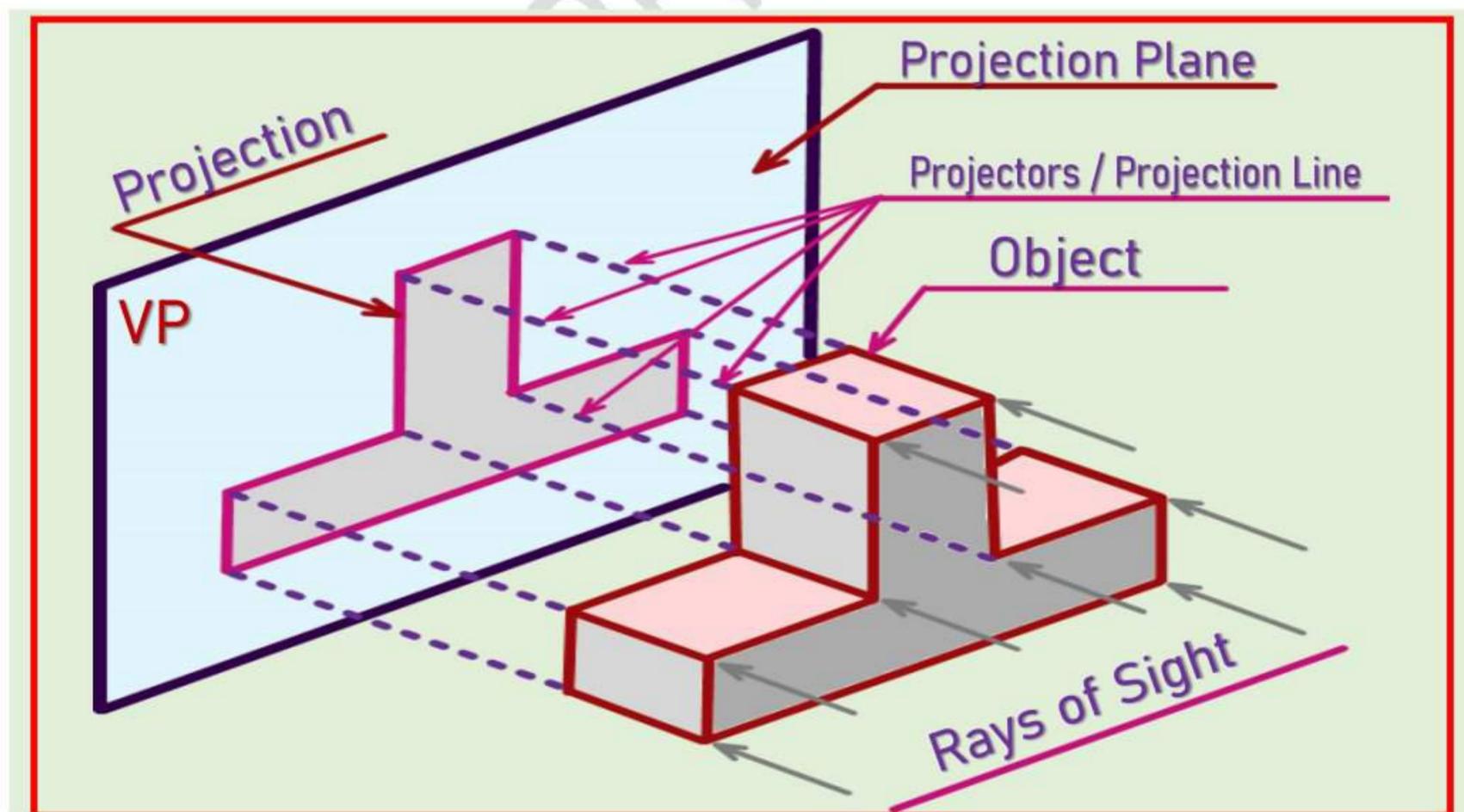


Figure: Projection Of an Object

Elements of Projection

1. **Projectors or Projection Line** – Imaginary lines joining the object and the plane of projection.
2. **Projection Plane** – The plane on which projection is obtained, (HP, VP, PP)
3. **Reference Line (XY line)** – The line of intersection between two planes of projection (used in orthographic projection).
4. **View** – The image of the object seen from a particular direction.

Planes of Projection

In orthographic projection, two main planes are used:

1. **Horizontal Plane (HP)** – Represents the top view of an object.
2. **Vertical Plane (VP)** – Represents the front view of an object.

These two planes intersect at the **XY line (Reference Line)**.

Sometimes a **Side or Profile Plane (PP)** is also used for the side view.

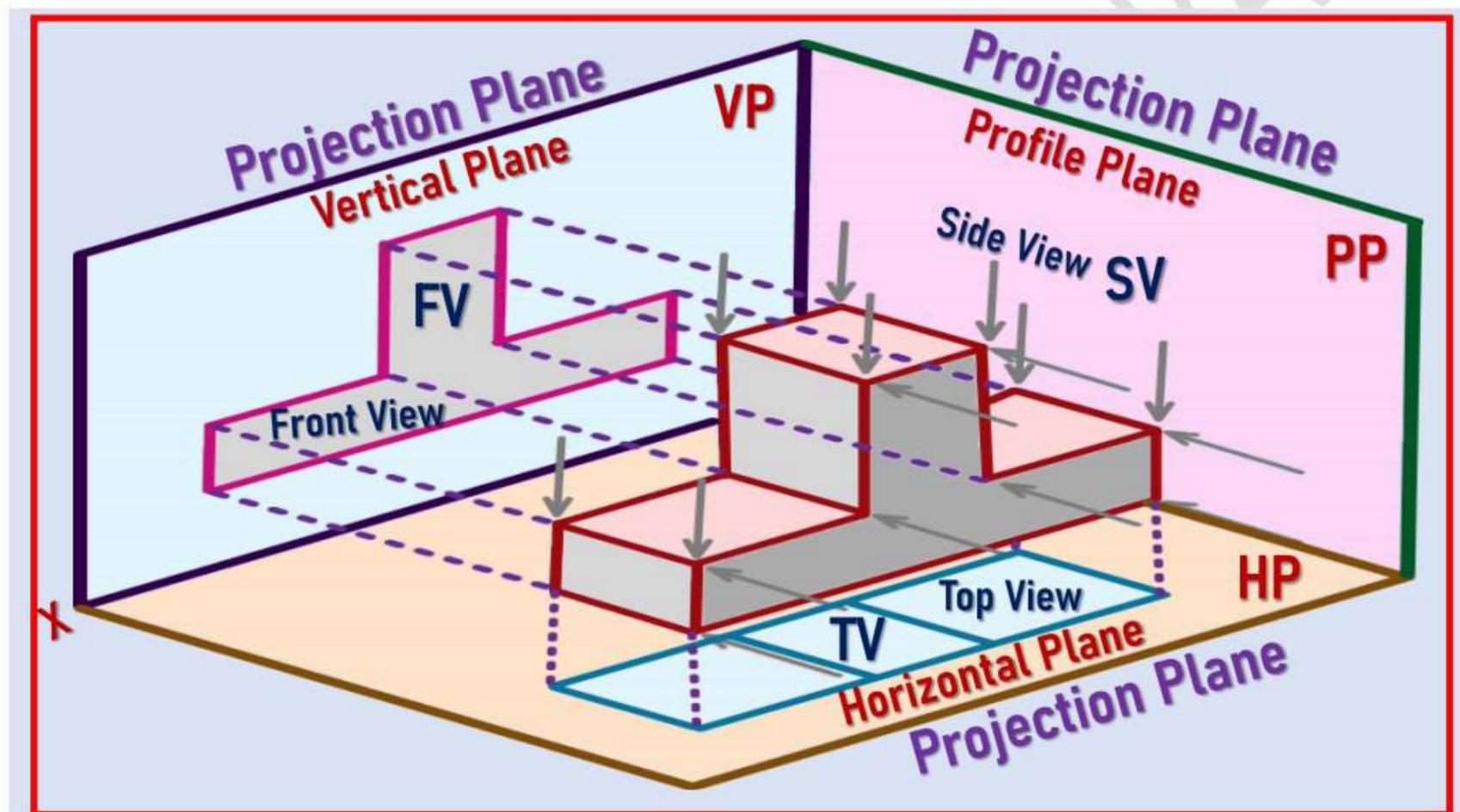


Figure: Projection and Projection Plane

Quadrants in Projection

When HP and VP intersect, they divide the space into **four quadrants**:

S.NO.	Quadrant	Object Position
1	First Quadrant	Object above HP and in front of VP
2	Second Quadrant	Object above HP and behind VP
3	Third Quadrant	Object below HP and behind VP
4	Fourth Quadrant	Object below HP and in front of VP

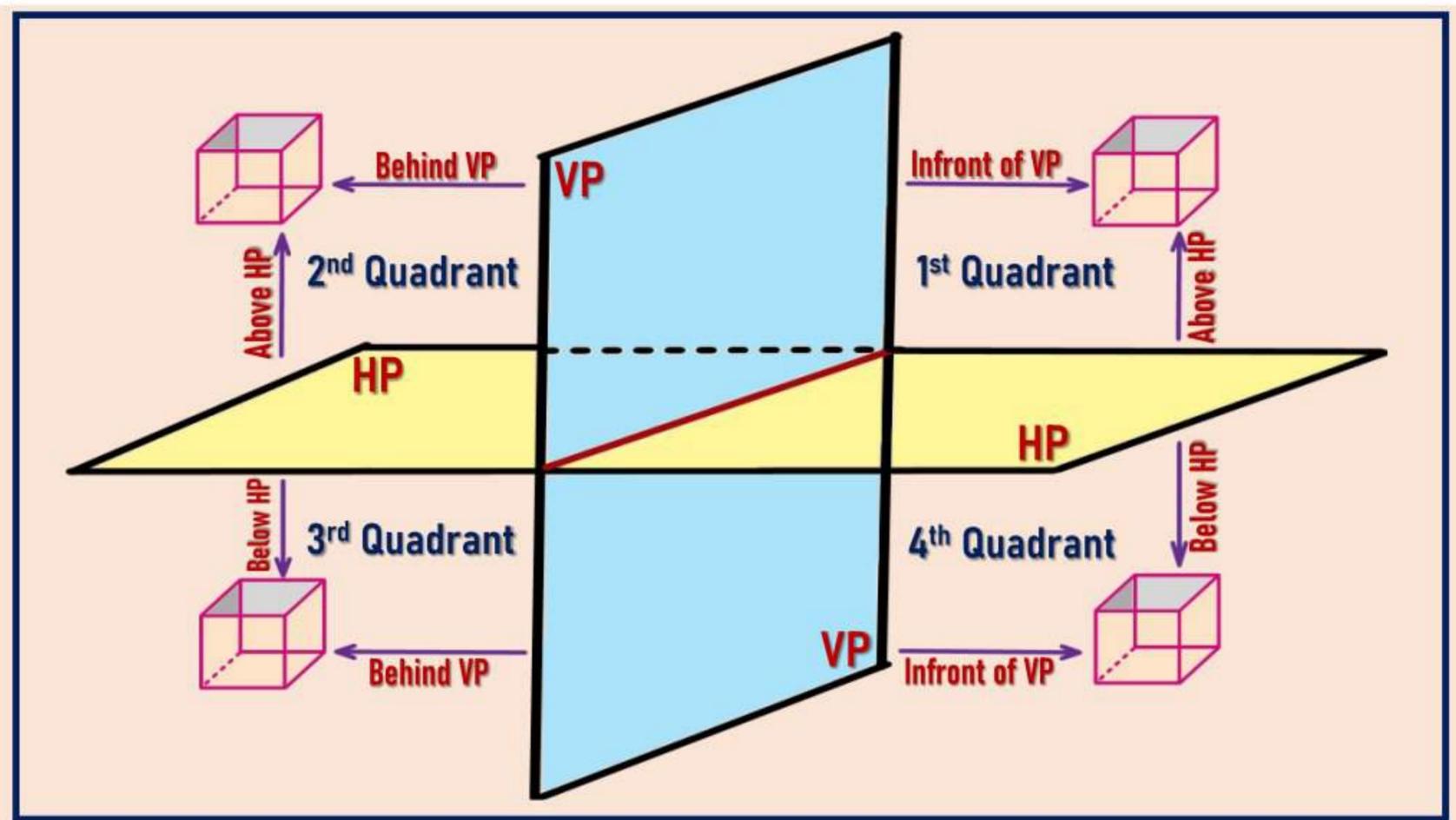


Figure: Quadrant System

Types of Orthographic Projection Methods

(a) First Angle Projection

- Object lies in the **first quadrant**.
- Object is **between the observer and the plane of projection**.
- Views are arranged as:
 - **Top view** → below front view
 - **Right side view** → left of front view

(b) Third Angle Projection

- Object lies in the **third quadrant**.
- Plane of projection is **between the observer and the object**.
- Views are arranged as:
 - **Top view** → above front view
 - **Right side view** → right of front view

In engineering drawing, we mainly use:

- **First Angle Projection** (Europe, India, Asia)
- **Third Angle Projection** (U.S.A, Canada)

Applications of Projection

- Used to create **engineering and architectural drawings**
- Helps in **visualizing the shape, size, and position** of components
- Used in **mechanical, civil, and electrical design**
- Essential for **manufacturing and construction** processes

Advantages of Projection

- Provides **accurate information** about object dimensions.
- Helps in **design and assembly** of complex parts.

