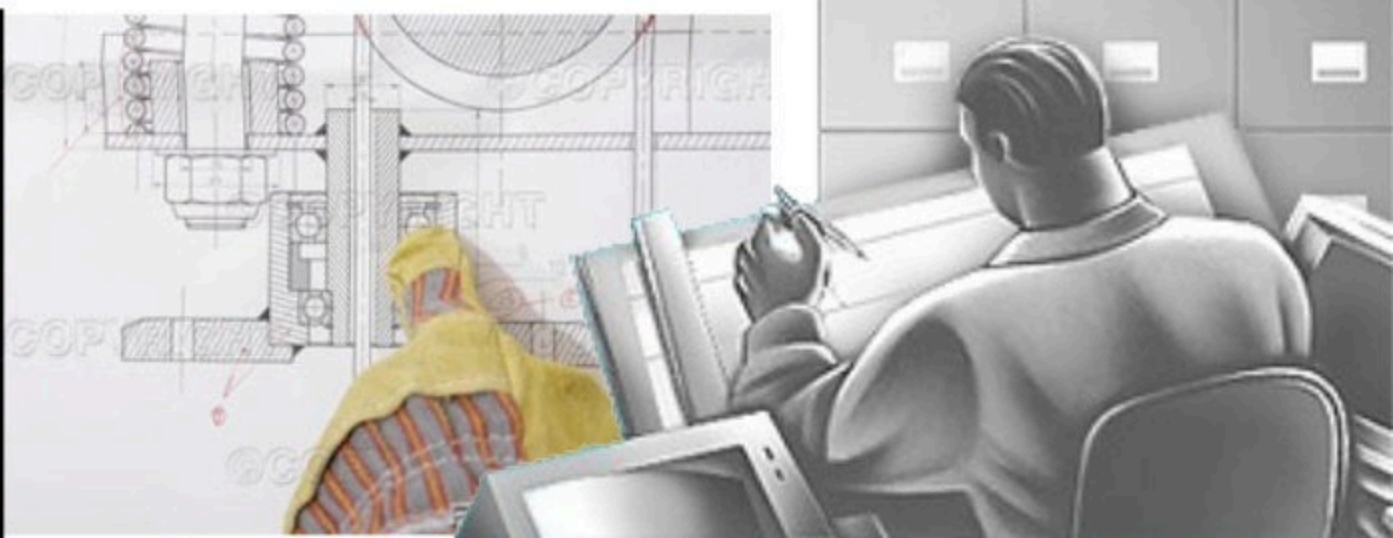
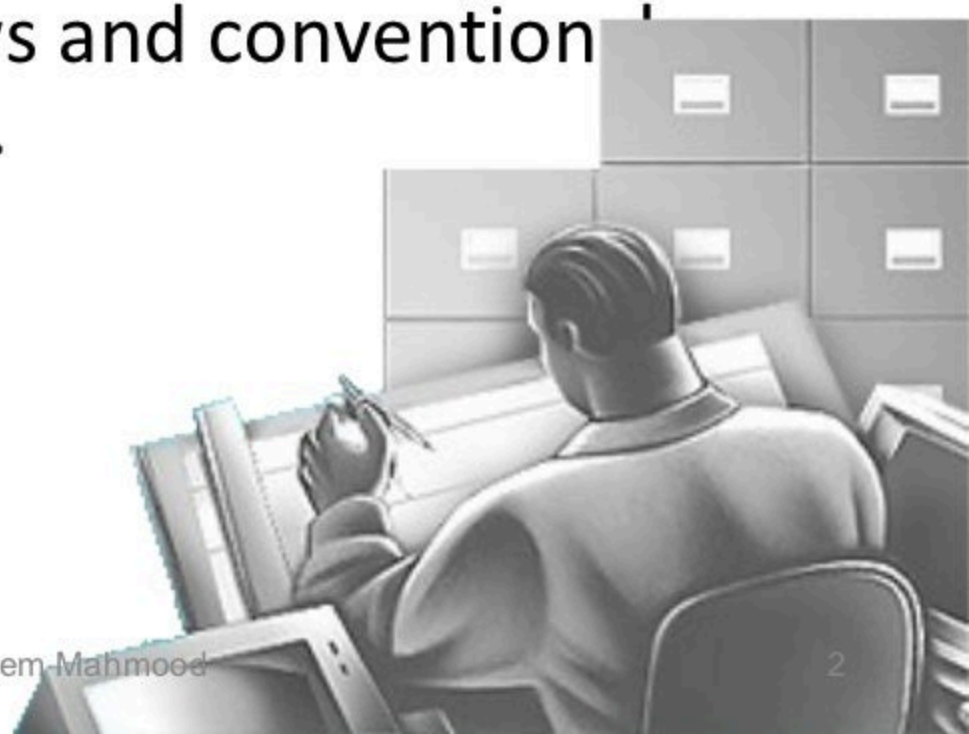
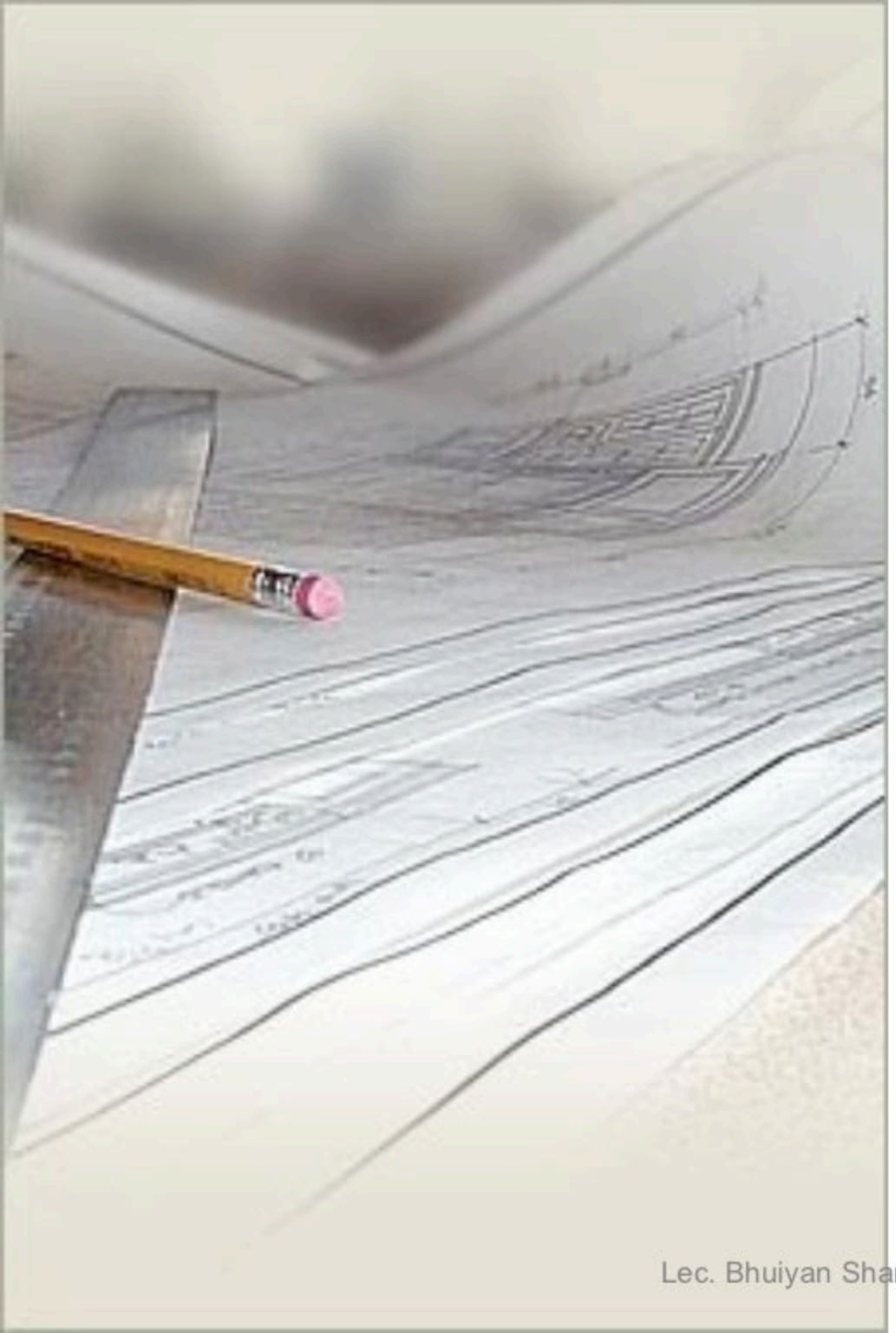
Engineering Drawing–I



Courses outline

- Introduction; Basic concepts of engineering drawing; Instruments and their uses; First and third angle projections; Orthographic drawings; Principal views, Isometric views; Missing lines and views; Sectional views and convention practices; Auxiliary views.





Text & Ref books

- Fundamentals of Engineering Drawing

  -by French & Vierck.
- Metric Drafting

  – by Paul Wallah.
- Drafting Technology and Practice

  – by William P. Spence
- Mechanical Engineering Drawing

  -by Dr. Md. Quamrul Islam

Class Schedule

1. Introduction: Basic Drawing Practice
2. Orthogonal views of simple block
3. Orthogonal views with circular holes
4. Orthogonal views with fillets and rounds
5. Sectional views
6. Sectional views (conventional practices)
7. Auxiliary views
8. Isometric views
9. Isometric views with circular holes
10. Missing Lines and Missing views.

Note:

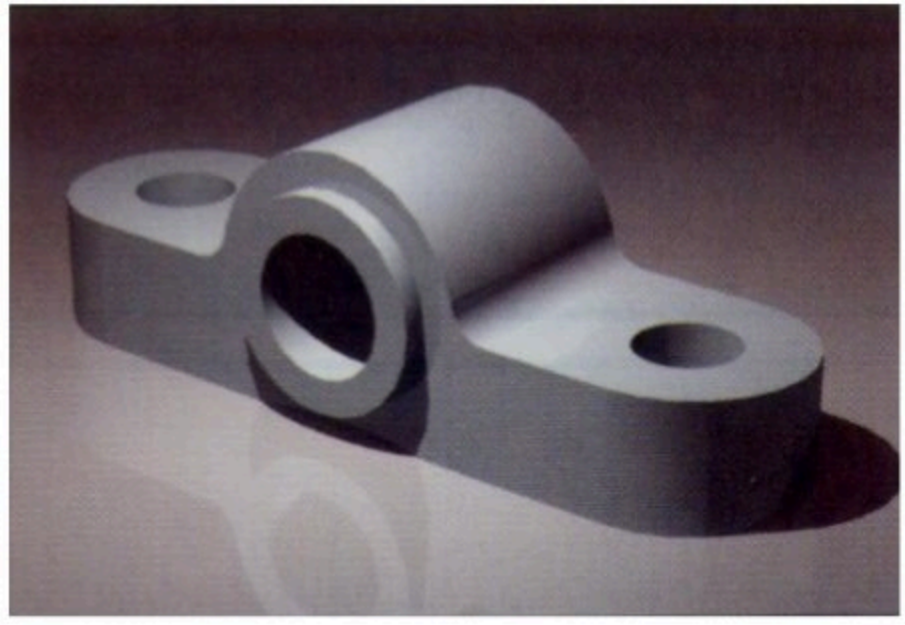
- If a student fails to attend in any drawing class, he/she will get **ZERO GRAD** in that drawing.
- No student will be allowed in the class without necessary **INSTRUMENTS** and **INSTRUCTION SHEET.**
- There will be a **QUIZ EXAM** /an **ORAL EXAM** during the term time. Marks obtained in these exams and those in drawing performed in the classes will be added together to calculate the final grade.

Graphics Language

Effectiveness of Graphics Language

1. Try to write a description of this object.

2. Test your written description by having someone attempt to make a sketch from your description.



You can easily understand that …

The word languages are <u>inadequate</u> for describing the ***size***, ***shape*** and ***features*** completely as well as concisely.

Composition of Graphic Language

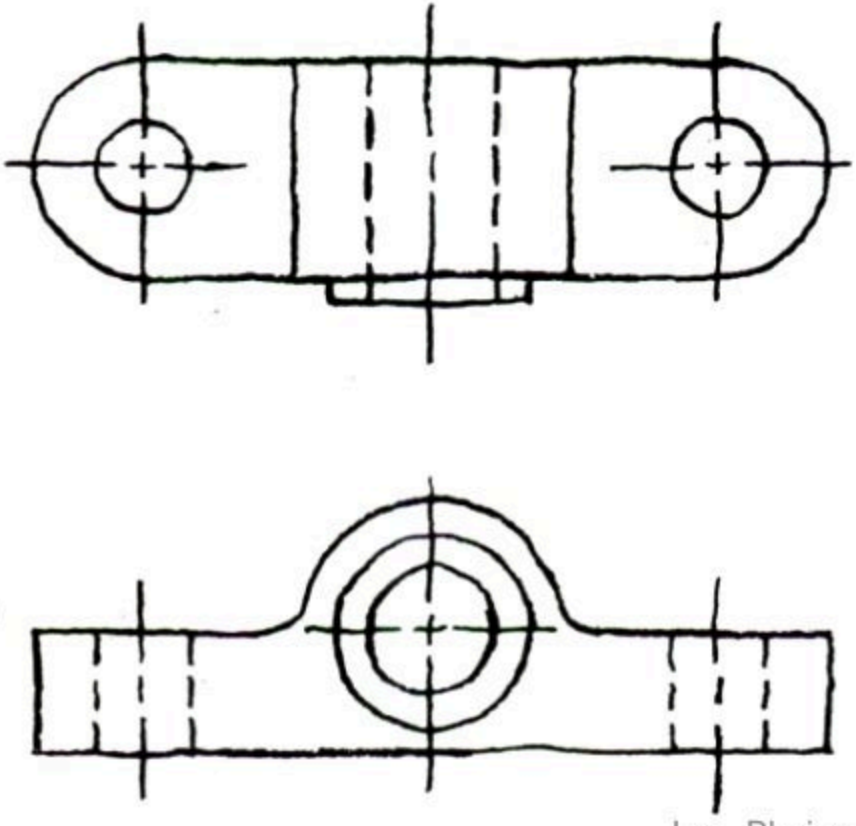
Graphic language in **"engineering application"** use ***lines*** to represent the ***surfaces***, ***edges*** and ***contours*** of objects.

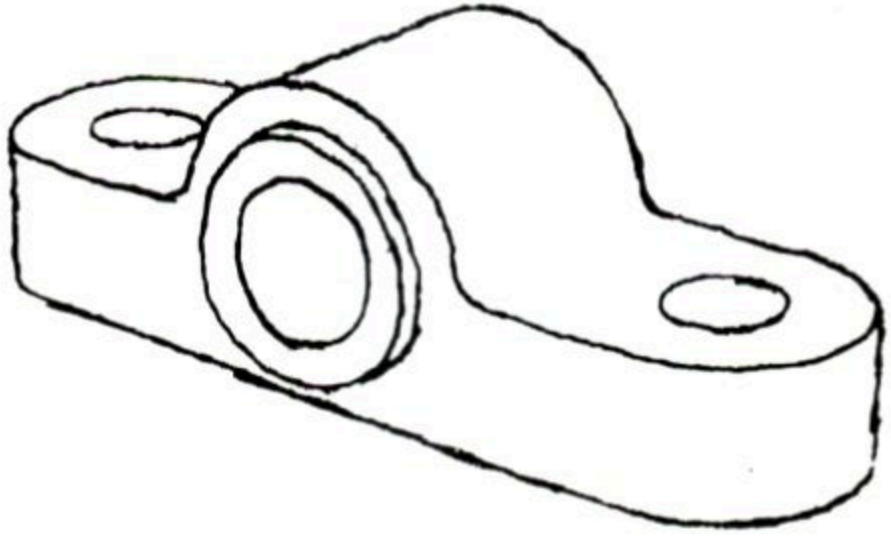
- The language is known as "***drawing***" or "***drafting***" .
- A drawing can be done using ***freehand***, ***instruments*** or ***computer*** methods.

Freehand drawing

The lines are sketched without using instruments other than pencils and erasers.

Example

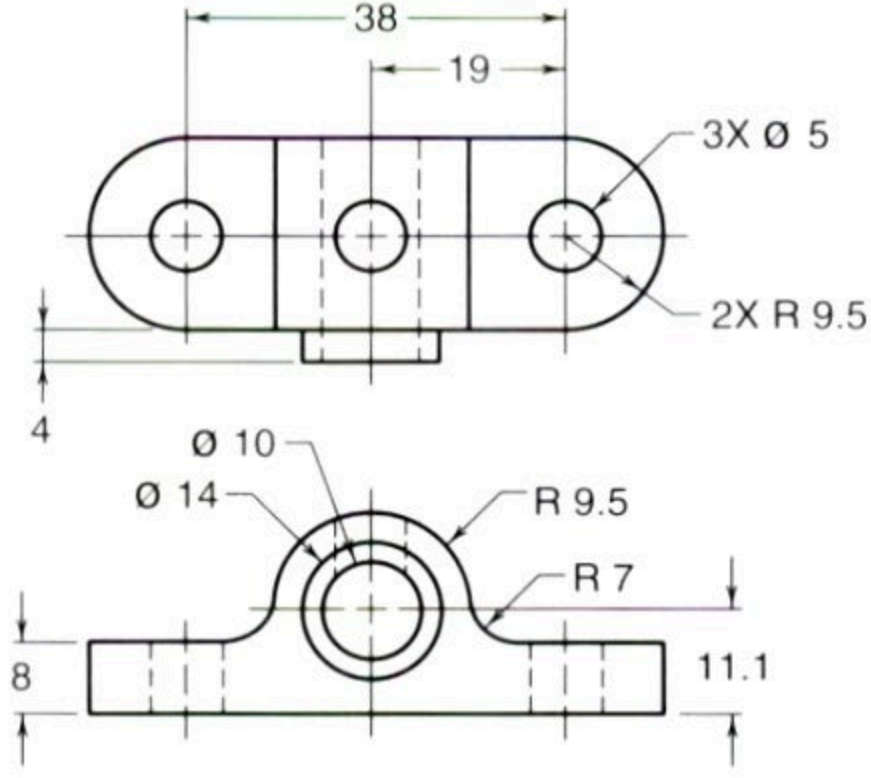




Instrument drawing

Instruments are used to draw straight lines, circles, and curves concisely and accurately. Thus, the drawings are usually made to scale.

Example



Computer drawing

The drawings are usually made by commercial software such as AutoCAD, solid works etc.

Example

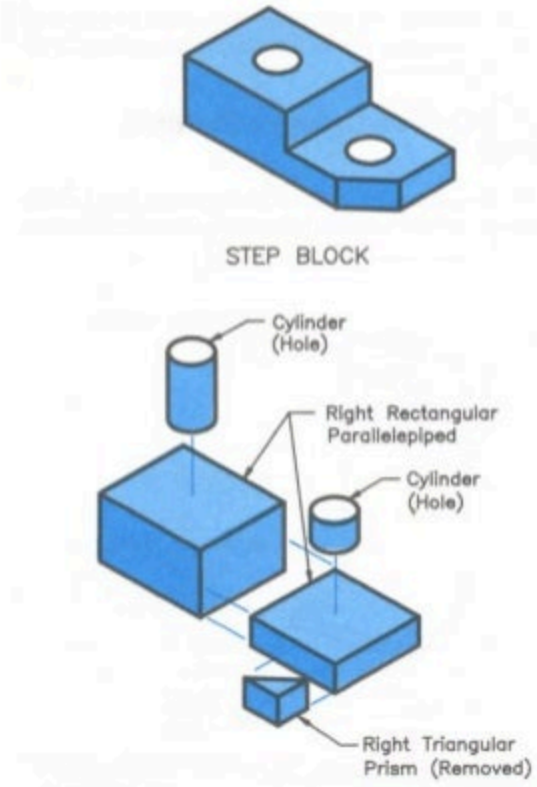
Engineering Drawing

Introduction

- An **engineering drawing** is a type of technical drawing, used to fully and clearly define requirements for engineered items, and is usually created in accordance with standardized conventions for layout, nomenclature, interpretation, appearance size, etc.
- Its purpose is to accurately and unambiguously capture all the geometric features of a product or a component.
- The end goal of an engineering drawing is to convey all the required information that will allow a manufacturer to produce that component.

Purpose of an Engineering Drawing

1. An engineering drawing is not an illustration.
2. It is a specification of the size and shape of a part or assembly.
3. The important information on a drawing is the dimension and tolerance of all of its features.



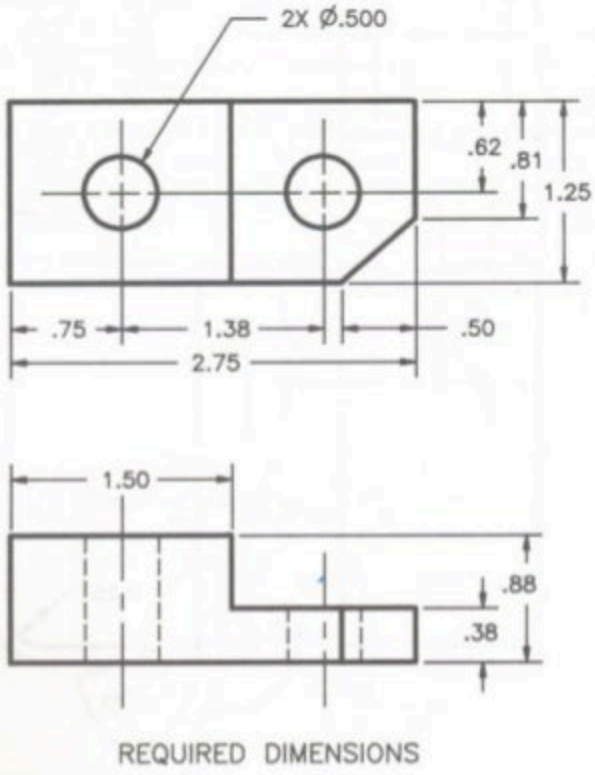


Figure 3-23. Mentally breaking a part into the geometric shapes that form the part is one method for determining the dimensions needed on a drawing.

Elements of Engineering Drawing

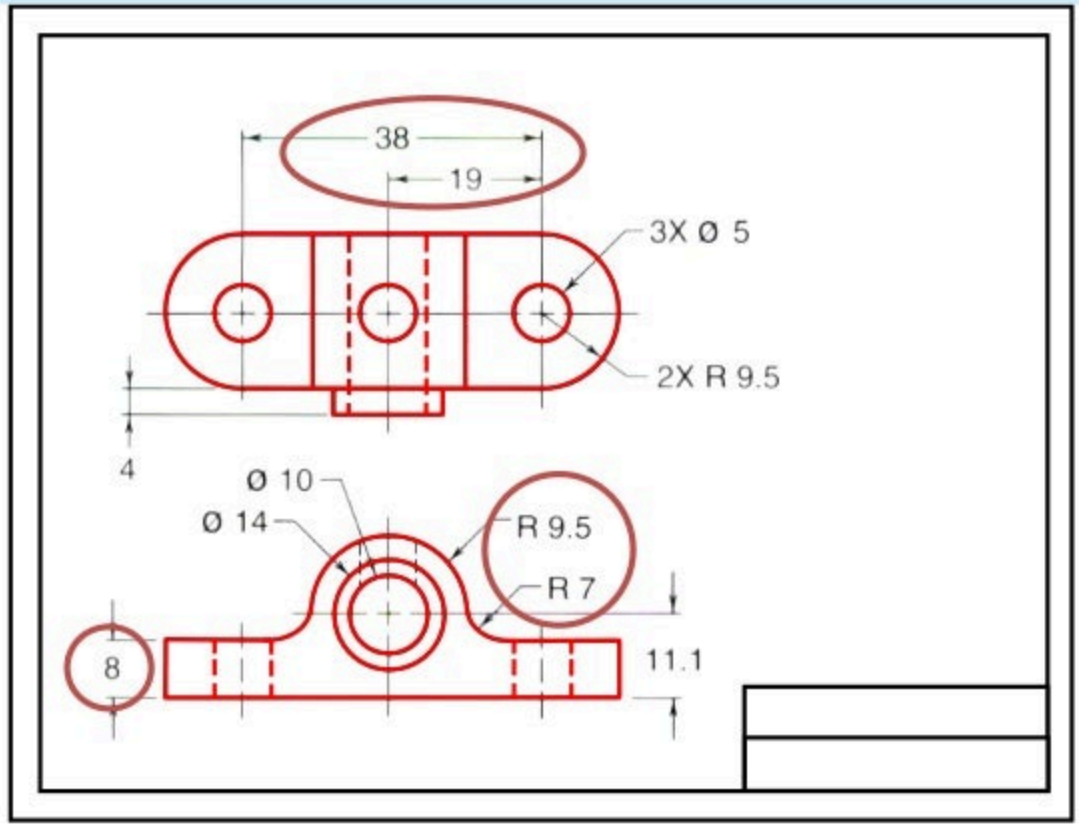
Engineering drawing are made up of ***graphics language*** and ***word language***.