- Ensures **clear communication** between engineers, manufacturers, and clients.

POINT PROJECTION

Projection of a Point

Introduction

In **Engineering Drawing**, *projection* means representing a three-dimensional object (or point) on a **two-dimensional plane** (the drawing sheet).

When we study the **projection of a point**, we learn how to locate and represent the position of a point in different quadrants with respect to the **reference planes** — the **Horizontal Plane (HP)** and the **Vertical Plane (VP)**.

Definition

It is the method of representing the position of a point with respect to the **reference planes (HP and VP)** on the drawing sheet, using **projectors** (imaginary perpendicular lines) and **reference line (XY line)**.

In simple terms:

“The projection of a point is the image or representation of that point on the reference planes (**HP and VP**).”

Concept of Projection of Point

To understand projections, consider two **imaginary perpendicular planes**:

- **Vertical Plane (VP)**: The plane in front of the observer — used to get the **Front View** of a point.
- **Horizontal Plane (HP)**: The plane on which the object rests — used to get the **Top View** of a point.

These two planes intersect each other at a line called the **Reference Line** or **XY Line**.

When these planes are unfolded or rotated into a single plane (the drawing sheet), both the projections — **Front View** and **Top View** — are visible.

Types of Projection of a Point

There are two main projections:

1. **Front View (FV)**: Projection of the point on the **Vertical Plane (VP)**.
 - It is shown **above or below the XY line**.
2. **Top View (TV)**: Projection of the point on the **Horizontal Plane (HP)**.
 - It is shown **below or above the XY line** depending on the quadrant.

Quadrants System in Point Projection

When HP and VP intersect, they divide the space into **four quadrants**:

S.NO.	Quadrant	Point Position
1	First Quadrant	Object above HP and in front of VP
2	Second Quadrant	Object above HP and behind VP
3	Third Quadrant	Object below HP and behind VP
4	Fourth Quadrant	Object below HP and in front of VP

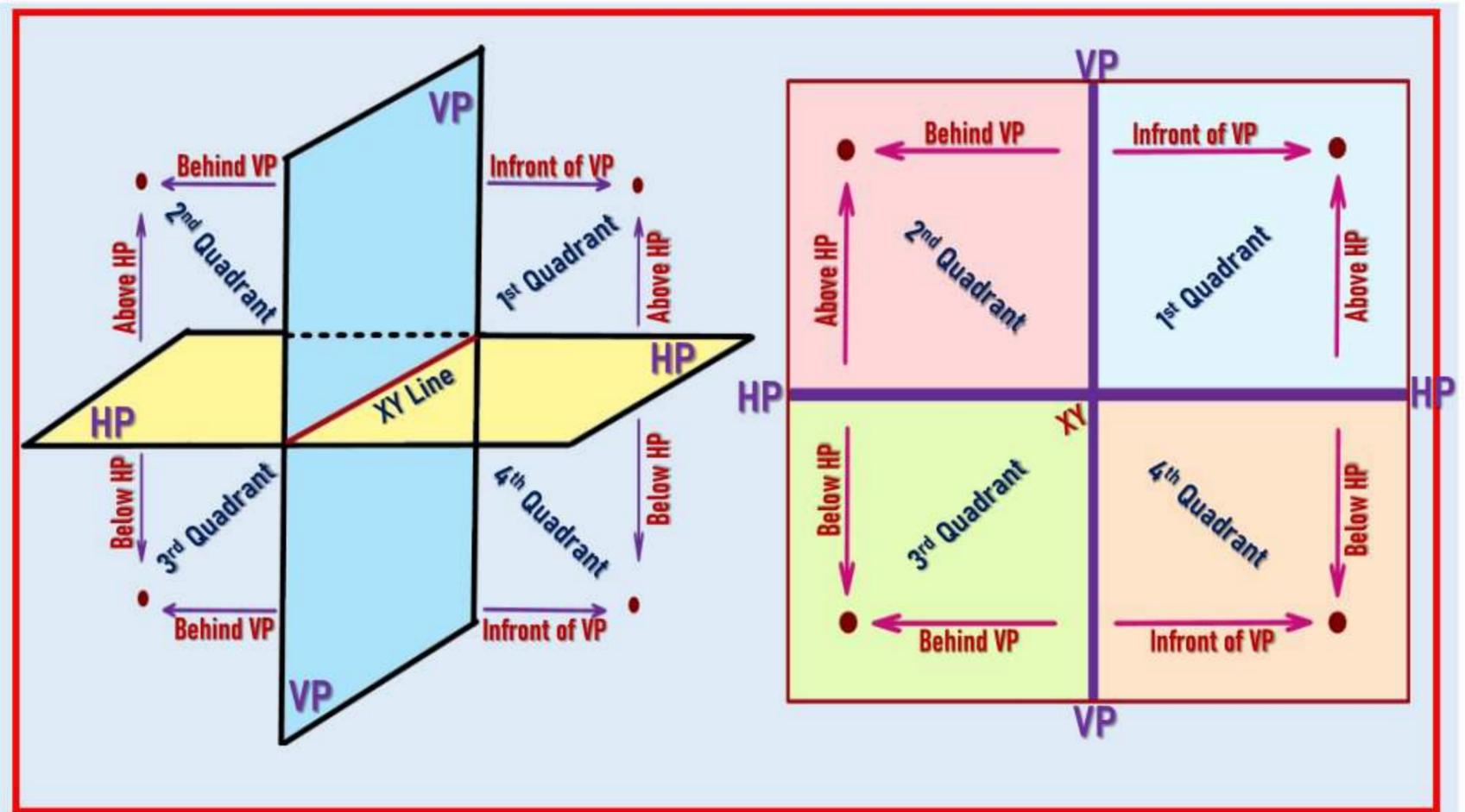


Figure: Quadrant System Location of Point

Projection System

- Observer
- Object
- Projectors
- Projection Plane

Observer

The **observer** is the person who looks at or views the object to obtain its projection on a plane.

In engineering drawing:

- The observer is assumed to look **perpendicular to the projection plane**.
- The direction from the **observer's eye** to the **object** is called the **line of sight** or **direction of projection**.

Example:

When you see a cube placed on a table, **you** are the observer viewing the cube.

Object

The **object** is the actual item or shape whose projection (image or drawing) is to be represented on a plane.

It is the **real 3D body** whose position and shape we want to represent on the **2D drawing sheet**.

Example:

A point, line, plane, or solid (like cube, prism, cone, etc.) used in engineering drawing is the **object**.

Projectors

The **projectors** are the **imaginary straight lines** drawn from the **observer's eye** through the **object** to the **projection plane**.

These projectors help locate the image of the object on the projection plane.

Types of projectors:

- **Parallel Projectors:** All projectors are parallel to each other (used in orthographic projection).
- **Convergent (Central) Projectors:** All projectors meet at a single point (the observer's eye) — used in perspective projection.

Example:

When light rays fall on an object and form its shadow on a wall — those light rays are like **projectors**.

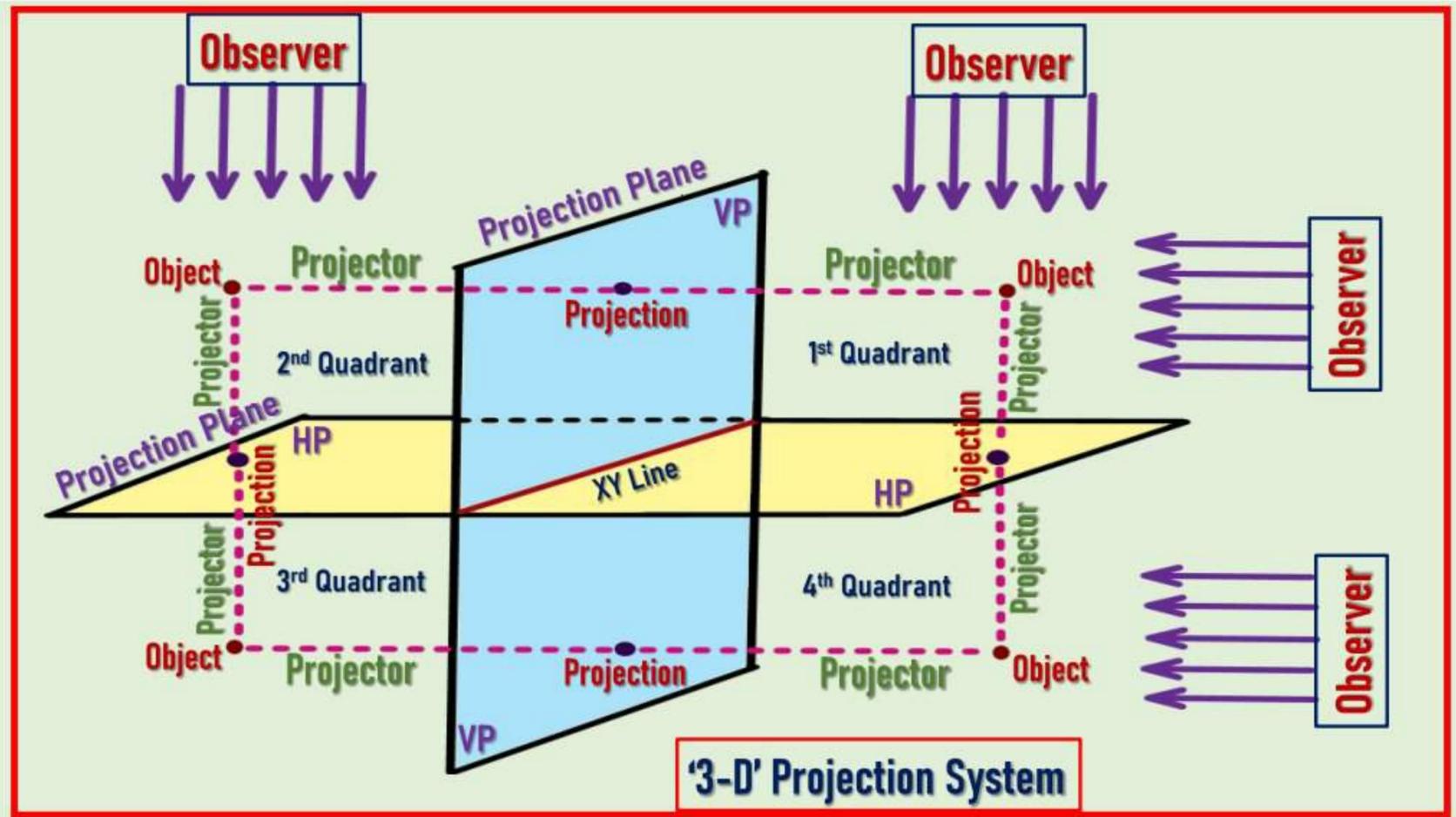


Figure: '3-D' Projection System

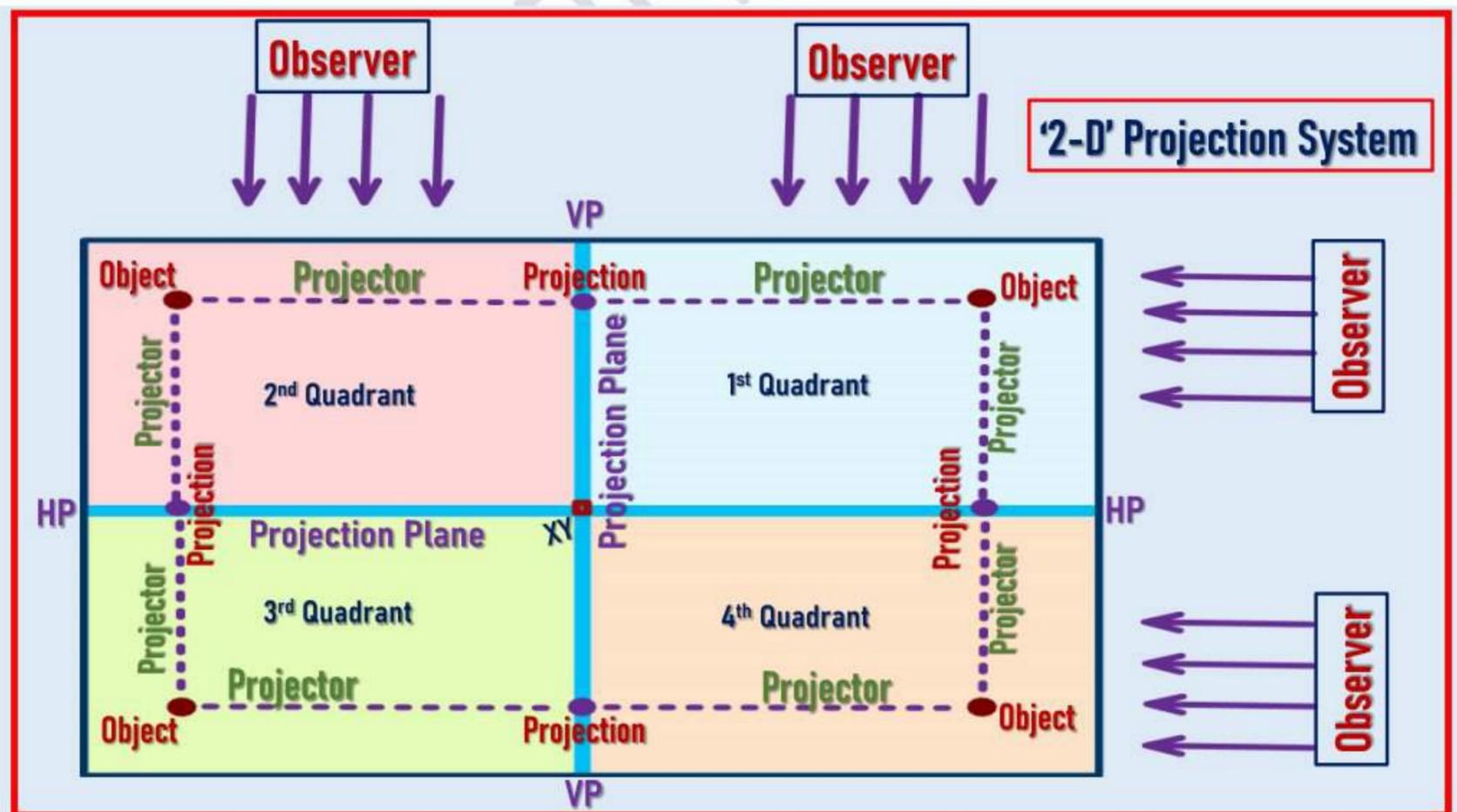


Figure: '2-D' Projection System

Projection Plane (Reference Plane)

The **projection plane** is an **imaginary transparent plane** on which the **image (projection)** of an object is obtained.

In engineering drawing, there are mainly **two principal projection planes**:

1. **Vertical Plane (VP)** → For **Front View**
2. **Horizontal Plane (HP)** → For **Top View**

These two planes intersect along the **XY line (Reference Line)**.

Example:

If a light falls on an object and creates a shadow on a wall, that wall acts as the **projection plane**.

Summary Table

Term	Definition	Example	Related To
Observer	The person who views the object.	Eye of the viewer	Source of projection
Object	The actual 3D item to be projected.	Cube, cone, etc.	The subject of drawing
Projectors	Imaginary lines from observer's eye to the object and plane.	Light rays	Connect observer, object, and plane
Projection Plane	The imaginary plane where projection is formed.	HP, VP	Base for drawing projections

Four Quadrants System in Projection of Points

The space around the intersection of HP and VP is divided into **four quadrants**:

Quadrant	Location of Point	Position of Front View	Position of Top View
1st Quadrant	Above HP and in front of VP	Above XY line	Below XY line
2nd Quadrant	Above HP and behind VP	Above XY line	Above XY line
3rd Quadrant	Below HP and behind VP	Below XY line	Above XY line
4th Quadrant	Below HP and in front of VP	Below XY line	Below XY line

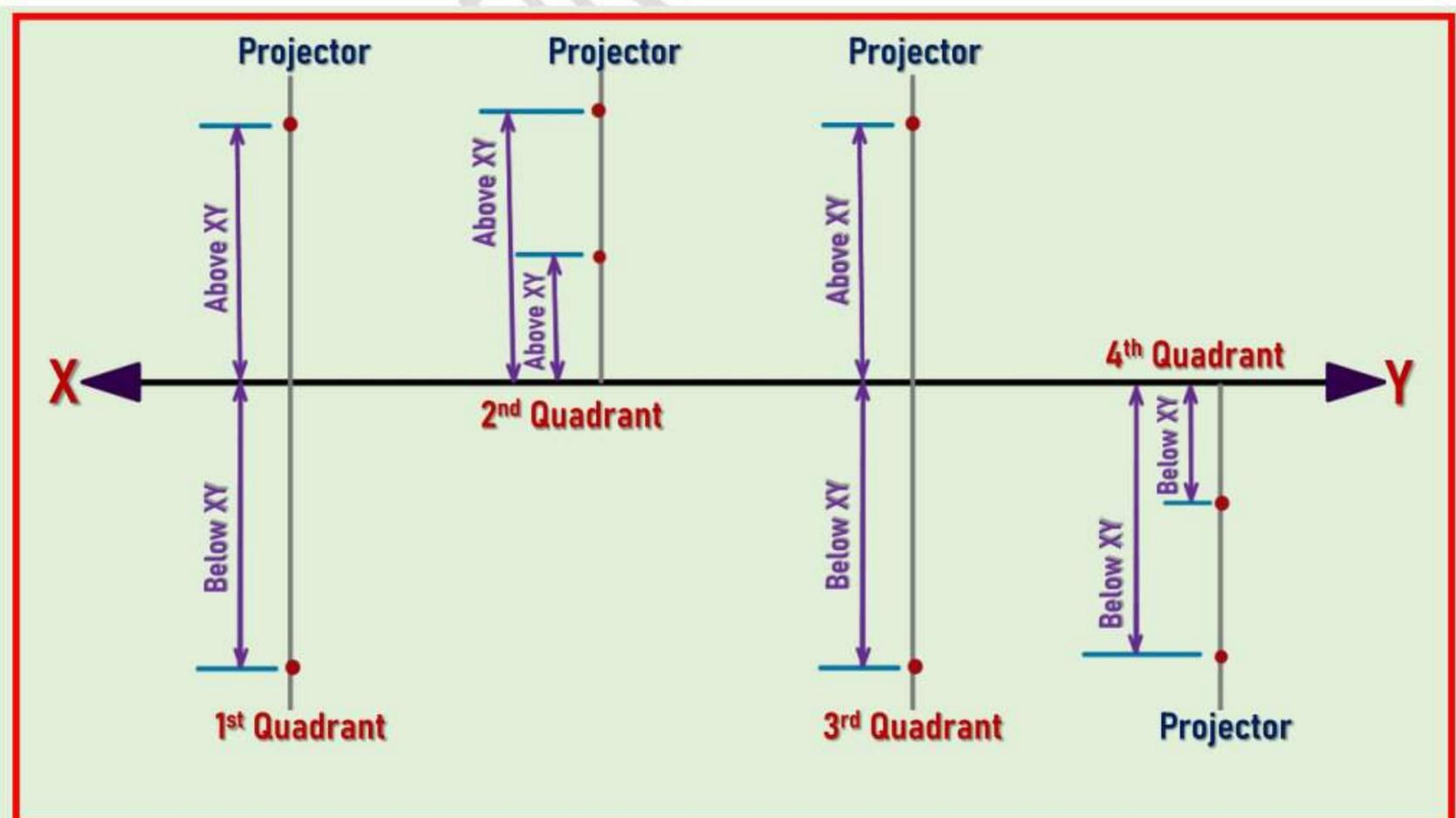


Figure: Projection of Point

Notations Used

Let the point be **P**, and its projections be:

- **p' (P dash)** → Front View of the point (on VP)
- **p (small p)** → Top View of the point (on HP)
- **XY line** → Reference line separating HP and VP

Distance conventions:

- Distance of point **above HP or below HP** → measured perpendicular to XY line (vertical distance).
- Distance of point **in front of or behind VP** → measured perpendicular to XY line (horizontal distance).

Step-by-Step Procedure to Draw Projection of a Point

Let's say a point **P** is located 25 mm above HP and 35 mm in front of VP (1st quadrant).

1. Draw a **horizontal XY line** to represent the intersection of HP and VP.
2. Draw a **projector line** (a light vertical line) perpendicular to XY line.
3. From XY line, mark **25 mm above** for the **Front View (p')**.
4. From XY line, mark **35 mm below** for the **Top View (p)**.
5. Label the points as **P' (Front View)** and **P (Top View)**.
6. Write the actual position:
"Point P, 25 mm above HP and 35 mm in front of VP."