Graphics language

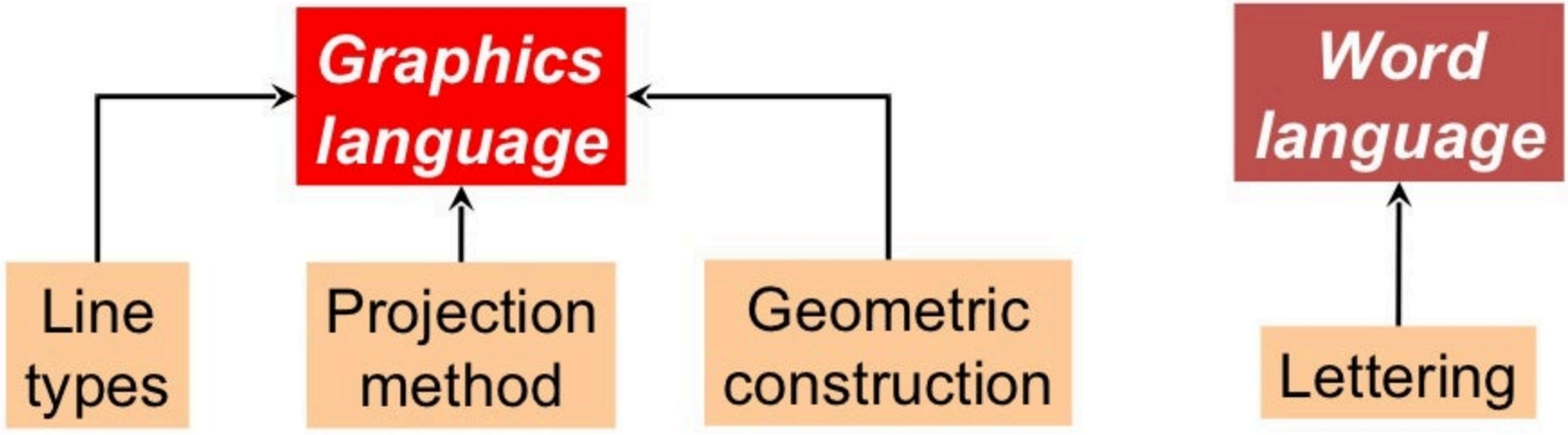
Describe a shape (mainly).

Word language

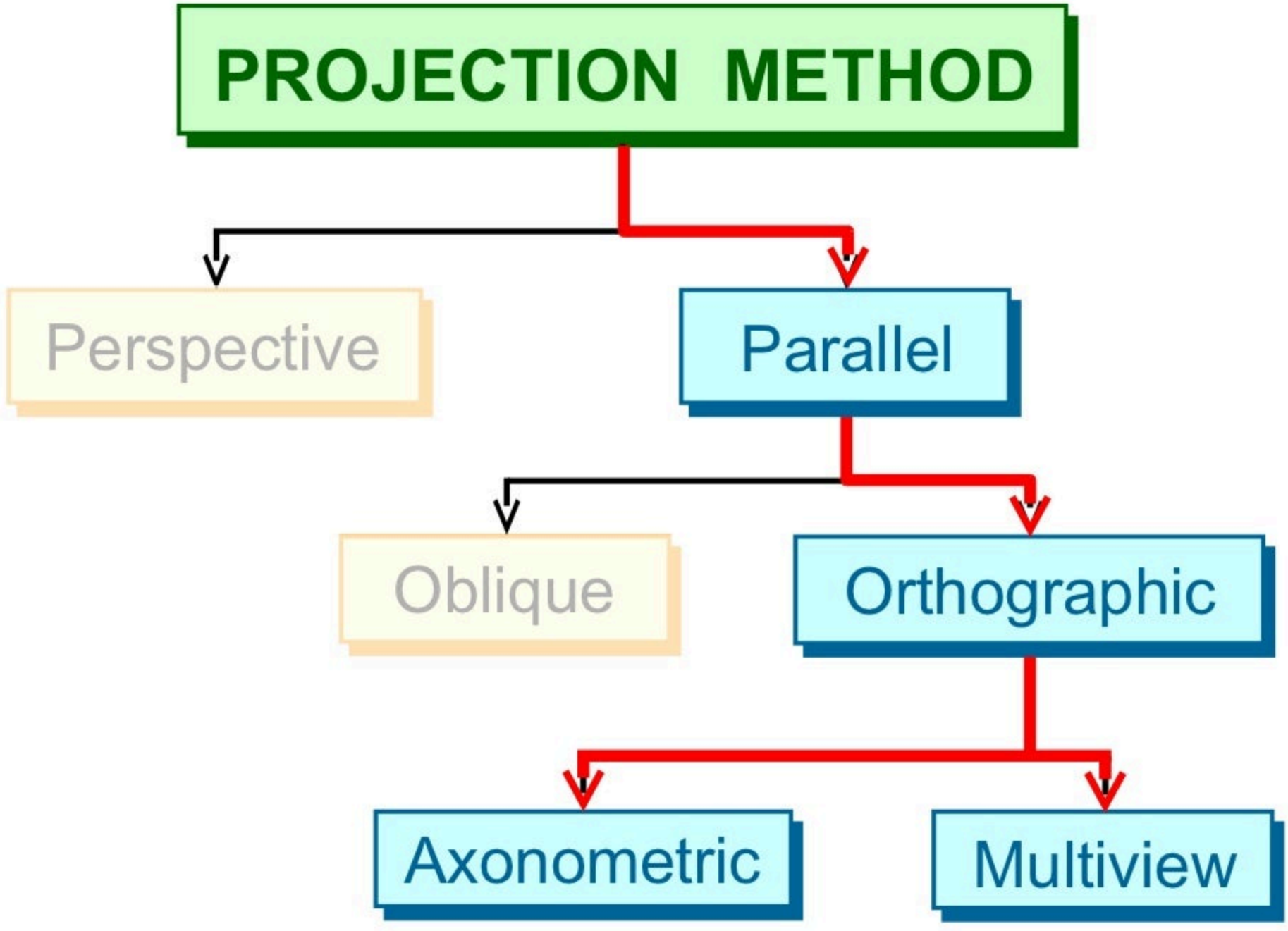
Describe size, location and specification of the object.



Basic Knowledge for Drafting



PROJECTION METHOD


PROJECTION METHOD
Perspective
Parallel
Oblique
Orthographic
Axonometric
Multiview

PROJECTION THEORY

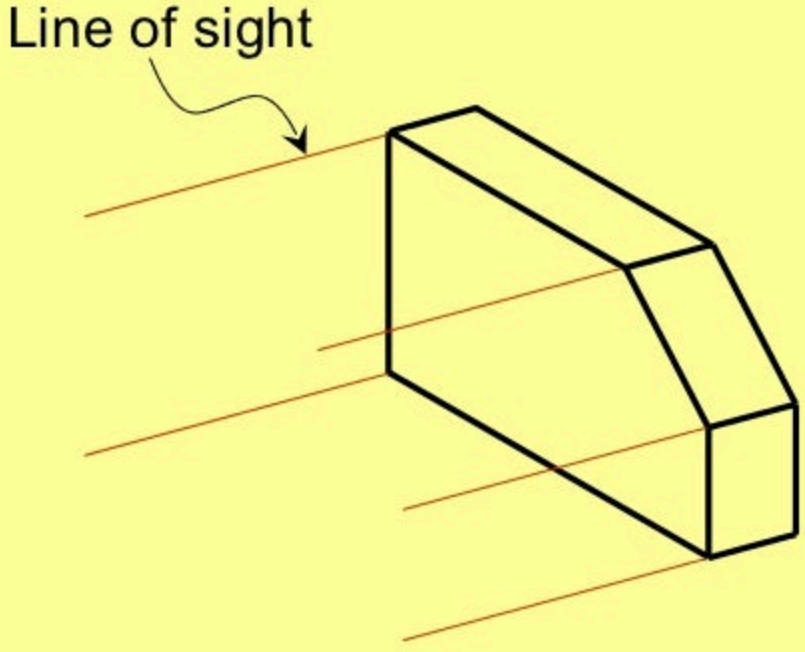
- The projection theory is used to graphically represent 3-D objects on 2-D media (paper, computer screen).

- The projection theory is based on two variables:
  1) Line of sight
  2) Plane of projection (image plane or picture plane)

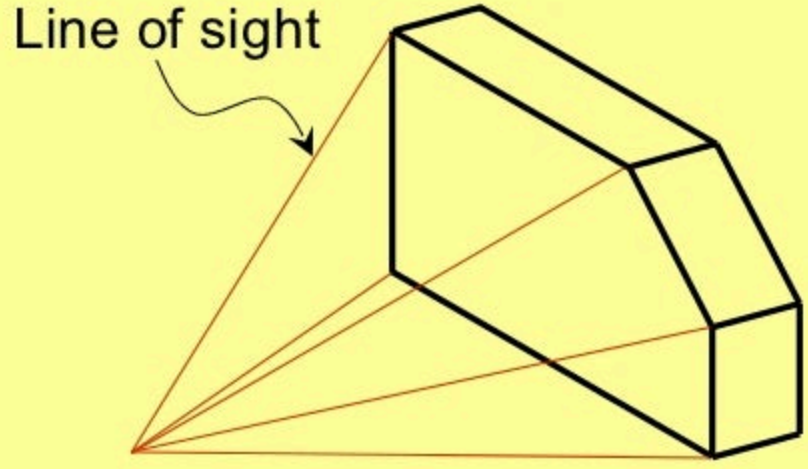
Line of sight is an imaginary ray of light between an observer's eye and an object.

- There are 2 types of LOS : parallel and converge

Parallel projection



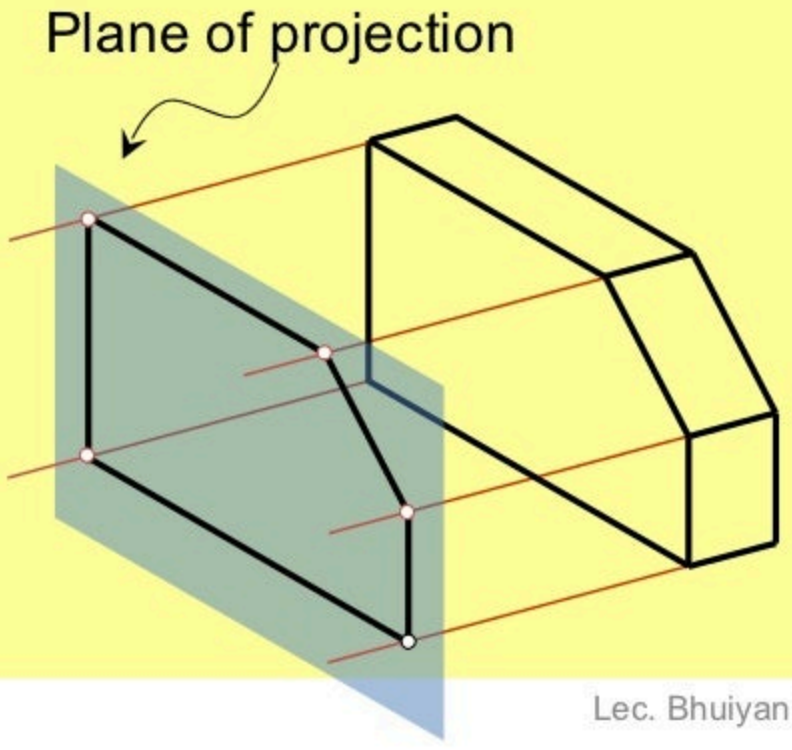
Perspective projection



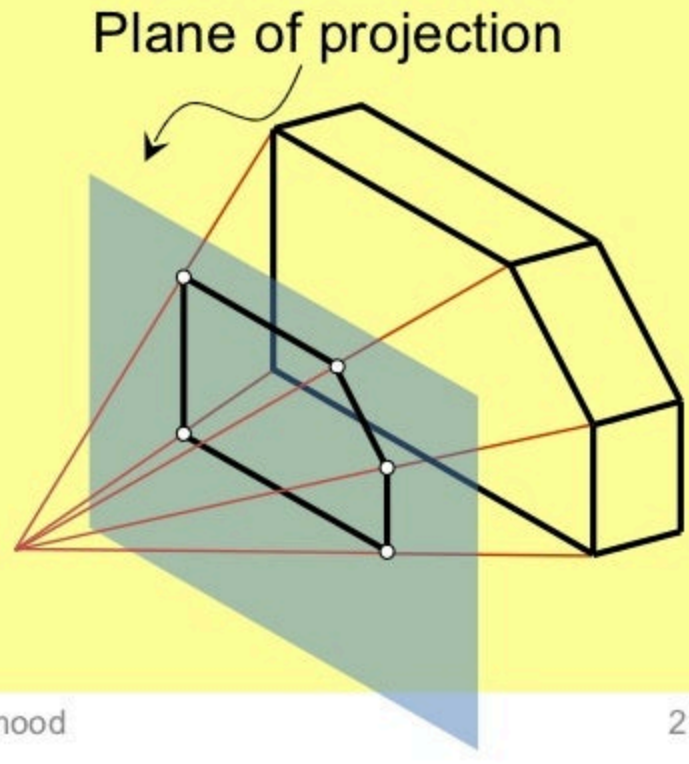
Plane of projection is an imaginary flat plane which the image is created.

- The image is produced by connecting the points where the LOS pierce the projection plane.

Parallel projection



Perspective projection



Disadvantage of Perspective Projection

- Perspective projection is ***not*** used by engineer for manu-facturing of parts, because

1) It is difficult to create.
2) It does not reveal exact shape and size.