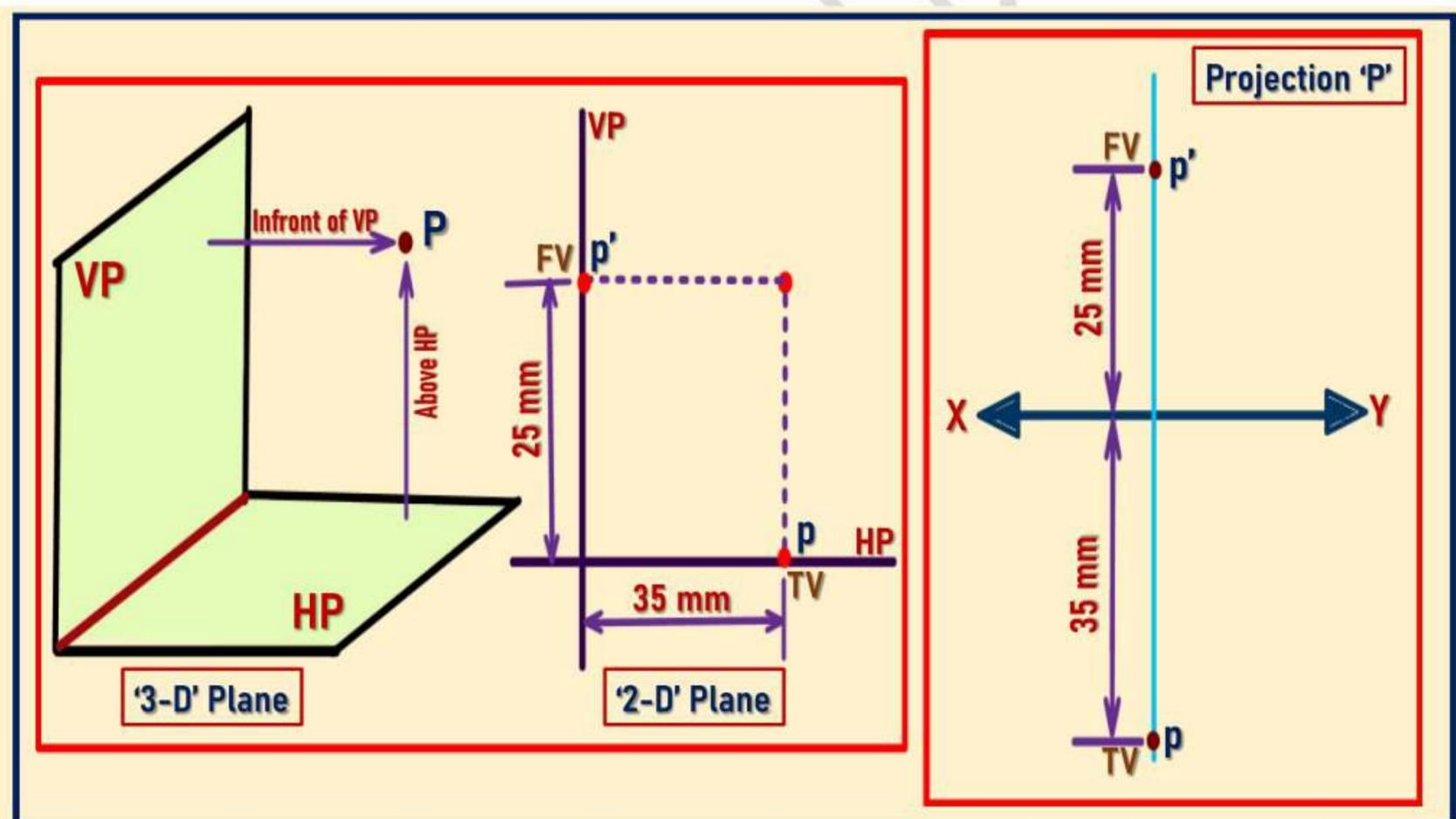


Figure: Above Example of Point Projection

Summary Table

S.NO.	Feature	Description
1	Quadrant	1 st Quadrant
2	Point Position with respect to HP	25 mm Above HP (Horizontal Plane)
3	Point Position with respect to VP	35 mm Infront of VP (Vertical Plane)
4	Front View	25 mm Above XY Line (Reference Line)
5	Top View	35 mm Below XY Line (Reference Line)

Example Problems

S.NO.	Position of Point	Quadrant	FV Position	TV Position
1	30 mm above HP, 40 mm in front of VP	1st	30mm Above XY	40mm Below XY
2	20 mm above HP, 30 mm behind VP	2nd	20mm Above XY	30mm Above XY
3	25 mm below HP, 35 mm behind VP	3rd	25mm Below XY	35mm Above XY
4	15 mm below HP, 45 mm in front of VP	4th	15mm Below XY	45mm Below XY

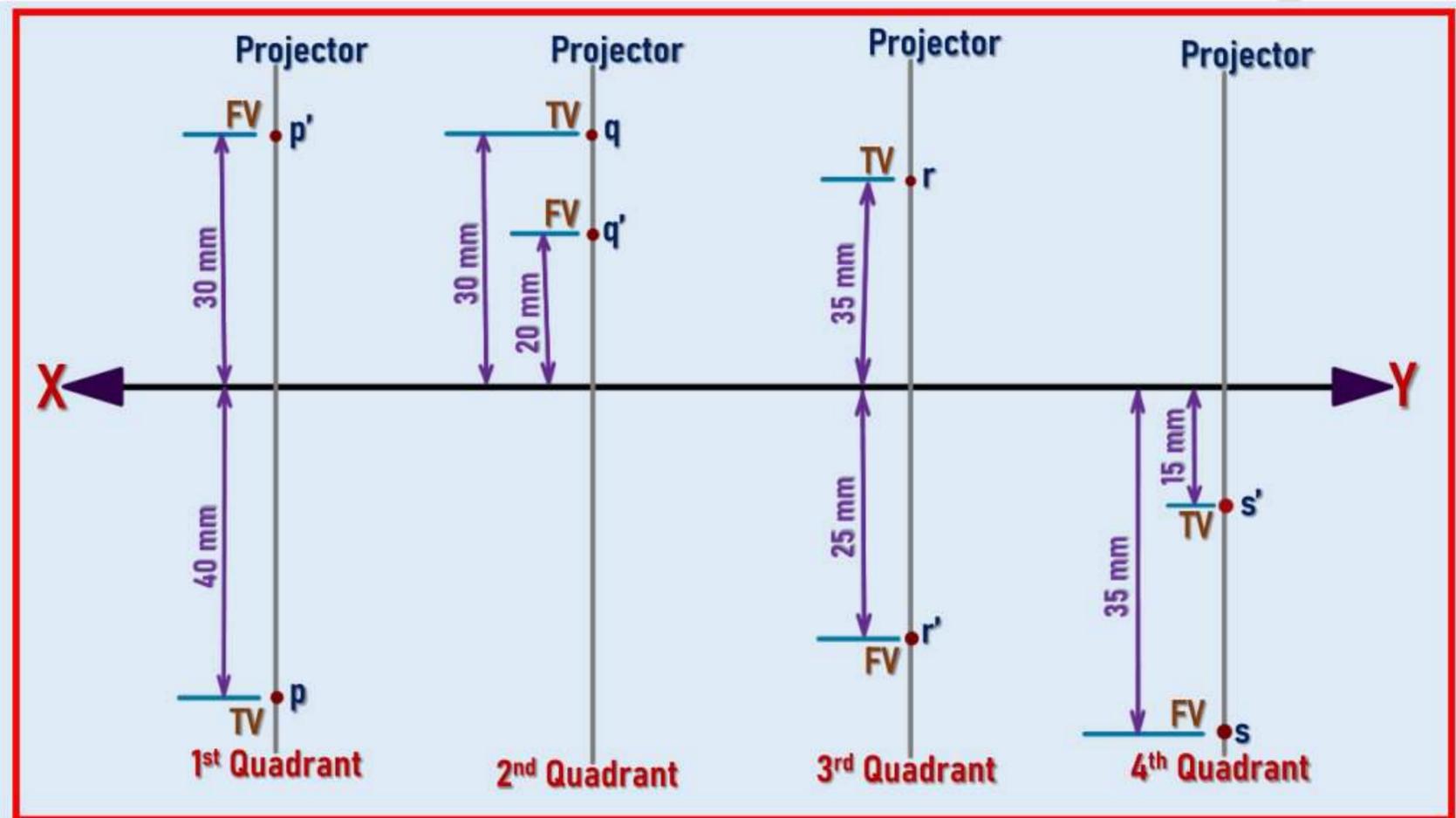


Figure: Example of Point Projection

Important Points to Remember

- The **XY line** separates HP and VP projections.
- The **Front View (p')** always lies on VP and the **Top View (p)** on HP.
- The relative positions of projections help identify the **quadrant** of the point.
- Always use **light construction lines** and label all points clearly.
- The **distance from HP or VP** is always **perpendicular** to the XY line.

Applications

Understanding projection of points is the foundation for:

- Projection of **lines, planes, and solids**.
- **Orthographic projection** drawings.
- **Machine part drawings** and **architectural drafting**.

Discussion Point Position with respect to Projection Plane

Case-1: Point Above HP Infront of VP (1st Quadrant)

Point 'A' Y mm Above HP and X mm Infront of VP. Draw its Projection.

Step-by-Step Procedure to Draw Projection of a Point

Let's say a point **A** is located **Y mm** above HP and **X mm** in front of VP (**1st Quadrant**).

1. Draw a **horizontal XY line** to represent the intersection of HP and VP.
2. Draw a **projector line** (a light vertical line) perpendicular to XY line.
3. From XY line, mark **Y mm above** for the **Front View (a')**.
4. From XY line, mark **X mm below** for the **Top View (a)**.
5. Label the points as **a'** (**Front View**) and **a** (**Top View**).
6. Write the actual position:
"Point A, Y mm above HP and X mm in front of VP."

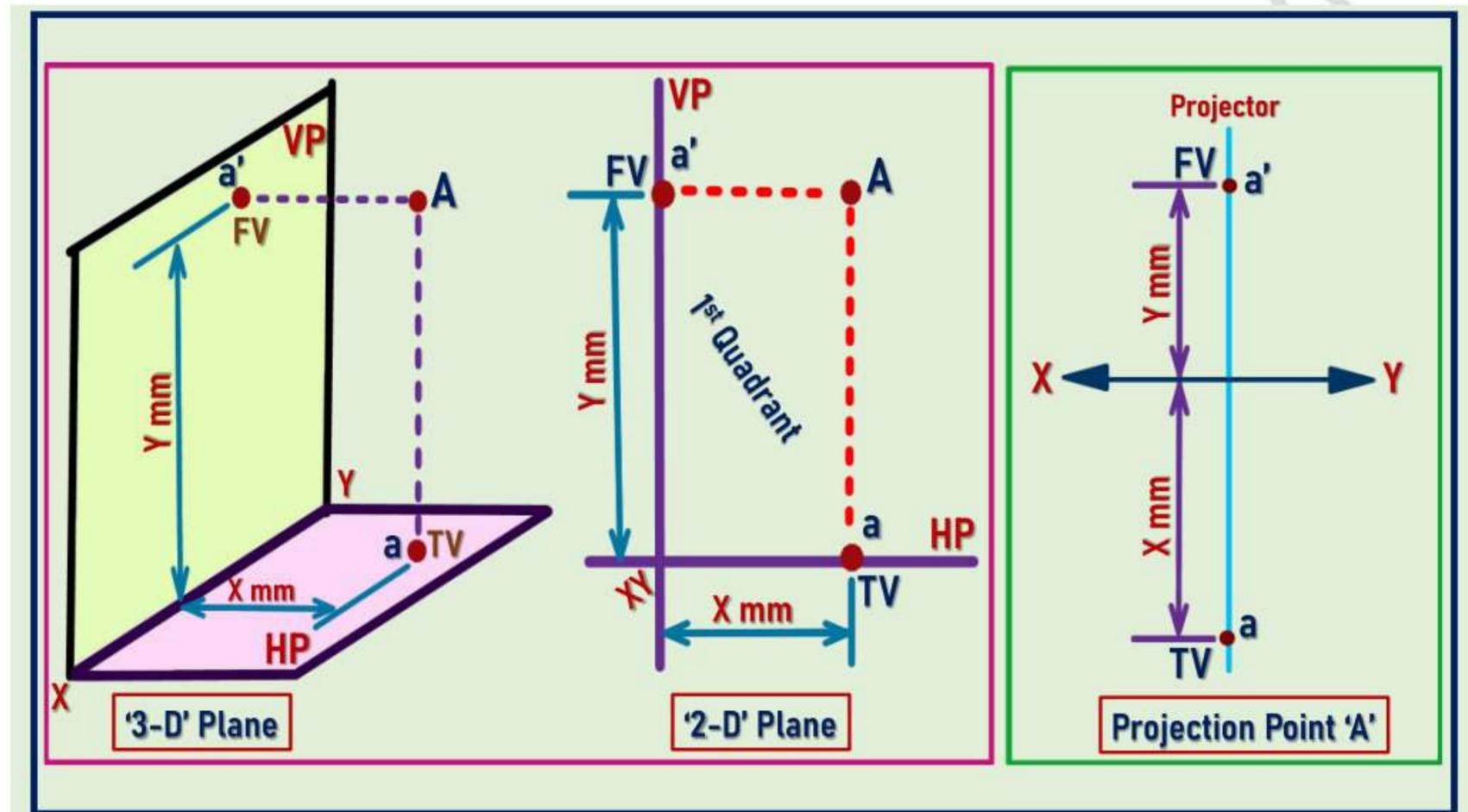


Figure: 1st Quadrant Point Projection

Summary Table

S.NO.	Feature	Description
1	Quadrant	1 st Quadrant
2	Point Position with respect to HP	Y mm Above HP (Horizontal Plane)
3	Point Position with respect to VP	X mm Infront of VP (Vertical Plane)
4	Front View	Y mm Above XY Line (Reference Line)
5	Top View	X mm Below XY Line (Reference Line)

Drawing-1:

Point 'A' 30 mm Above HP and 25 mm Infront of VP. Draw its Projection.