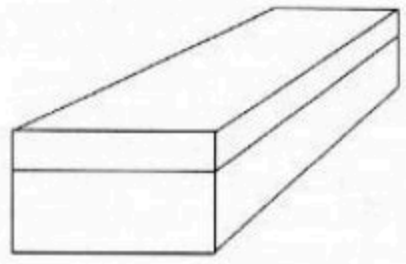
Orthographic Projection

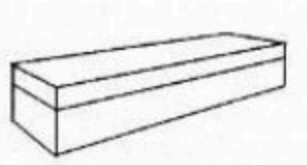
Orthographic projection

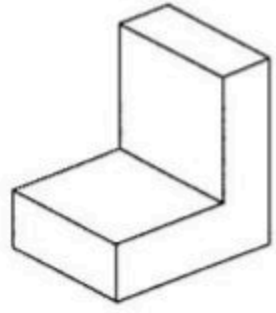
- Orthographic" comes from the Greek word for "straight writing (or drawing)." This projection shows the object as it looks from the front, right, left, top, bottom, or back, and are typically positioned relative to each other according to the rules of either “First Angle” or “Third Angle” projection.

Pictorial

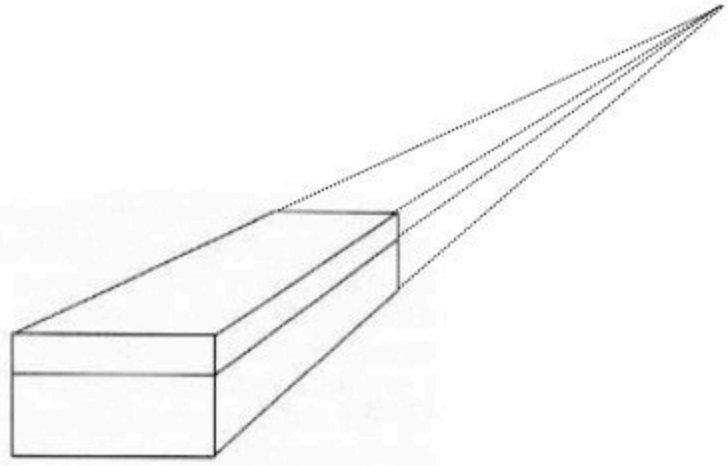
- 3-dimensional representations
  - One-point
    - one vanishing point
    - lines that are not vertical or horizontal converge to single point in distance
  - Two-point or Three-point
    - two or three vanishing points
      - With two points, vertical **or** horizontal lines parallel, but not both
      - With three-point, no lines are parallel
  - Isometric
    - Drawing shows corner of object, but parallel lines on object are parallel in drawing
    - Shows three dimensions, but no vanishing point(s)

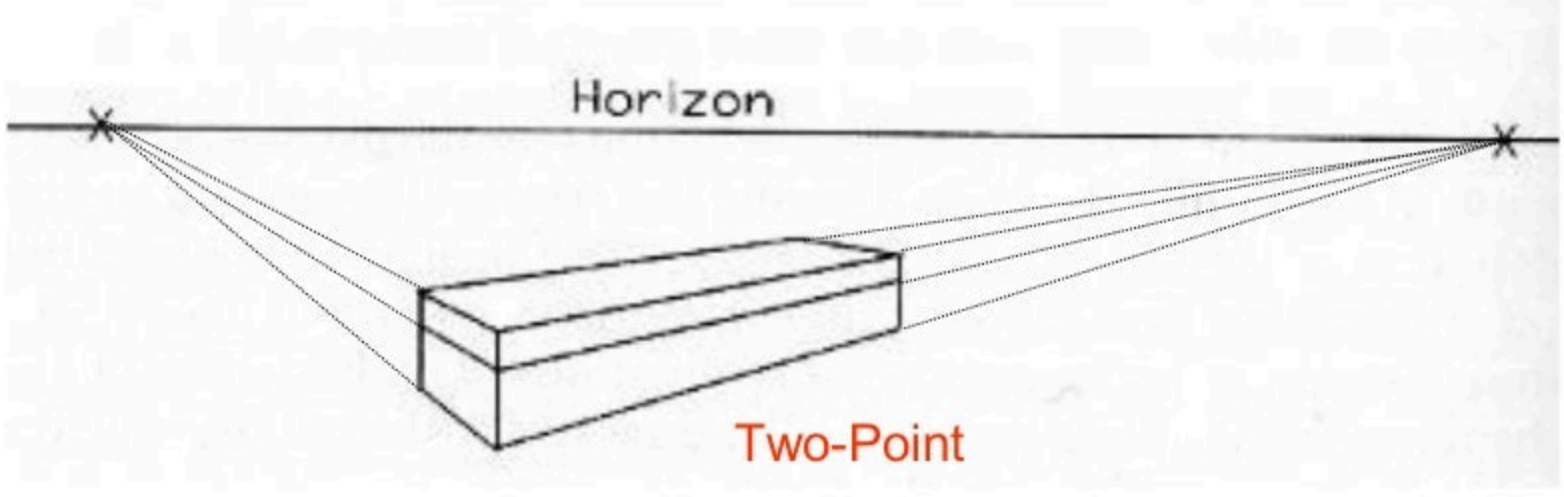




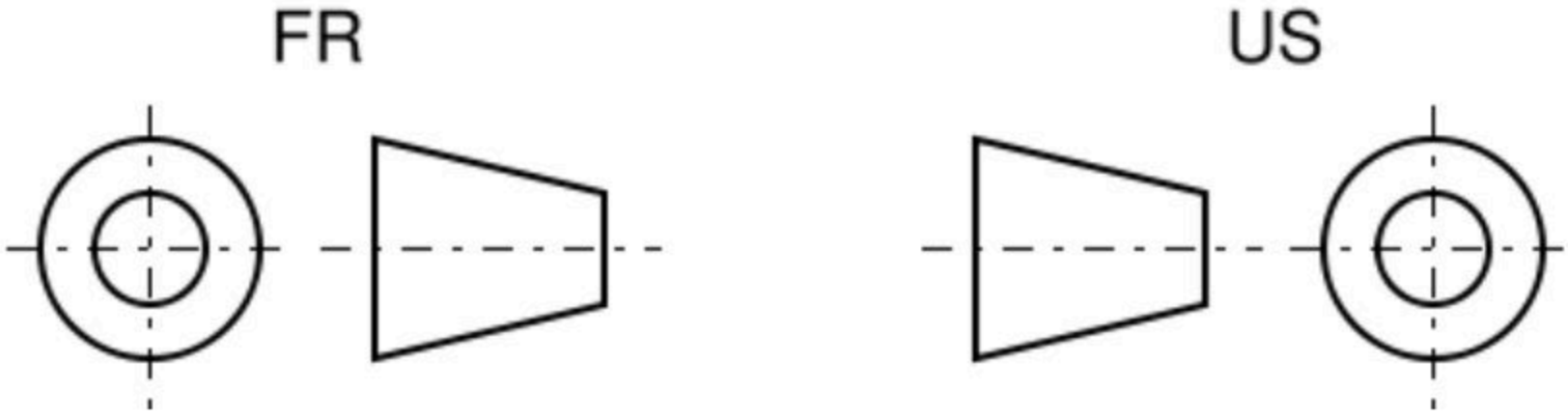


One-point





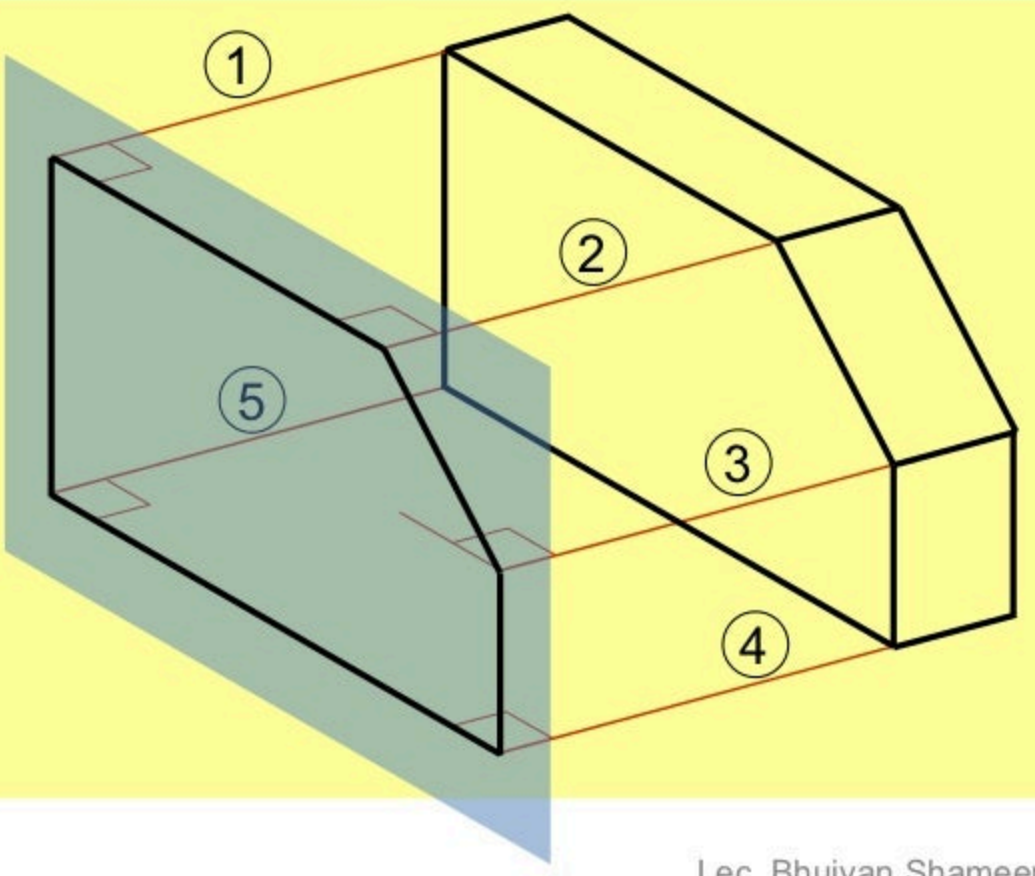
Symbols for Third Angle (right)or First Angle (left).



- First angle projection is the ISO standard and is primarily used in Europe. The 3D object is projected into 2D "paper" space as if you were looking at an X-ray of the object: the top view is under the front view, the right view is at the left of the front view.
- Third angle projection is primarily used in the United States and Canada, where it is the default projection system according to BS 8888:2006, the left view is placed on the left the top view on the top.

MEANING

Orthographic projection is a parallel projection technique in which the parallel lines of sight are ***perpendicular*** to the projection plane



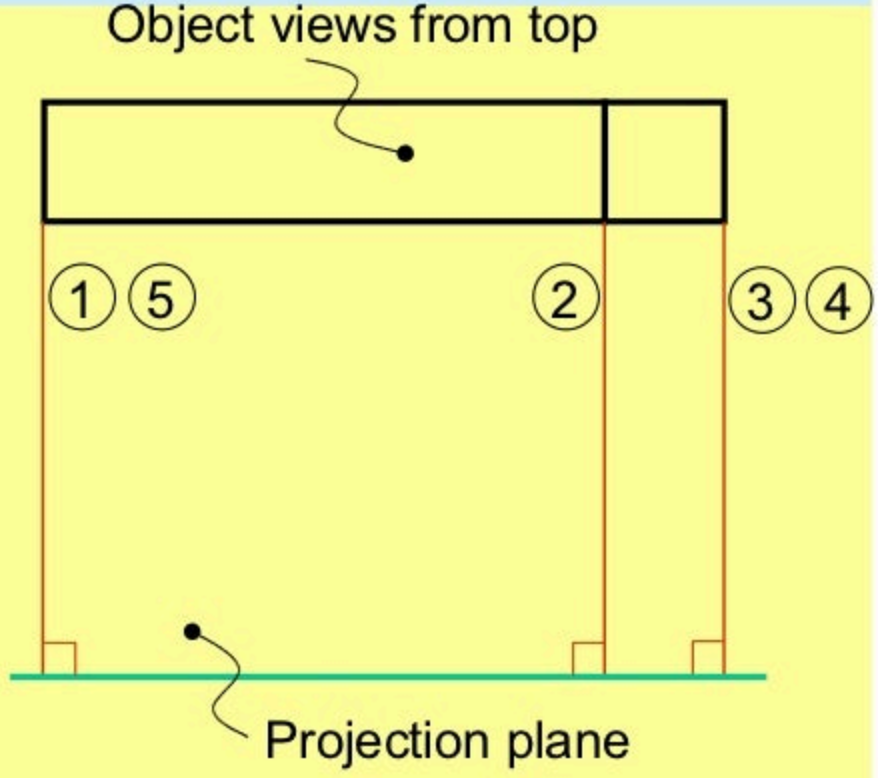
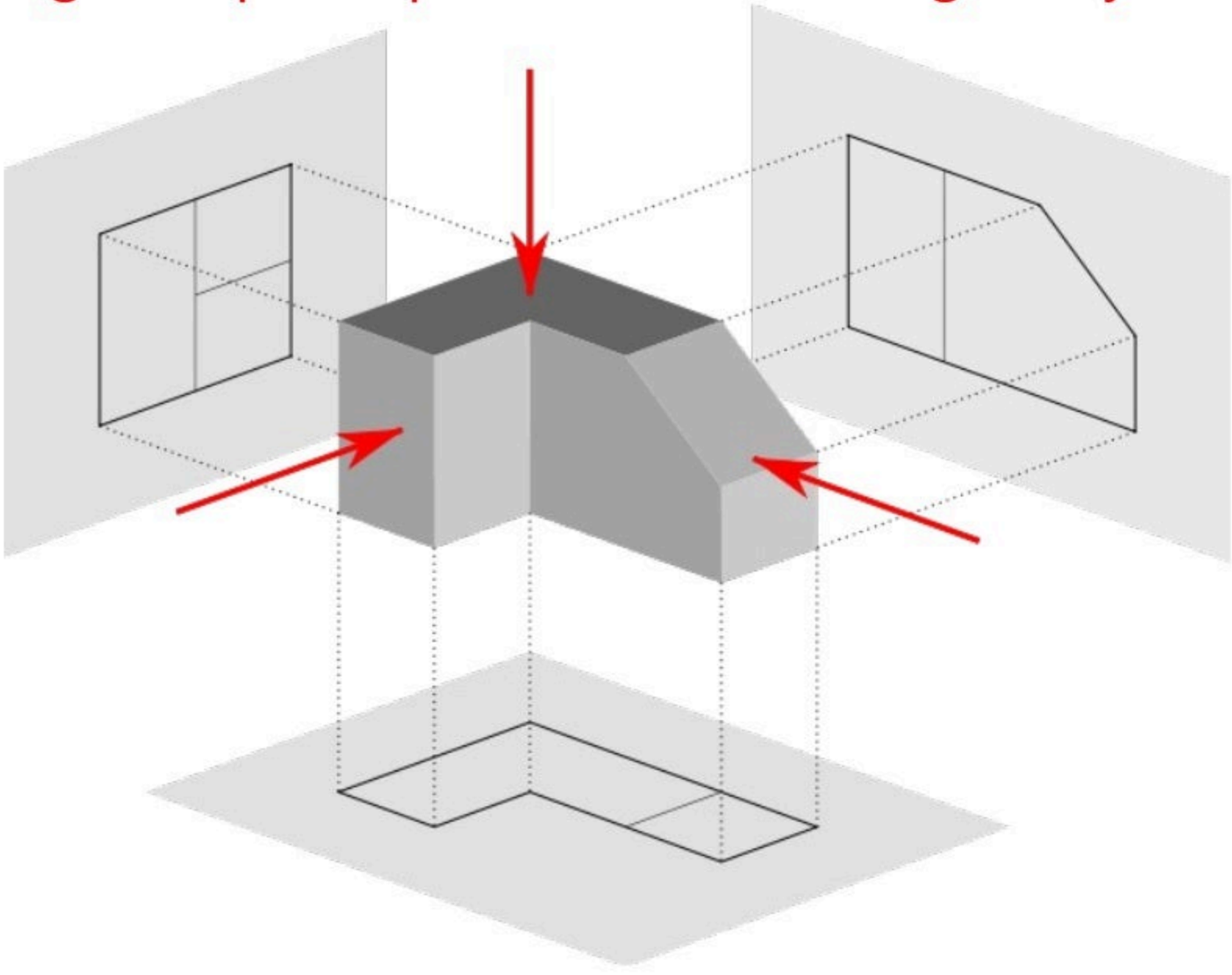
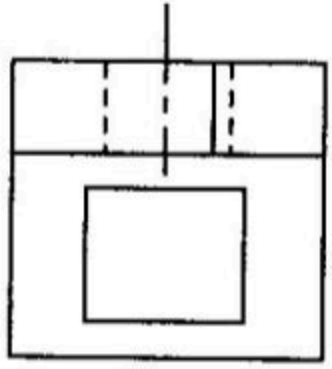


Image of a part represented in First Angle Projection

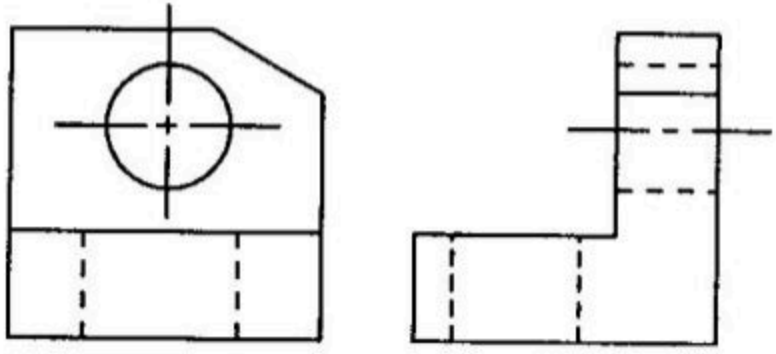


Orthographic / Multiview

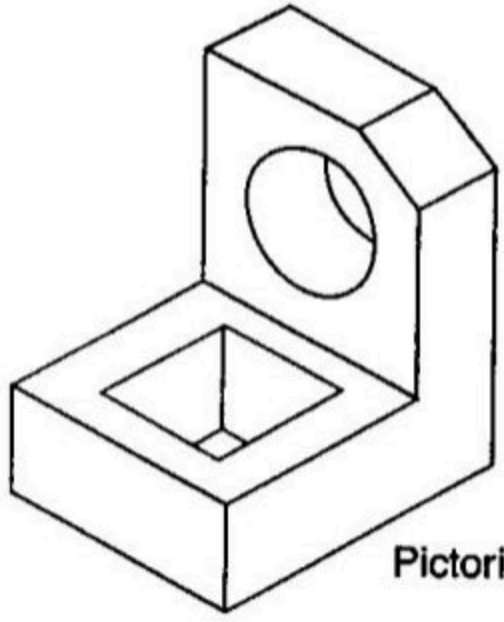
- Draw object from two / three perpendicular views