Step-by-Step Procedure to Draw Projection of a Point

Let's say a point **A** is located **Y mm** above HP and **X mm** in front of VP (**1st Quadrant**).

1. Draw a **horizontal XY line** to represent the intersection of HP and VP.
2. Draw a **projector line** (a light vertical line) perpendicular to XY line.
3. From XY line, mark **30 mm above** for the **Front View (a')**.

Case-1: Line Parallel to HP and Perpendicular to VP

Position of the Line

- The line is **parallel to the Horizontal Plane (HP)**.
- The line is **perpendicular to the Vertical Plane (VP)**.
- Therefore, the line lies **horizontally** in front of the VP at some distance.
- Both **endpoints of the line** are at the **same height from HP**.

Characteristics

Feature	Description
Relation with HP	Parallel → Line maintains constant height from HP.
Relation with VP	Perpendicular → Line faces the VP directly.
Inclinations	$\theta = 0^\circ$ with HP, $\phi = 90^\circ$ with VP.
True Length	Shown in Top View .
Front View	Appears as a point (since it is perpendicular to VP).

Projection Views

Top View (Plan)

- Shows the **true length** of the line.
- Appears as a **vertical line perpendicular to the XY line**.
- Both ends (a and b) are **below the XY line**, representing the same height above HP.

Front View (Elevation)

- Appears as a **single point** (a' and b' coincide).
- Because the line is perpendicular to VP, both ends project on the same vertical projector.

Step to draw projection of line

Let, A line AB = L mm long, parallel to HP and perpendicular to VP and its end point A Y mm above HP & X mm Infront of VP.

1. Draw a **horizontal XY line (reference line)** to represent the intersection of HP and VP.
2. Draw a **projector line (vertical line)**, light vertical line perpendicular to XY line.
3. **Locate a' (front / elevation)**, Since A is Y mm above HP, measure Y mm above the XY line and mark point a' on the projector.
4. **Locate a (top / plan)**, Since A is X mm in front of VP, measure X mm below the XY line and mark point a on the projector.
5. **Place b (top) to give true length 'L' mm.**
 - Because the line is **parallel to HP**, the **top view** shows the **true length** as a straight line along the projector direction. So, move **further below** from a in the same vertical direction by L mm.
 - From a (which is at -X mm), go down another L mm → mark **b (Top)** at $-X + L$ mm from below XY line.
6. **Locate b' (front).**
 - As the line is **perpendicular to VP**, both ends have the **same elevation**. So, b' coincides with a' (both Y mm above XY line). Mark b' at the same point as a' (mark a' & b' together and write a' b' or a'/b').
7. Label the points properly. a' b' (Front View), and a b (Top View).

- As the line is **perpendicular to VP**, both ends have the **same elevation**. So, **b'** coincides with **a'** (both 25 mm above XY). Mark **b'** at the same point as **a'** (mark **a' & b'** together and write **a' b'** or **a'/b'**).

7. Label the points properly. **a' b'** (Front View), and **a b** (Top View).

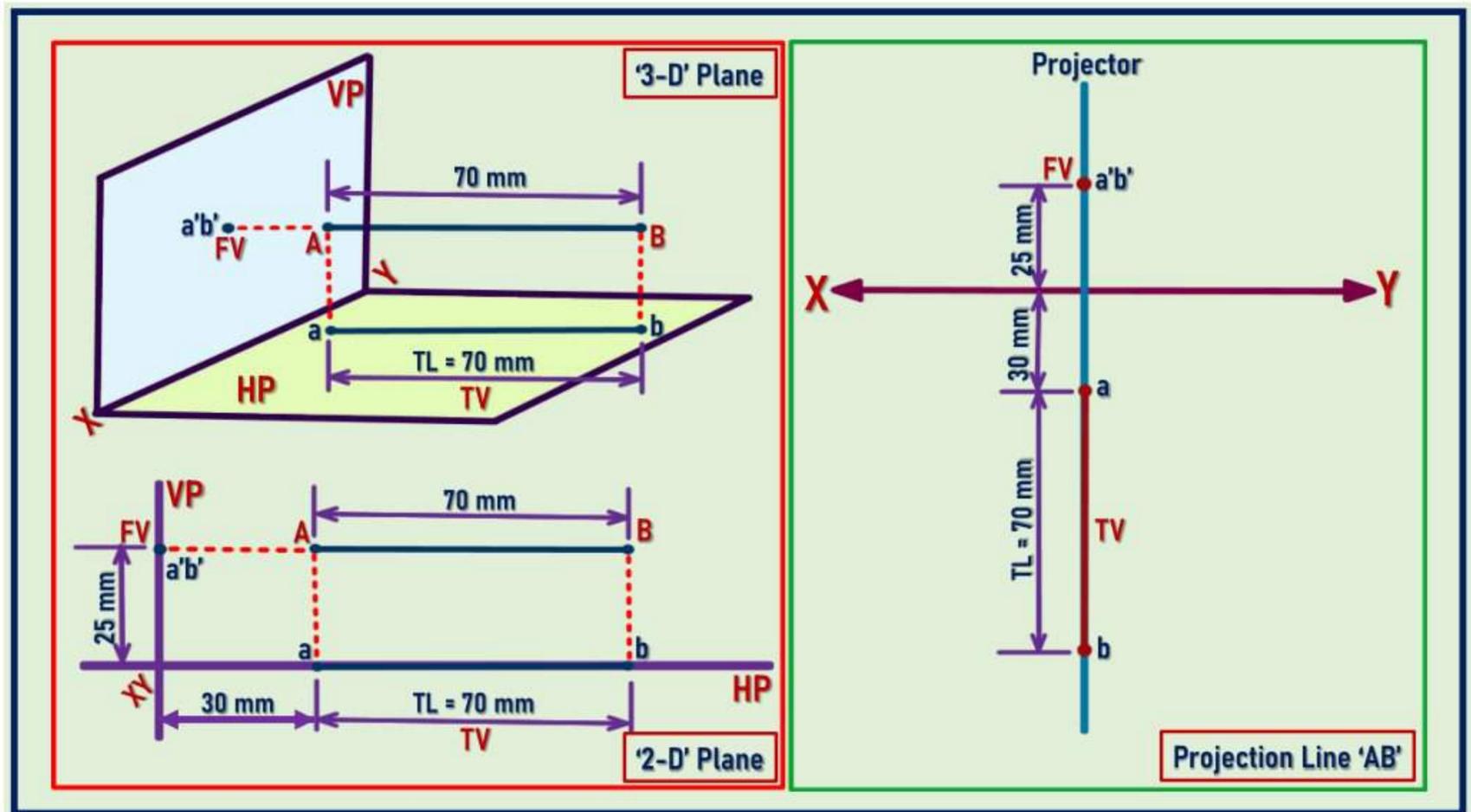


Figure: Case-1: Practical Example

Summary Table

View	Description
Front View (a' b')	A single point above XY line (line appears as a point).
Top View (a b)	A straight vertical line perpendicular to below XY line, showing true length .
True Length	Seen in Top View (Line ab)
Point	Seen in front view (Point a' b')
Inclination with HP	0° (parallel).
Inclination with VP	90° (perpendicular).

Case-2: Line Parallel to VP and Perpendicular to HP

Position of the Line

- The line is **parallel to the Vertical Plane (VP)**.
- The line is **perpendicular to the Horizontal Plane (HP)**.
- Therefore, the line lies **Vertically** in above of the HP at some distance.
- Both **endpoints of the line** are at the **same distance from VP**.

Characteristics

Feature	Description
Relation with VP	Parallel → Line maintains constant distance from VP.
Relation with HP	Perpendicular → Line faces the HP directly.

Inclinations	$\phi = 0^\circ$ with VP, $\theta = 90^\circ$ with HP.
True Length	Shown in Front View .
Top View	Appears as a point (since it is perpendicular to HP).

Projection Views

Front View (Elevation)

- Shows the **true length** of the line.
- Appears as a **vertical line perpendicular to the XY line**.
- Both ends (a' and b') are **above the XY line**, representing the same distance Infront of VP.

Top View (Plan)

- Appears as a **single point** (a and b coincide).
- Because the line is perpendicular to HP, both ends project on the same vertical projector.

Step to draw projection of line

Let, A line AB = L mm long, parallel to VP and perpendicular to HP and its end point A Y mm above HP & X mm Infront of VP.

1. Draw a **horizontal XY line (reference line)** to represent the intersection of HP and VP.
2. Draw a **projector line (vertical line)**, light vertical line perpendicular to XY line.
3. **Locate a' (front / elevation)**, Since A is Y mm above HP, measure Y mm above the XY line and mark point a' on the projector.
4. **Locate a (top / plan)**, Since A is X mm in front of VP, measure X mm below the XY line and mark point a on the projector.
5. **Place b' (front) to give true length 'L' mm.**
 - Because the line is **parallel to VP**, the **front view** shows the **true length** as a straight line along the projector direction. So, move **further above** from a' in the same vertical direction by L mm.
 - From a' (which is at -Y mm), go up another L mm → mark **b' (front)** at $-Y + L$ mm from above XY line.
6. **Locate b (top).**
 - As the line is **perpendicular to HP**, both ends have the **same plan**. So, **b** coincides with **a** (both X mm below XY line). Mark **b** at the same point as **a** (mark **a & b** together and write **ab** or **a/b**).
7. Label the points properly. **a' b'** (Front View), and **a b** (Top View).

Practical Example:

Let the line $AB = 80$ mm long, inclined at 45° with HP & inclined at 30° with VP. Its end point A is 20 mm Above HP & 25 mm Infront of VP. Draw its Projection.

Step-by-Step Procedure to Draw the Projections of Line

1. Draw a horizontal XY line (reference line) to represent the intersection of HP and VP.
2. Draw a projector line (vertical line), light vertical line perpendicular to XY line.
3. Draw Front View (Elevation) and Top View (Plan)
 - Draw Front View point a' locate 20 mm above XY line in a projector, from point a' draw horizontal line (Locus-1') parallel to XY which is equal to true length 80 mm and mark at end b'_1
 - Keeping fixed a point a' and rotate line $a' b'_1$ to make 45° with XY line and mark at end b'_2
 - Draw horizontal line (Locus-2') parallel to XY line at point b'_2
 - Draw Top View point a locate 25 mm below XY line in a projector, from point a draw horizontal line (Locus-1) parallel to XY which is equal to true length 80 mm and mark at end b_1
 - Keeping fixed a point a and rotate line $a b_1$ to make 30° with XY line and mark at end b_2
 - Draw horizontal line (Locus-2) parallel to XY line at point b_2
4. draw Front View (Elevation)
 - Draw vertical line from point b_2 and intersect with line $a' b'_1$ (locus-1'), mark point b'_3
 - Keeping fixing a point a' and rotate line $a' b'_3$ and intersect with locus-2', mark point b' to make α° with XY line
 - To draw Front View to connect point a' & b' , label $a' b'$ (Front View)
5. draw Top View (Plan)
 - Draw vertical line from point b'_2 and intersect with line $a b_1$ (locus-1), mark point b_3
 - Keeping fixing a point a and rotate line $a b_3$ and intersect with locus-2, mark point b to make β° with XY line
 - To draw Top View to connect point a & b , label $a b$ (Top View)
6. Label Final Points

Label the final projections as:

 - $a' b'$ — Front View (Elevation)
 - a, b — Top View (Plan)
 - Both these lines are inclined to XY and shorter than the true length 80 mm.

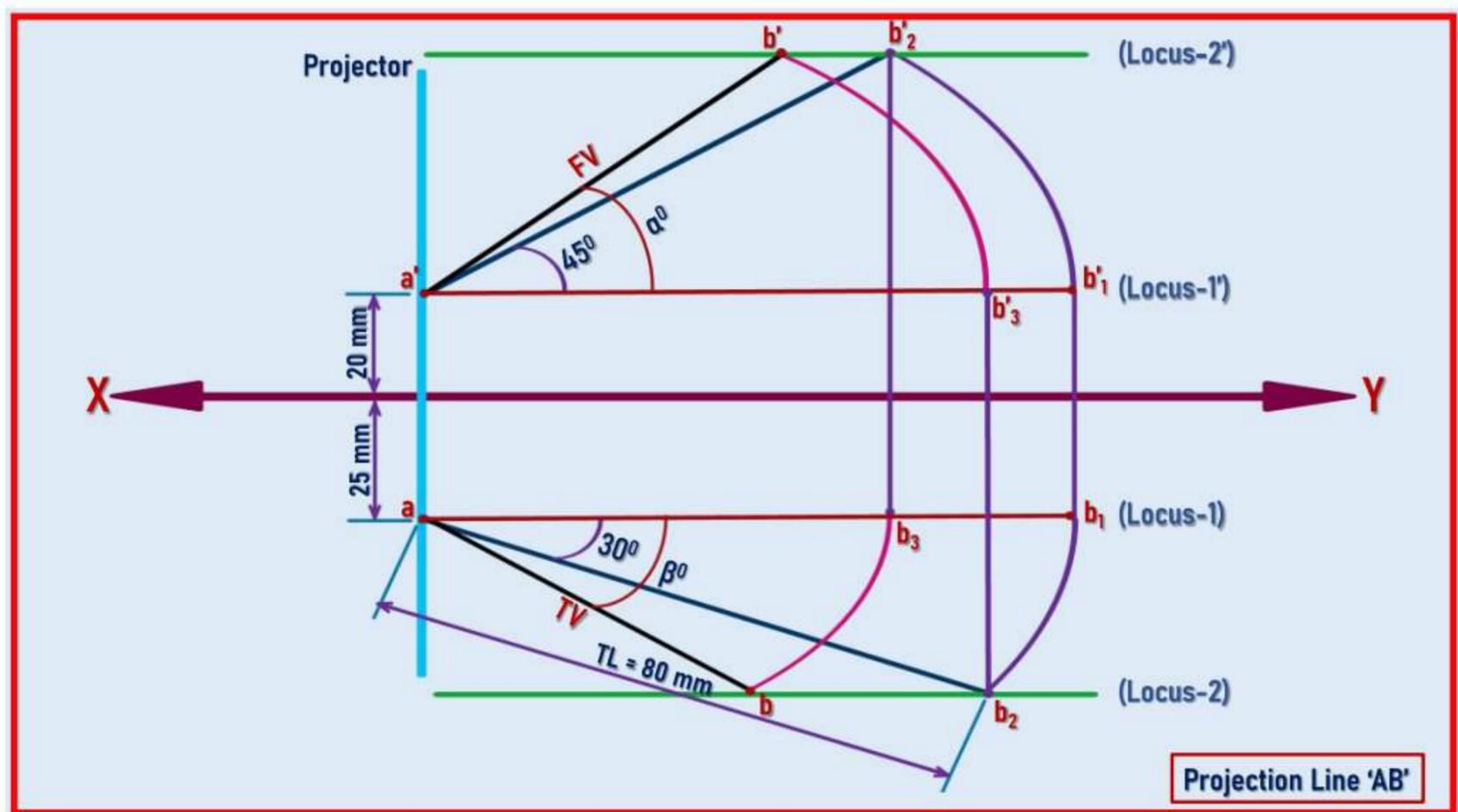


Figure: Practical Example Line Projection Inclined both HP & VP

Summary of the Projection Features

Property	Description
Front, point a'	20 mm above XY line
Top, point a	25 mm below XY line
Angle with HP ($\theta = 45^\circ$)	The inclination of the line above the HP
Angle with VP ($\phi = 30^\circ$)	The inclination of the line in front of VP
True Length (TL = 80 mm)	Length of the line in 3D space, must be found using auxiliary method
Front View (Elevation)	Appears shorter than true length and inclined at 45° to XY
Top View (Plan)	Appears shorter than true length and inclined at 30° to XY

Type-1:

Let the line $AB = L$ mm long, inclined at θ° with HP & inclined at ϕ° with VP. Its end point A is Y mm Above HP & X mm Infront of VP. Draw its Projection.

Let the line $AB = L$ mm long.

Inclined at θ° with HP & inclined at ϕ° with VP.

Its end point A is Y mm Above HP & X mm Infront of VP.

Step-by-Step Procedure to Draw the Projections of Line

1. Draw a horizontal XY line (reference line) to represent the intersection of HP and VP.
2. Draw a projector line (vertical line), light vertical line perpendicular to XY line.
3. Draw Front View (Elevation) and Top View (Plan)
 - Draw Front View point a' locate Y mm above XY line in a projector, from point a' draw horizontal line (Locus-1') parallel to XY which is equal to true length L mm and mark at end b'_1
 - Keeping fixed a point a' and rotate line $a' b'_1$ to make θ° with XY line and mark at end b'_2
 - Draw horizontal line (Locus-2') parallel to XY line at point b'_2

- Draw **Top View point a** locate X mm below XY line in a projector, from **point a** draw **horizontal line (Locus-1)** parallel to XY which is equal to **true length L mm** and mark at end b_1
- Keeping fixed a point a and **rotate line $a b_1$** to make ϕ° with XY line and mark at end b_2
- Draw **horizontal line (Locus-2)** parallel to XY line at point b_2

4. draw Front View (Elevation)

- Draw vertical line from point b_2 and intersect with line $a' b'_1$ (locus-1'), mark point b'_3
- Keeping fixing a point a' and rotate line $a' b'_3$ and intersect with locus-2', mark point b' to make α° with XY line
- To draw **Front View** to connect point a' & b' , label $a' b'$ (Front View)

5. draw Top View (Plan)

- Draw vertical line from point b'_2 and intersect with line $a b_1$ (locus-1), mark point b_3
- Keeping fixing a point a and rotate line $a b_3$ and intersect with locus-2, mark point b to make β° with XY line
- To draw **Top View** to connect point a & b , label $a b$ (Top View)

6. Label Final Points

Label the final projections as:

- $a' b'$ – Front View (Elevation)
- a, b – Top View (Plan)
- Both these lines are **inclined to XY** and **shorter than the true length L mm**.

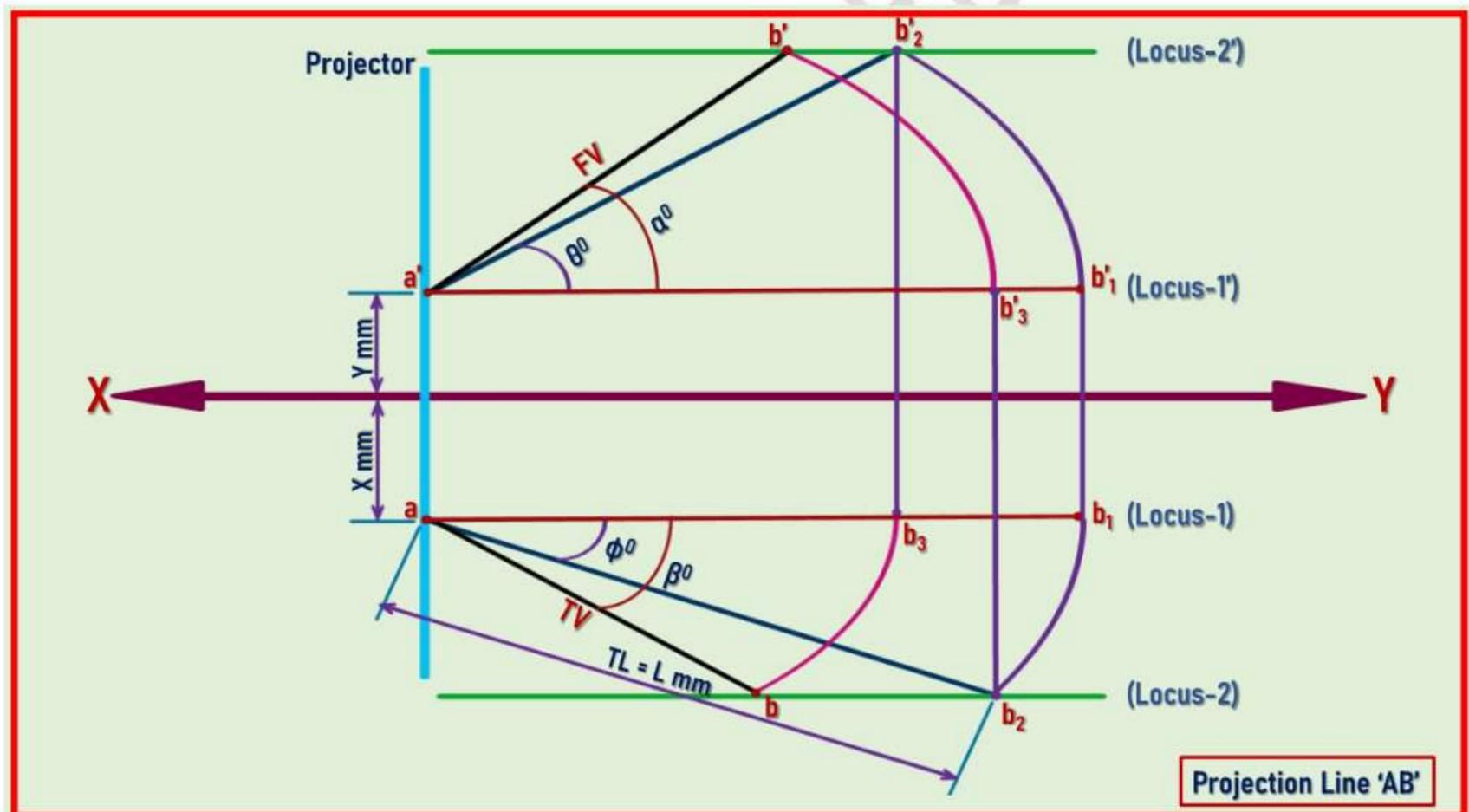


Figure: Type 1

Summary of the Projection Features

Property	Description
Front, point a'	Y mm above XY line
Top, point a	X mm below XY line
Angle with HP (θ)	The inclination of the line above the HP
Angle with VP (ϕ)	The inclination of the line in front of VP
True Length (TL)	Length of the line in 3D space, must be found using auxiliary method

Front View (Elevation)	Appears shorter than true length and inclined to XY
Top View (Plan)	Appears shorter than true length and inclined to XY

Example: Type-1:

Draw the projection of a line AB 70 mm long, which is inclined at 45° to HP and 30° to VP. it's one end A is 30 mm above the HP and 25 mm in front of the VP. Draw its projection.

Let the line AB = 70 mm long.