Multiview
with hidden and
center lines

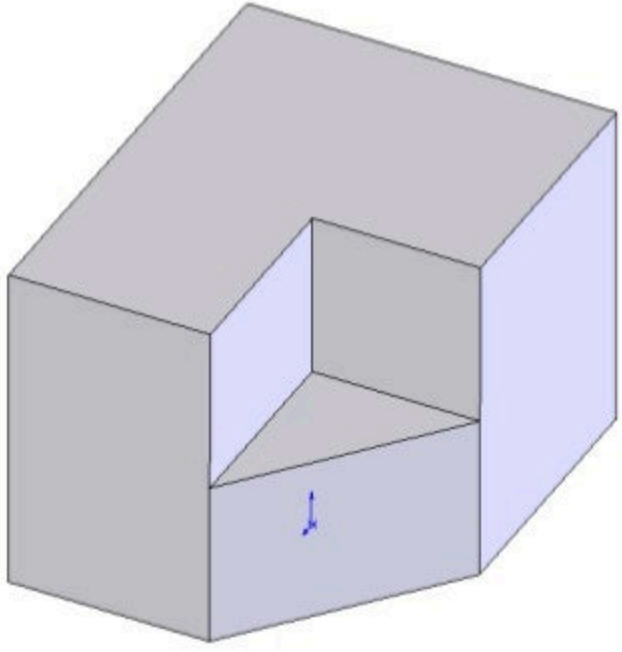


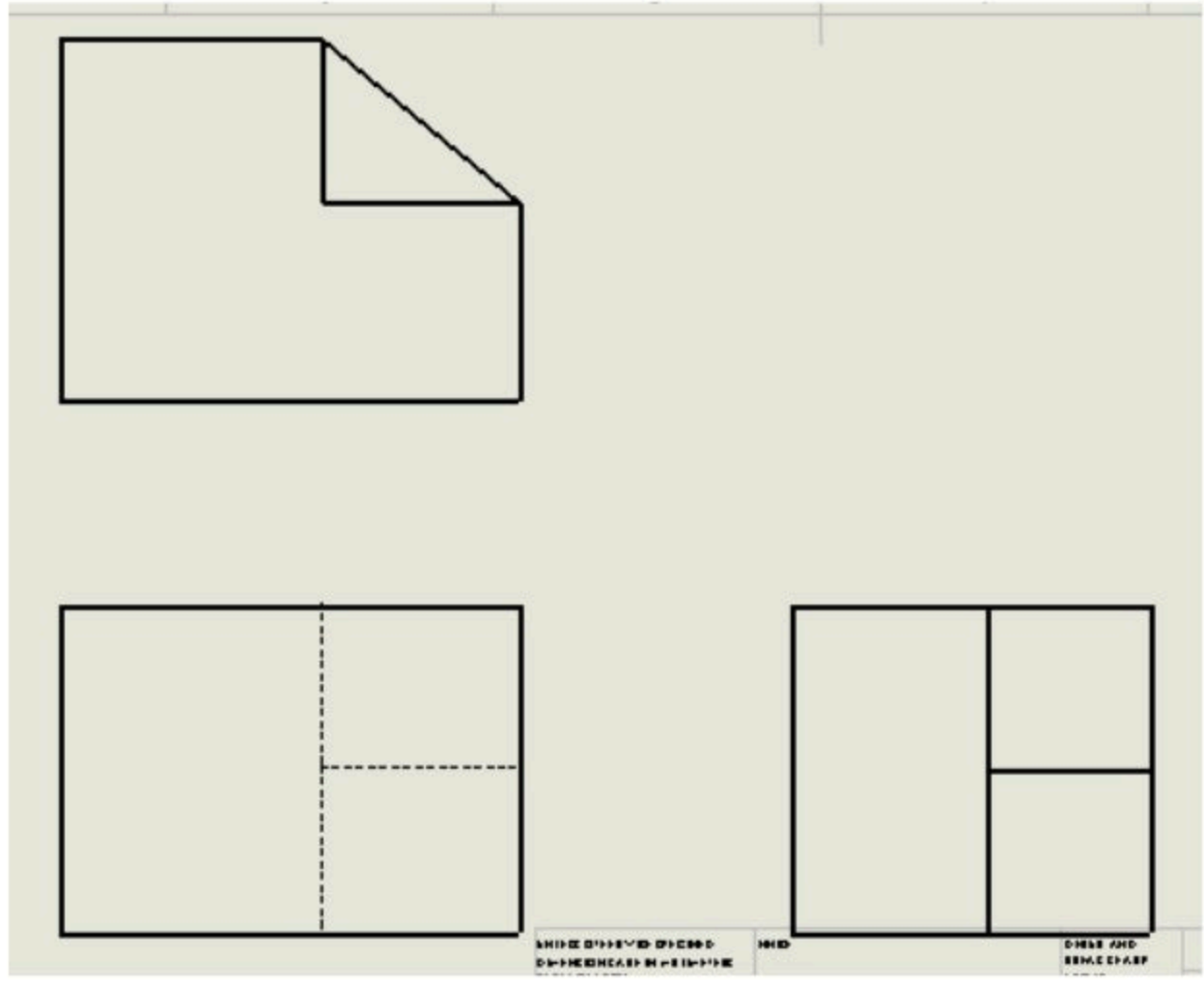
Multiview drawing. / Orthographic

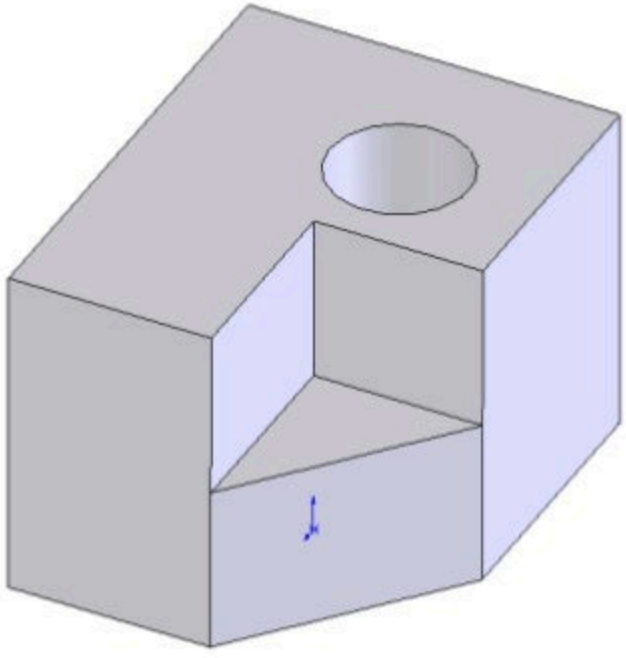


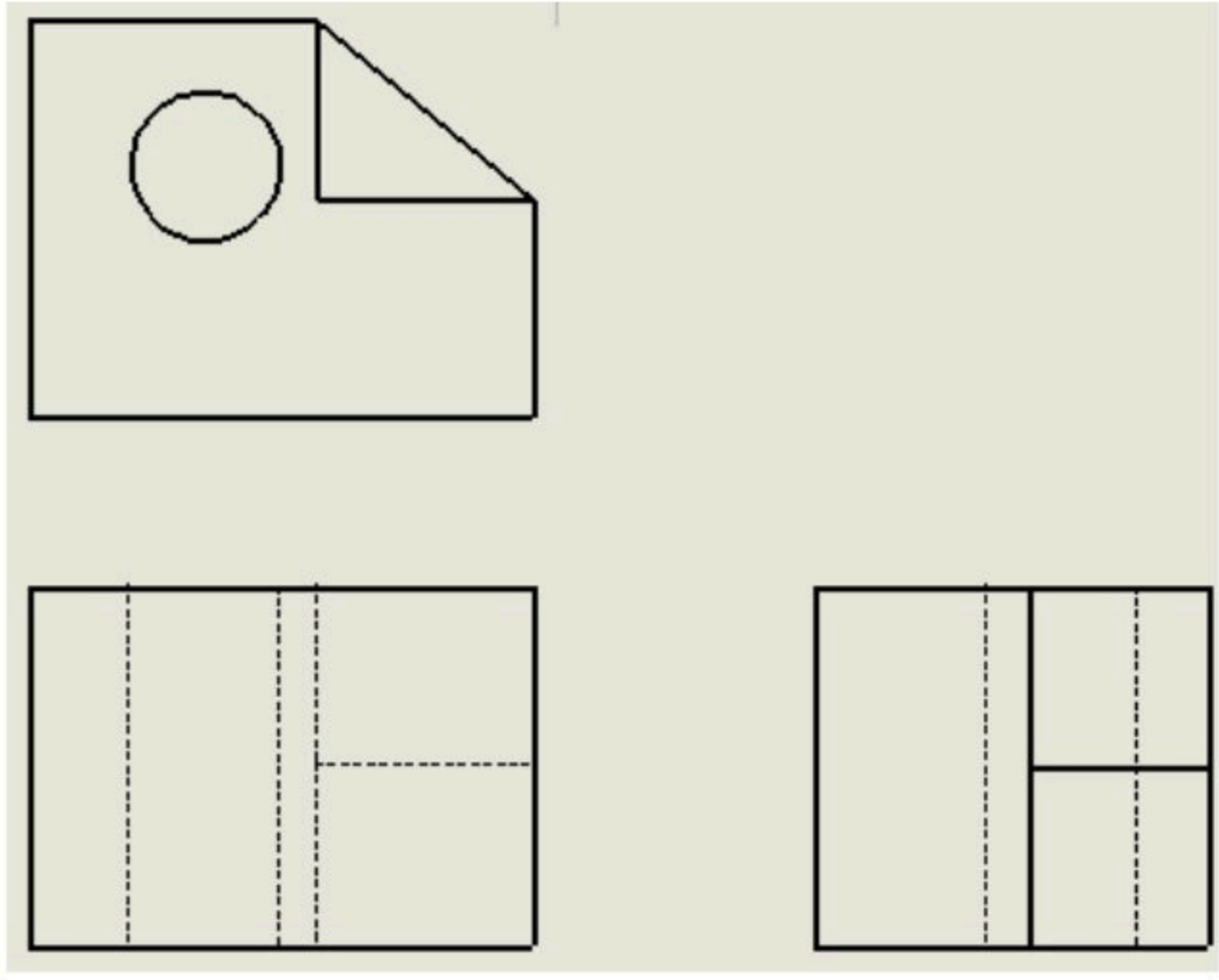
Pictorial

What it looks
like pictorially







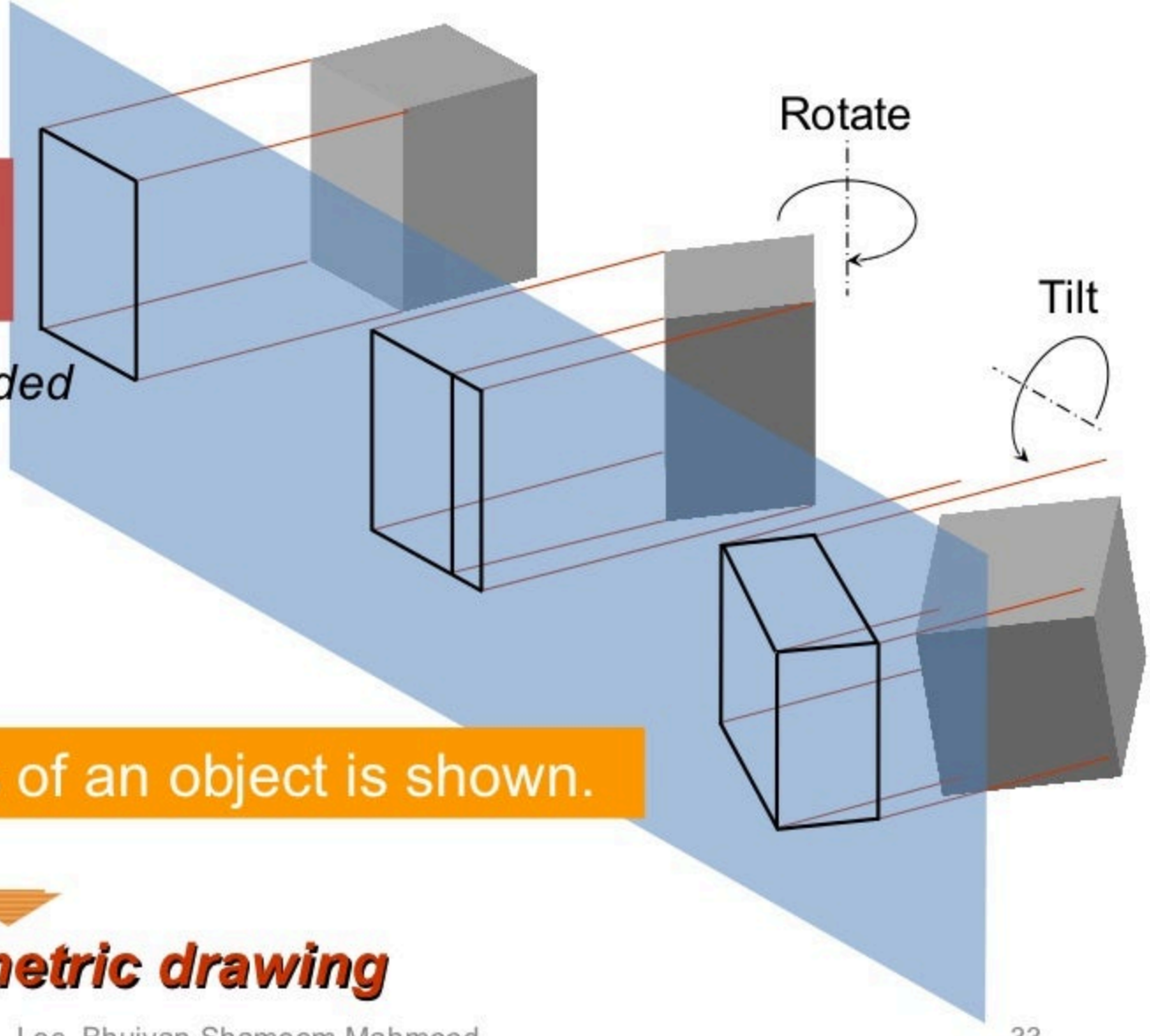


ORTHOGRAPHIC VIEW

Orthographic view depends on relative position of the object to the line of sight.

Two dimensions of an object is shown.

More than one view is needed to represent the object.



Multiview drawing

Three dimensions of an object is shown.

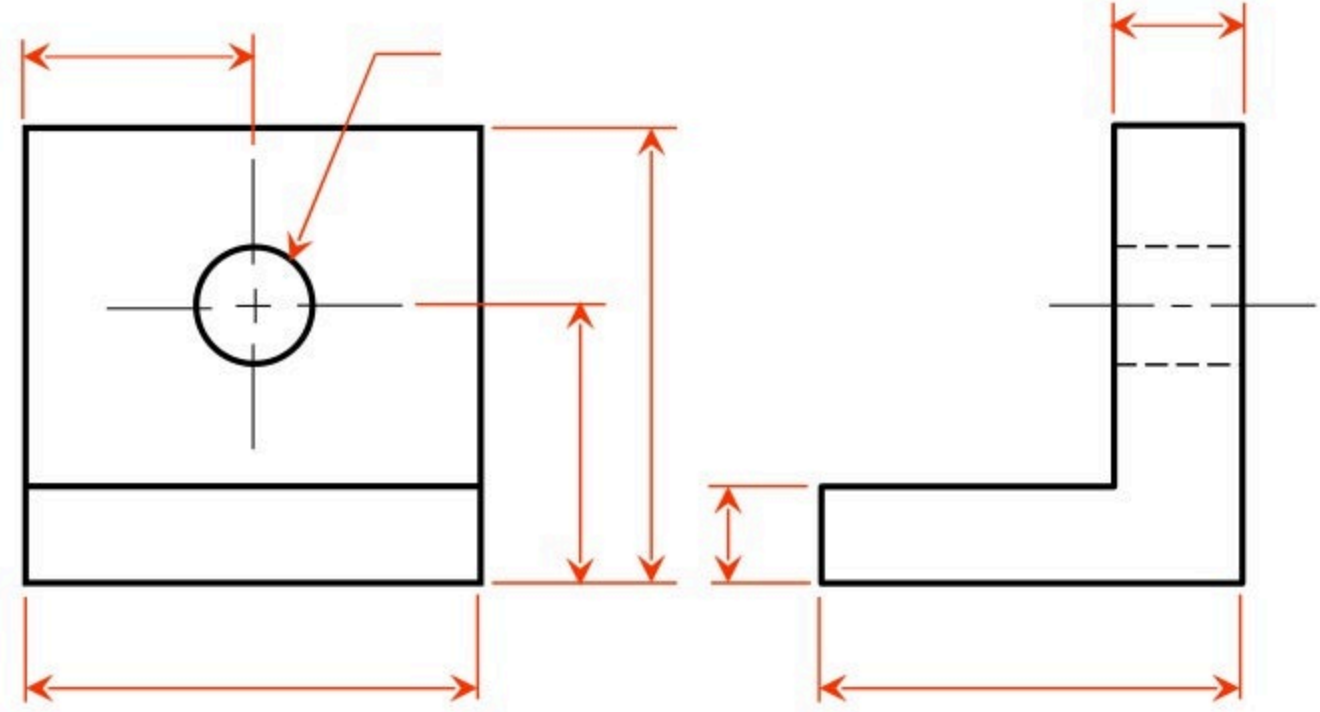
Axonometric drawing

Multiview Drawing

Advantage It represents accurate **shape and size.**

Disadvantage Require practice in writing and reading.

Example Multiviews drawing (2-view drawing)