Inclined at 45° with HP & inclined at 30° with VP.

Its end point A is 30 mm Above HP & 25 mm Infront of VP.

Step-by-Step Procedure to Draw the Projections of Line

1. Draw a **horizontal XY line (reference line)** to represent the intersection of HP and VP.
2. Draw a **projector line (vertical line)**, light vertical line perpendicular to XY line.
3. Draw **Front View (Elevation) and Top View (Plan)**
 - Draw **Front View point a'** locate **30 mm above XY line** in a projector, from **point a'** draw **horizontal line (Locus-1')** parallel to XY which is equal to **true length 70 mm** and mark at end **b'₁**
 - Keeping fixed a point **a'** and **rotate line a' b'₁** to make **45°** with XY line and mark at end **b'₂**
 - Draw **horizontal line (Locus-2')** parallel to XY line at point **b'₂**
 - Draw **Top View point a** locate **25 mm below XY line** in a projector, from **point a** draw **horizontal line (Locus-1)** parallel to XY which is equal to **true length 70 mm** and mark at end **b₁**
 - Keeping fixed a point **a** and **rotate line a b₁** to make **30°** with XY line and mark at end **b₂**
 - Draw **horizontal line (Locus-2)** parallel to XY line at point **b₂**
4. draw **Front View (Elevation)**
 - Draw vertical line from point **b₂** and **intersect with line a' b'₁ (locus-1')**, mark point **b'₃**
 - Keeping fixing a point **a'** and **rotate line a' b'₃** and **intersect with locus-2'**, mark point **b'** to make **α°** with XY line
 - To draw **Front View** to **connect point a' & b'**, label **a' b' (Front View)**
5. draw **Top View (Plan)**
 - Draw vertical line from point **b'₂** and **intersect with line a b₁ (locus-1)**, mark point **b₃**
 - Keeping fixing a point **a** and **rotate line a b₃** and **intersect with locus-2**, mark point **b** to make **β°** with XY line
 - To draw **Top View** to **connect point a & b**, label **a b (Top View)**
6. Label Final Points

Label the final projections as:

 - **a' b'**— Front View (Elevation)
 - **a, b** — Top View (Plan)
 - Both these lines are **inclined to XY** and **shorter than the true length 70 mm**.

- To obtain the **true shape** of an inclined plane, we use:
 - **Auxiliary Plane Method**, or
 - **Rotation Method**

Important Observations

- A plane **parallel to HP** shows **true shape in top view**.
- A plane **parallel to VP** shows **true shape in front view**.
- A plane **inclined to both HP and VP** never show true shape in normal views.
- The **edge view** of a plane appears as a straight line.

Applications

- Designing machine components
- Sheet metal work
- Structural engineering drawings
- Visualization of inclined surfaces

Summary

- A **plane** is a flat surface with length and width.
- The **projection of planes** depends on their orientation to HP and VP.
- **True shape** appears only when the plane is parallel to the projection plane.
- **Inclined planes** require auxiliary views to find true shape.
- Understanding plane projections is essential for **accurate engineering drawings**.

1st Step to Start Drawing of a Plane Projection: **Starting Diagram (True Shape):**

Case – 1: Plane in the HP or Base Parallel to the HP

Condition – A: Draw Plane Projection, One of its Side/Edge/Face/Line of Plane in the HP or Parallel to HP-

When **One of the sides of Plane** lies in the HP, the starting diagram or the **true shape** is drawn below the reference line, and that **Plane Side** is drawn on the left side.

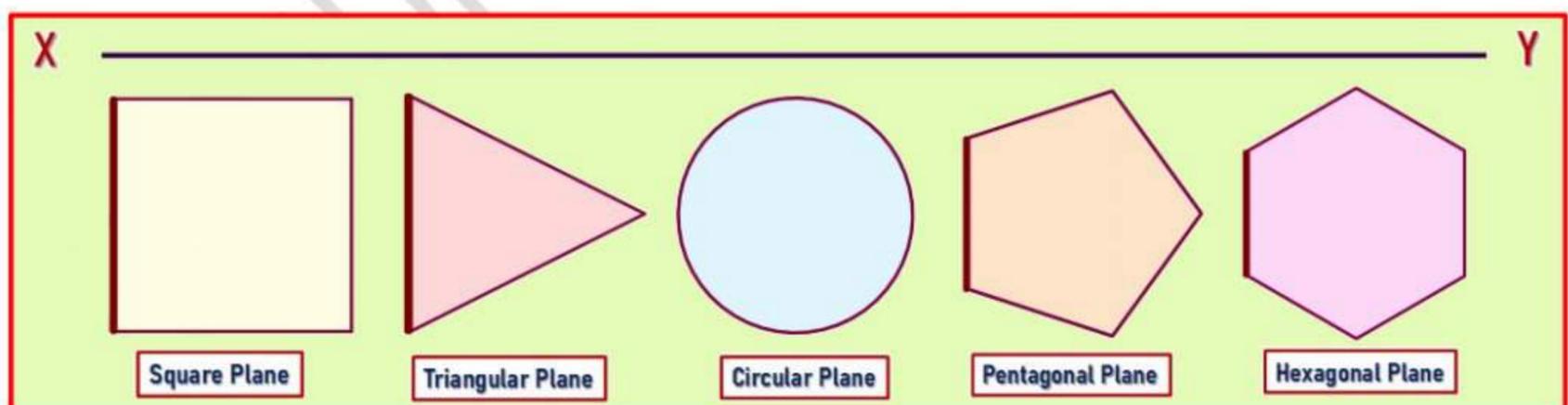


Figure: Condition-A: Side/Edge of Plane in the HP

Condition – B: Draw Plane Projection, One of its Corner/Point of Plane in the HP or Parallel to HP-

When **One of the Corner of Plane** lies in the HP, the starting diagram or the **true shape** is drawn below the reference line, and that **Plane Corner** is drawn on the left side.

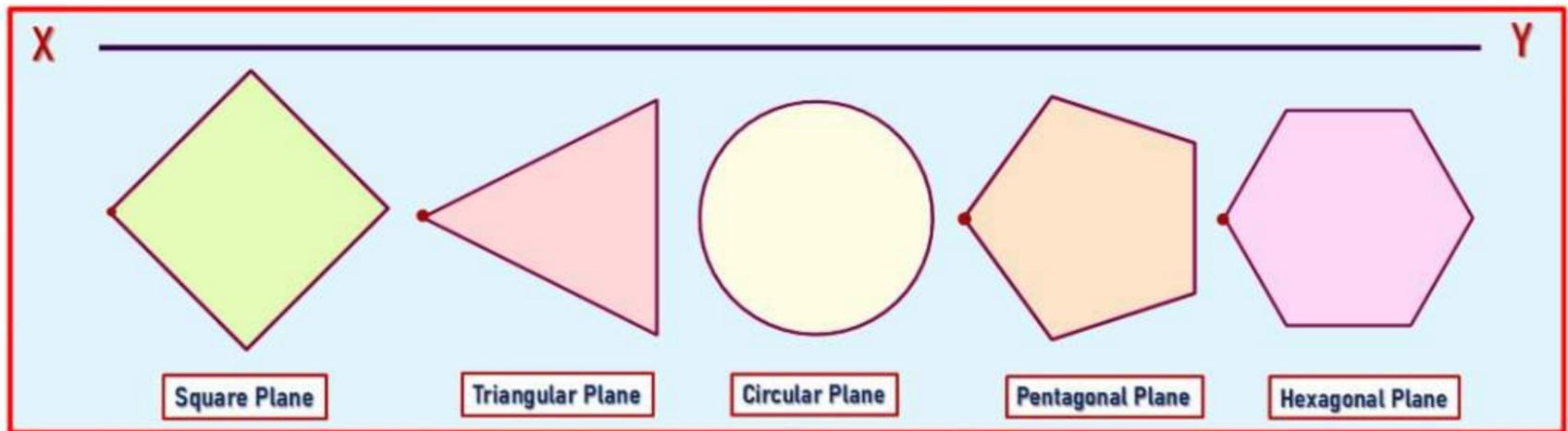


Figure: Condition-B: Corner/Point of Plane in the HP

Case – 2: Plane in the VP or Base Parallel to the VP

Condition – C: Draw Plane Projection, One of its Side/Edge/Face/Line of Plane in the VP or Parallel to VP-

When **One of the sides of Plane** lies in the VP, the starting diagram or the **true shape** is drawn **Above the reference line**, and that **Plane Side** is drawn on the **left side**.

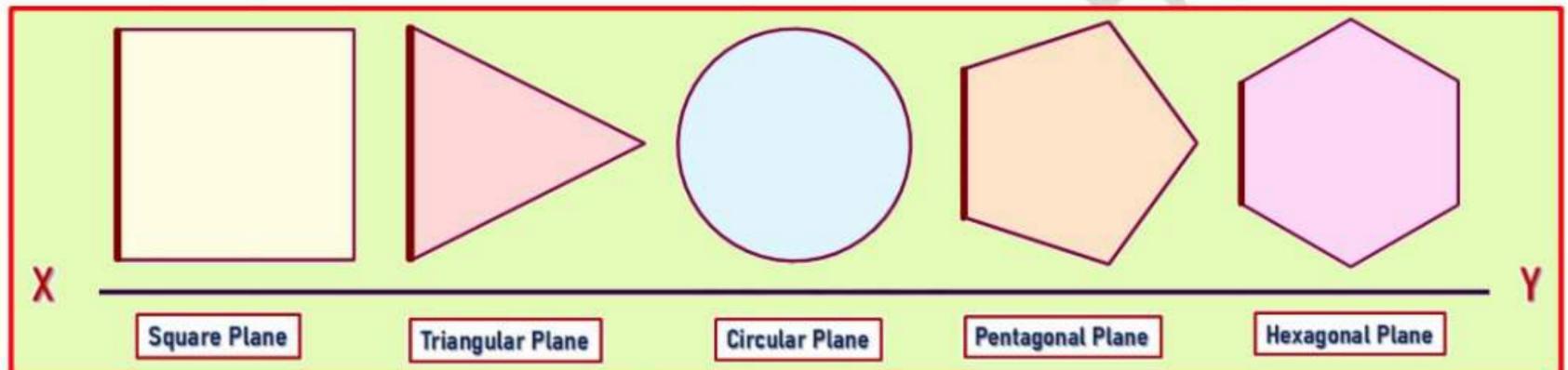


Figure: Condition-C: Side/Edge of Plane in the VP

Condition – D: Draw Plane Projection, One of its Corner/Point of Plane in the VP or Parallel to VP-

When **One of the Corner of Plane** lies in the VP, the starting diagram or the **true shape** is drawn **Above the reference line**, and that **Plane Corner** is drawn on the **left side**.

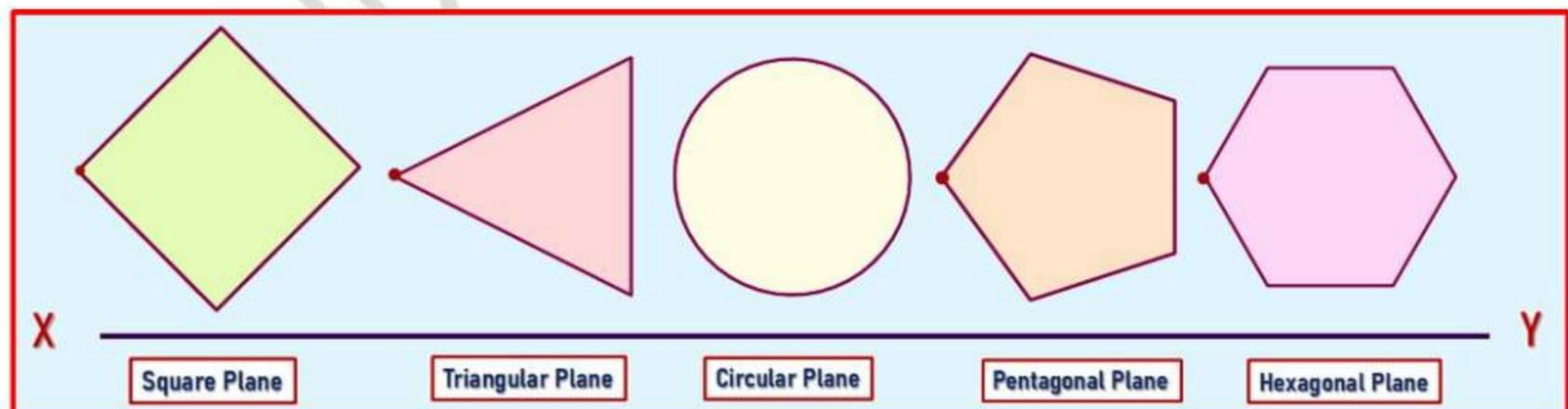


Figure: Condition-D: Corner/Point of Plane in the VP

General Steps to Draw Projection of a Plane

Case - 1: Plane in the HP or Plane Parallel to the HP

1. Draw the XY reference line.
2. Plane is in the HP or Parallel to the HP, Draw its Strating Diagram (true shape) of Plane Below the Reference Line.
3. Project all Point of True Shape to Reference line and draw second view (line or foreshortened view) is known as True Line or Surface.
4. Inclined to the Surface (True length) with the HP, in Above the reference Line XY.
5. Project the final Top view in below reference line XY.
6. Inclined to the Line/Plane as given in the question with the VP, in Below the reference Line XY.
7. Project the final Front view in above the reference line.
8. Project the final top and front views.

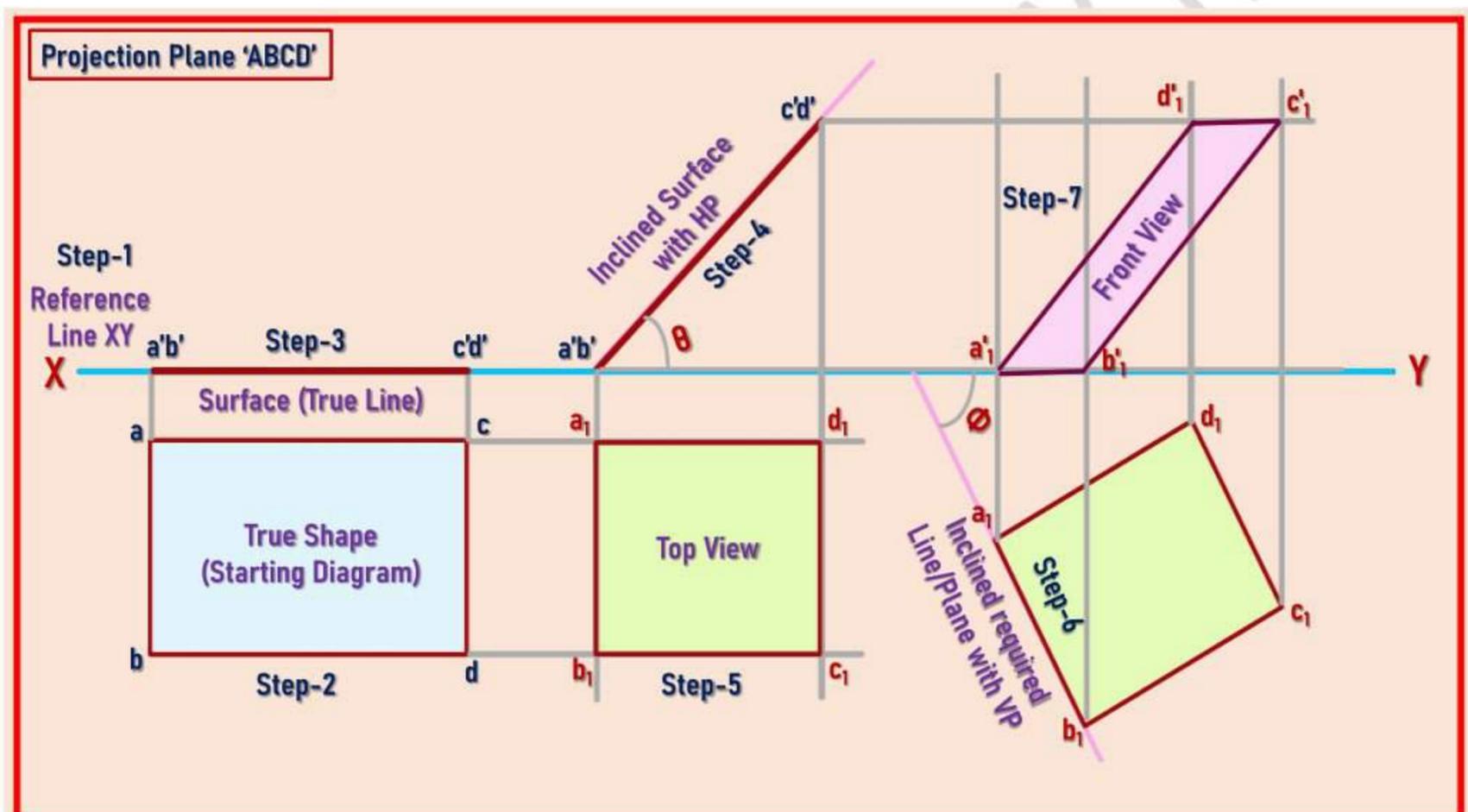


Figure: Case-1: General Step to Draw Projection of Plane is in the HP

Case - 2: Plane in the VP or Plane Parallel to the VP

1. Draw the XY reference line.
2. Plane is in the VP or Parallel to the VP, Draw its Strating Diagram (true shape) of Plane Above the Reference Line.
3. Project all Point of True Shape to Reference line and draw second view (line or foreshortened view) is known as True Line or Surface.
4. Inclined to the Surface (True length) with the VP, in Below the reference Line XY.
5. Project the final Front view in Above the reference line XY.
6. Inclined to the Line/Plane as given in the question with the HP, in Above the reference Line XY.
7. Project the final Top view in Below the refence line.
8. Project the final top and front views.

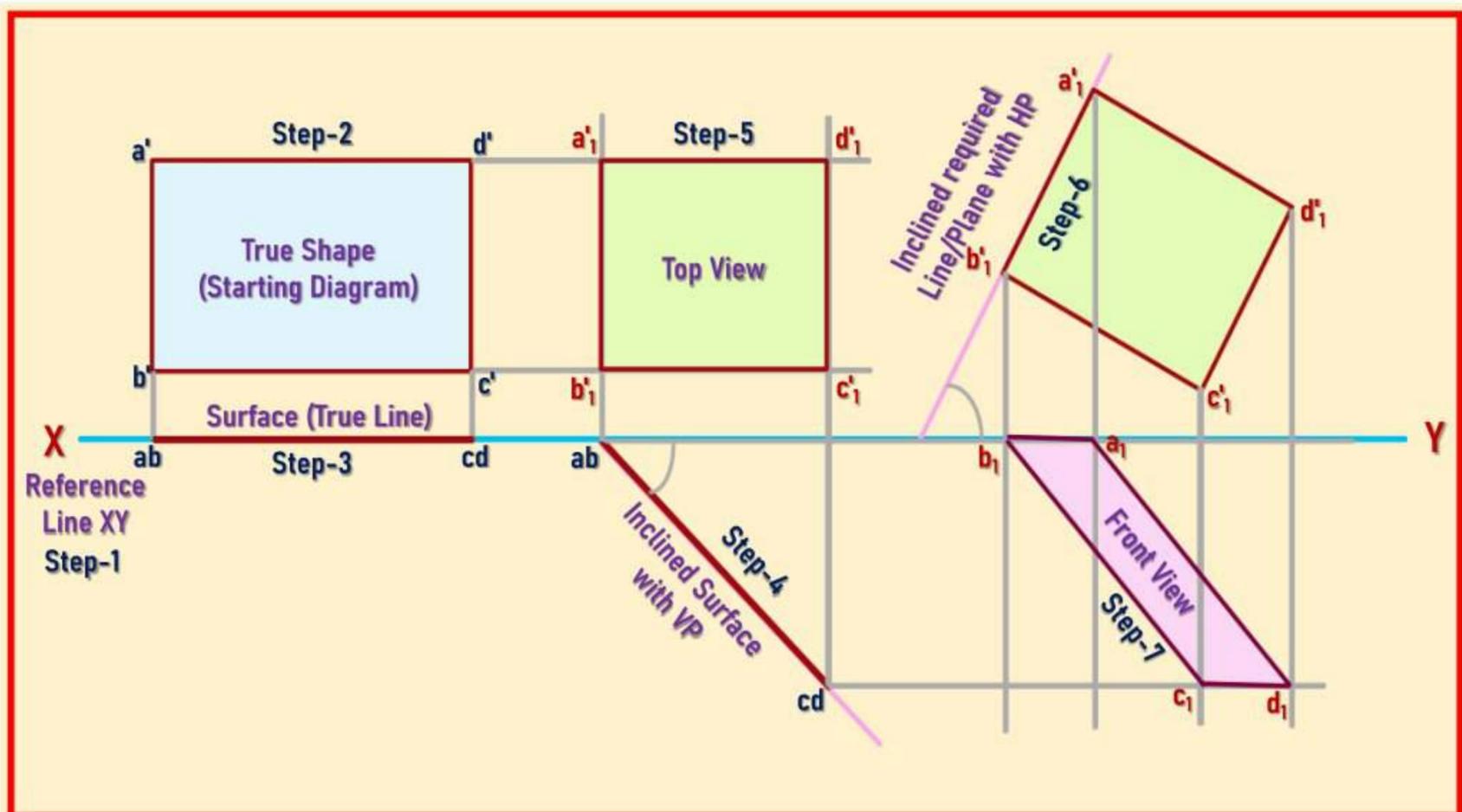


Figure: Case-2: General Step to Draw Projection of Plane is in the VP

Drawing -1: A rectangular plane $60 \text{ mm} \times 30 \text{ mm}$ has its shorter side in HP and the surface makes an angle of 45° with HP. Draw its projections.

Given Data

- Plane: Rectangle
- Length = 60 mm
- Breadth (shorter side) = 30 mm
- Shorter side lies in HP
- Plane surface inclined at 45° to HP

Step-by-Step Construction Procedure

1. Draw a horizontal Reference XY line to represent the intersection of HP and VP.
2. Draw True Shape in HP (Initial Position/Starting Diagram)
 - Since the shorter side is in HP. Keep the 30 mm side (a b) perpendicular to XY (in the HP).
 - Draw a rectangle a b c d ($60 \text{ mm} \times 30 \text{ mm}$) below XY line. 30 mm shorter side (a b) draw left side.
 - This rectangle represents the true shape.
3. Draw Surface (True line)
 - From points a b c d draw projectors upward to VP.
 - Since the plane is in the HP, all points lie on XY line.
 - Mark the Surface as a', b', c', d' on XY.
4. Incline Surface to the HP
 - Now the surface is inclined at 45° to HP.
 - Draw a new front view $a' b' c' d'$ making 45° with XY.
5. Draw Final Top View
 - From the inclined Surface, draw projectors downward to below the reference line.
 - From the true shape draw the projectors horizontal right side and with intersect vertical projectors which is draw from the inclined surface to obtain points $a_1 b_1 c_1 d_1$

- Join these points in sequence to get the **final top view**.

Final Result

- **Surface (new front view):** Inclined line at 45° to XY
- **Top View:** Foreshortened rectangle
- Shorter side remains in **HP**

Important Notes

- Plane inclined to HP → **Front view is inclined, Top view is reduced.**
- True shape is seen **only when plane is parallel** to the reference plane.
- Always start drawing from the **simple position**.

GCP JDP (PREPARED BY RAY)