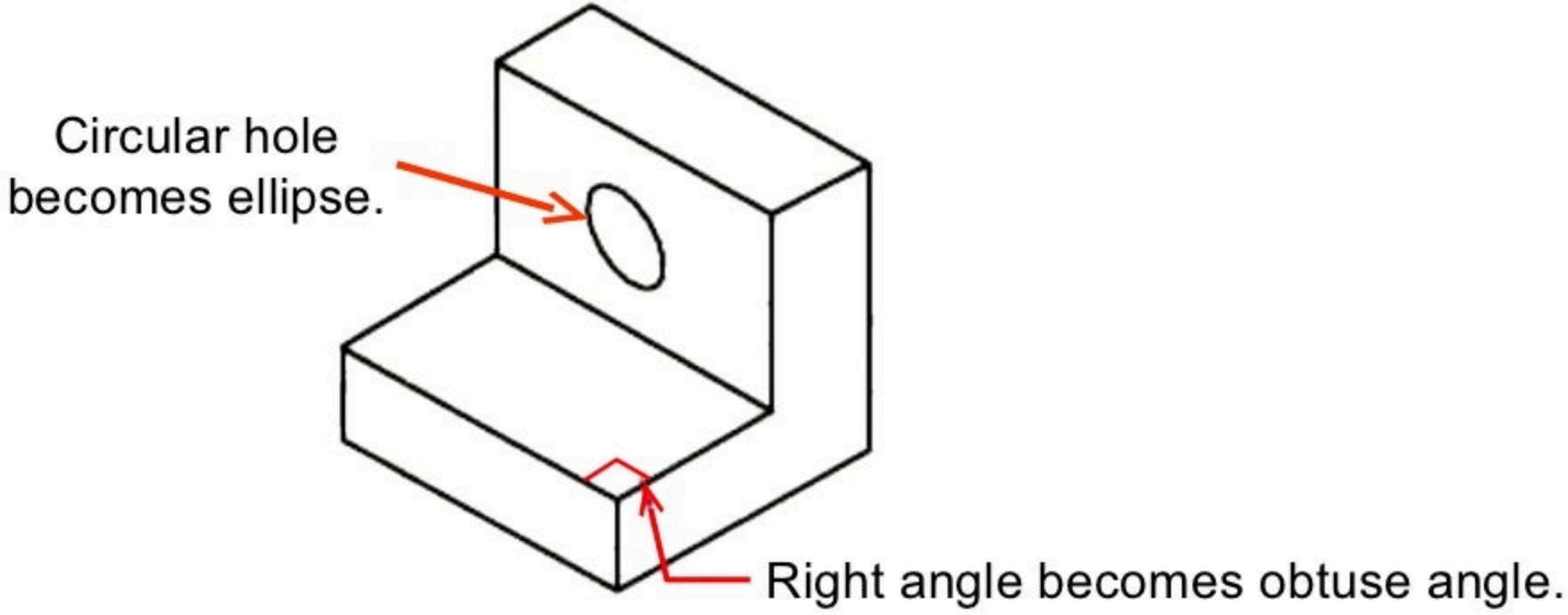


Axonometric (Isometric) Drawing

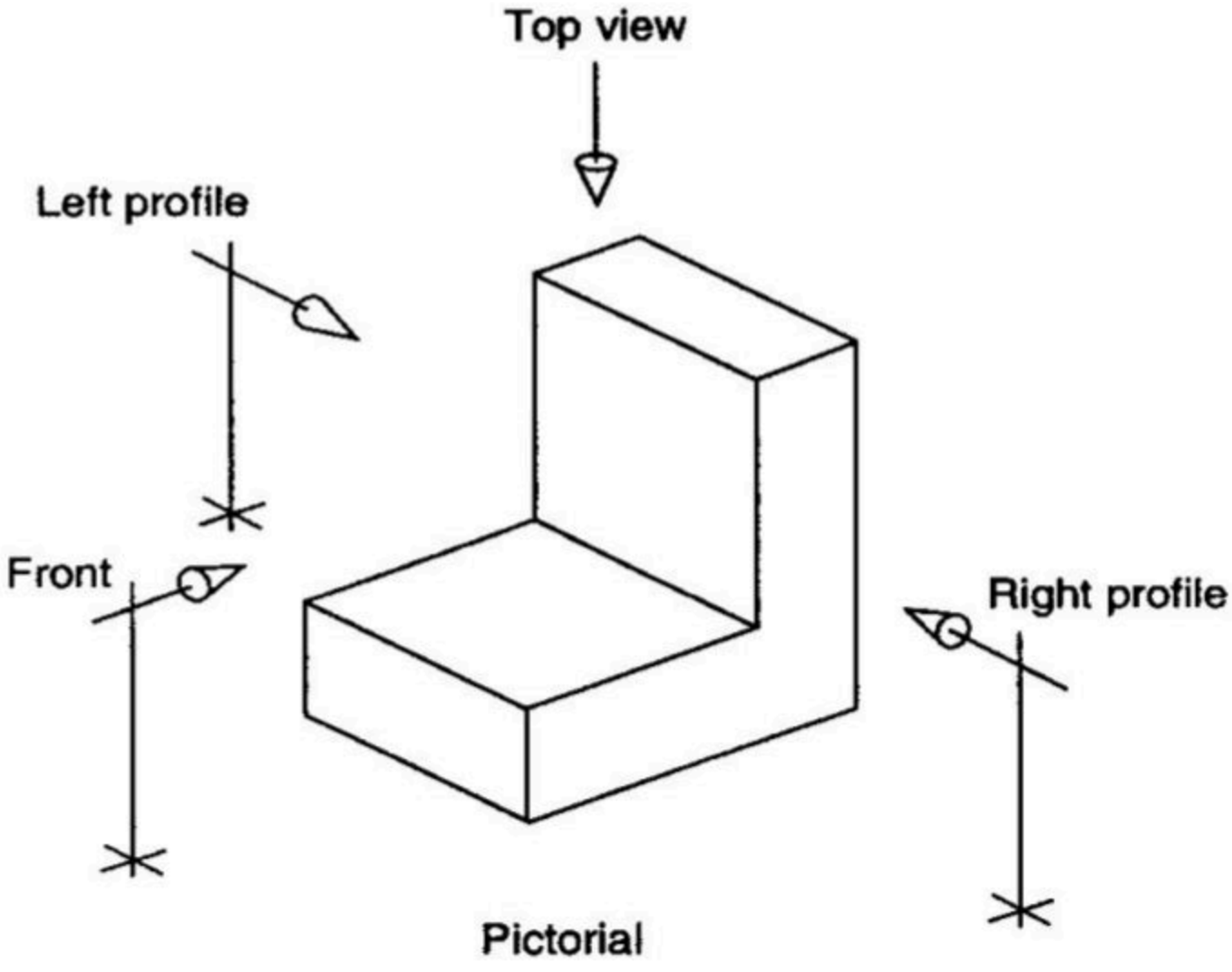
Advantage Easy to understand

Disadvantage Shape and angle distortion

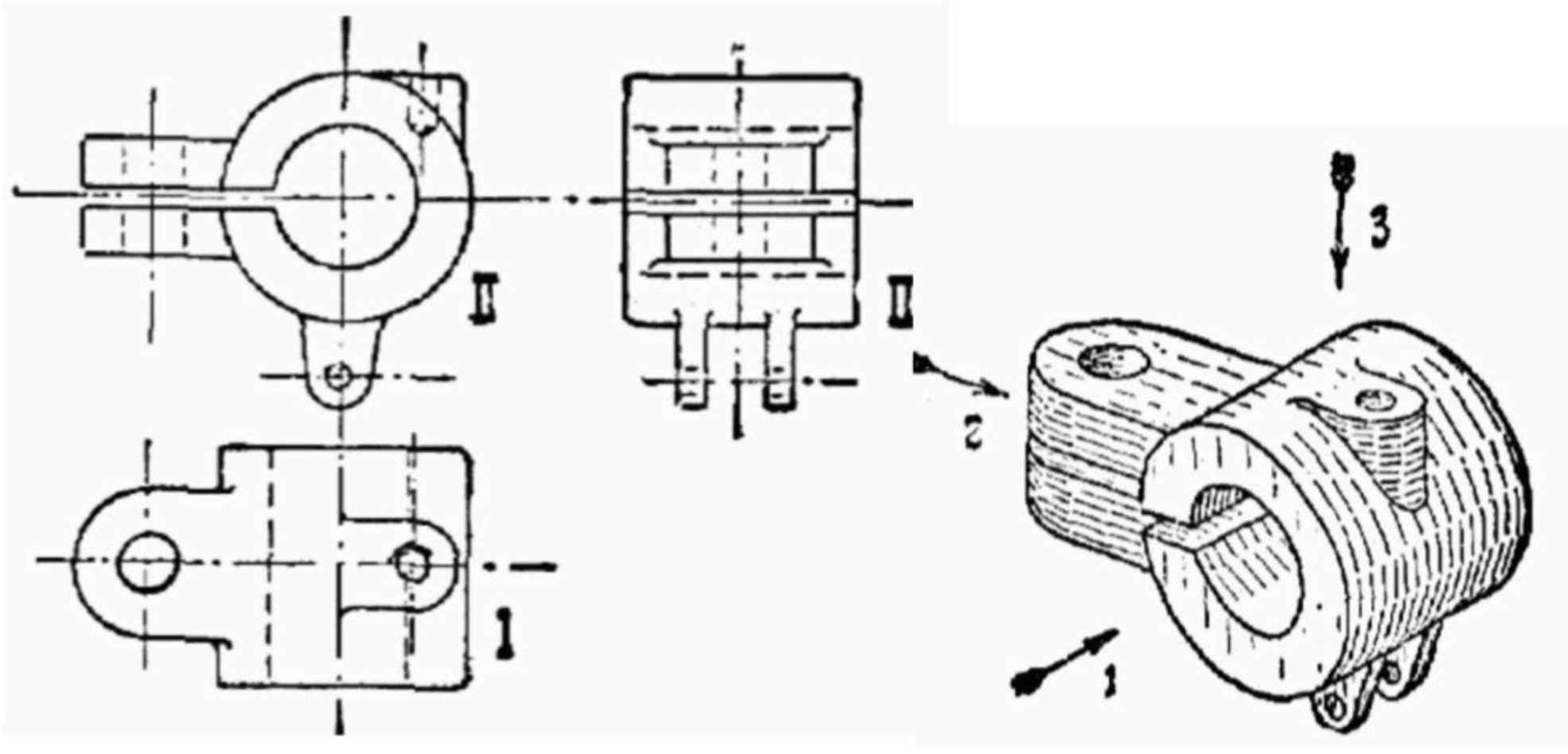
Example Distortions of shape and size in isometric drawing



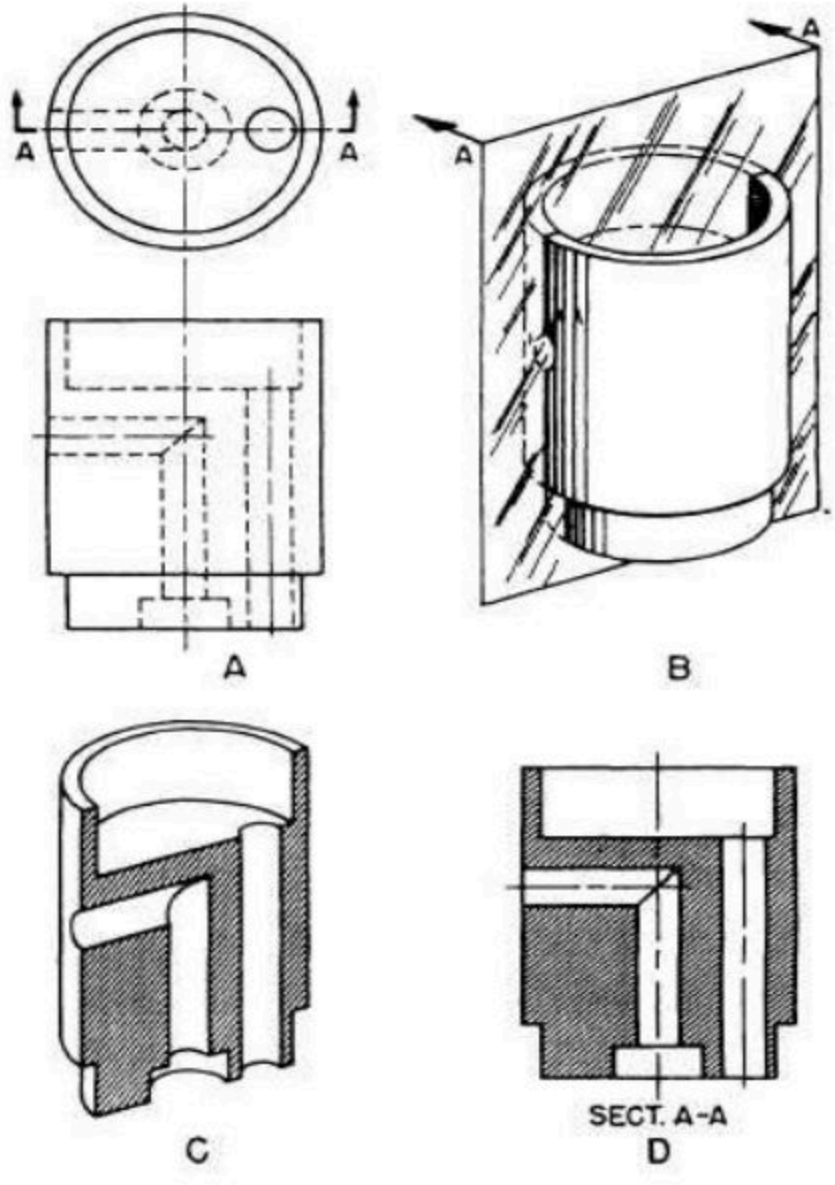
Isometric projection



Isometric projection

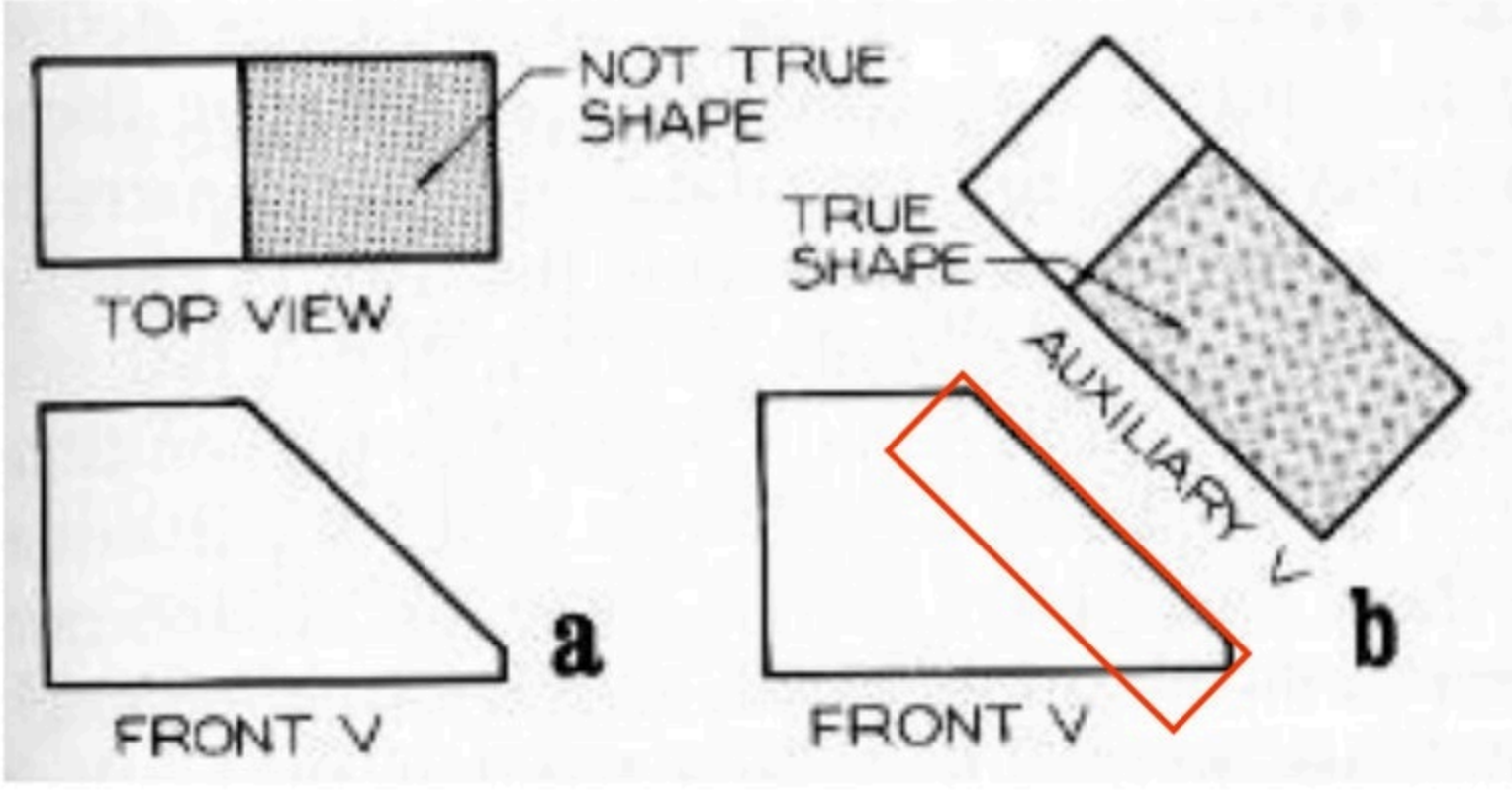


Sectional views

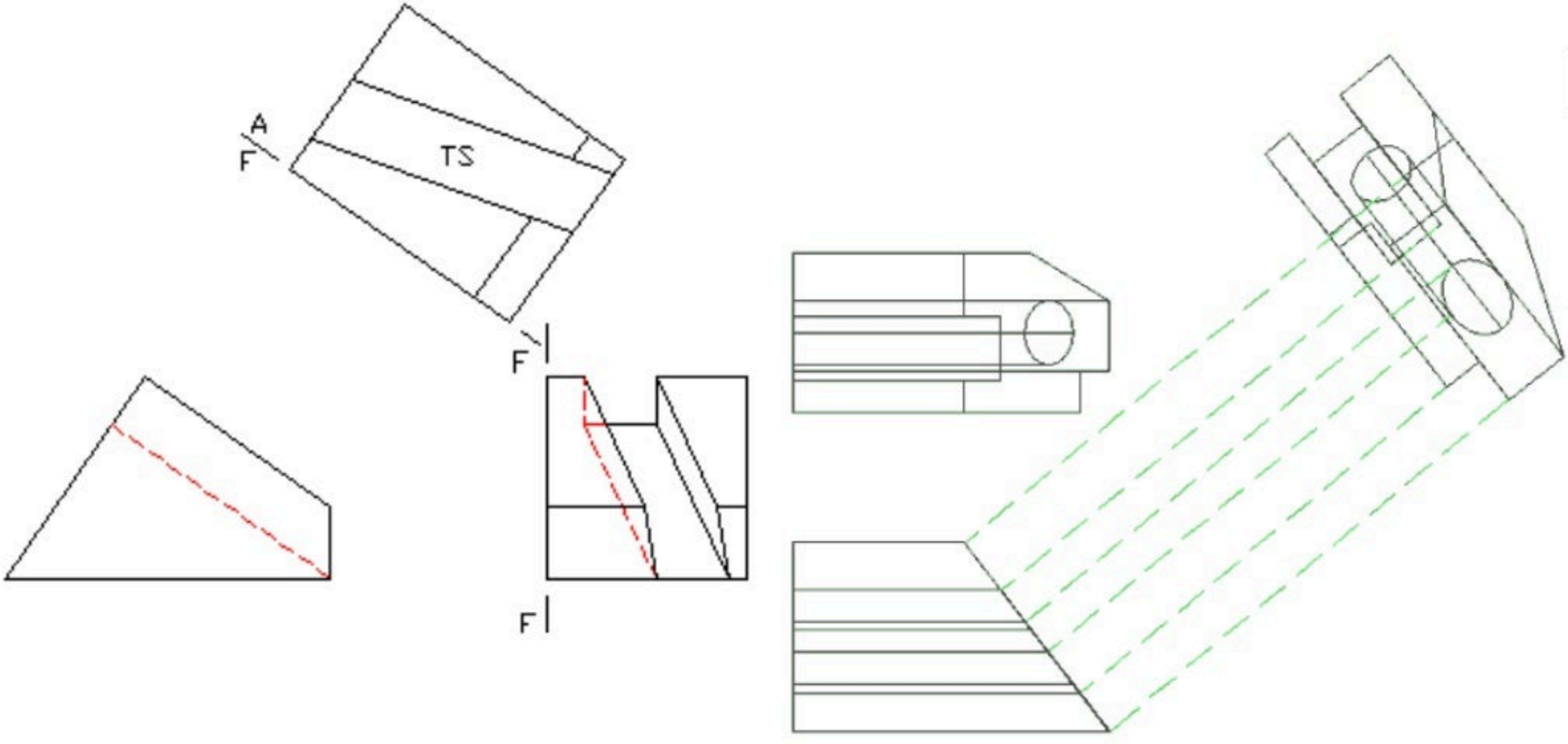


Auxiliary Views

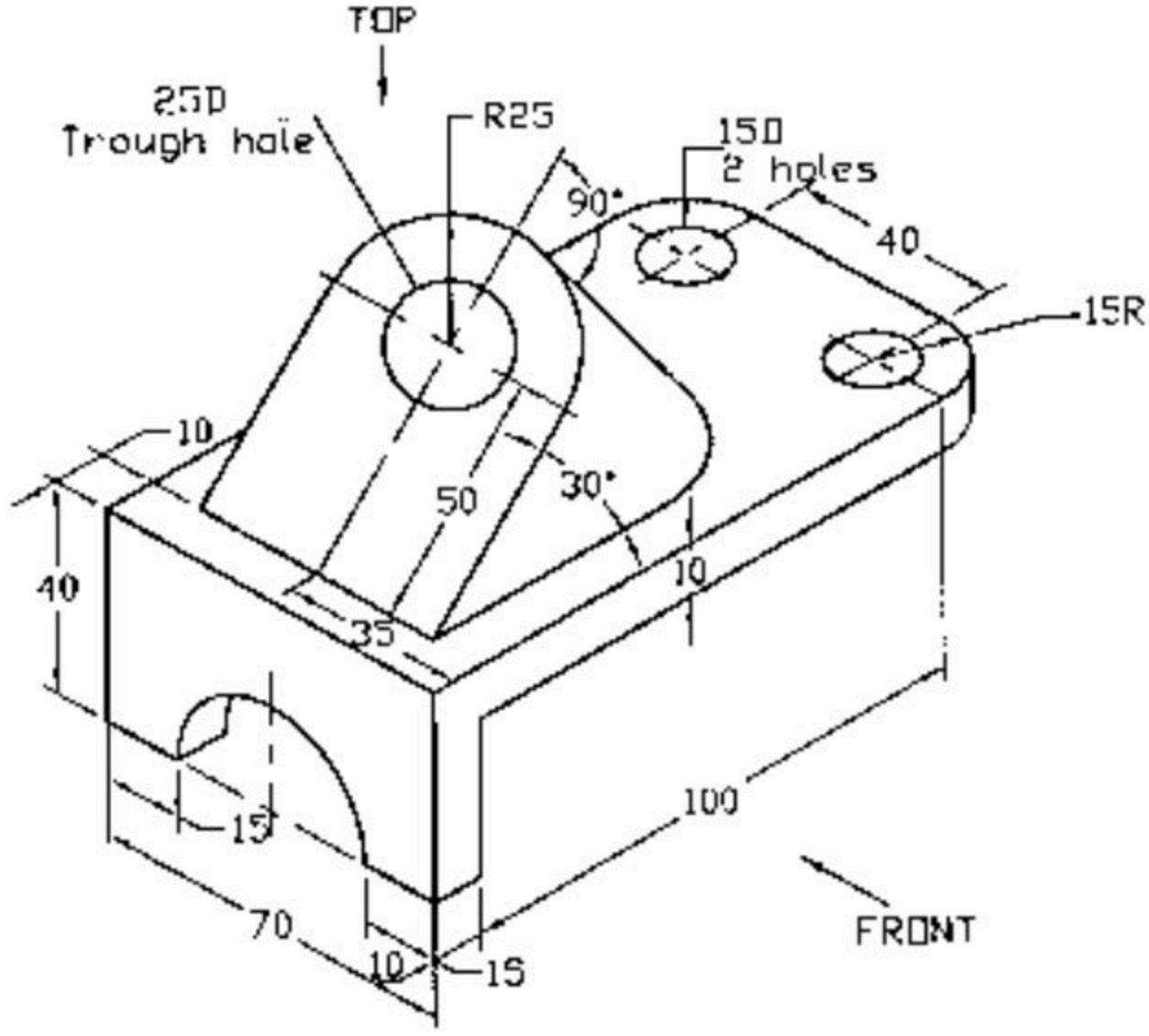
- Used to show true dimensions of an inclined plane.



Auxiliary projection



Auxiliary projection

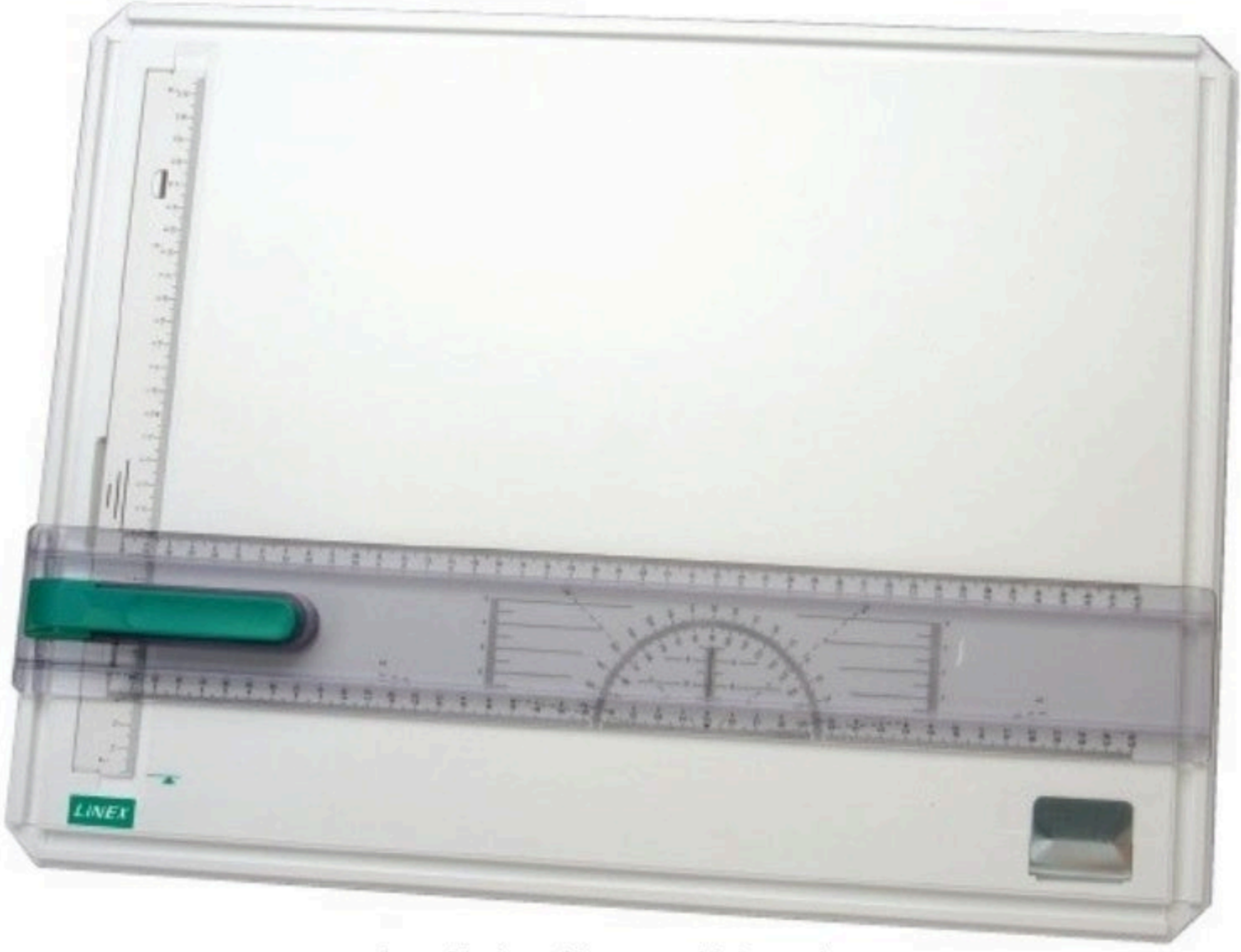


Traditional Drawing Tools

Instruments

- Drawing board/table.
- Drawing sheet/paper.
- Drafting tape.
- Pencils.
- Eraser.
- Sharpener.
- T-square.
- Set-squares/triangles.
- Scales.
- Compass and divider.

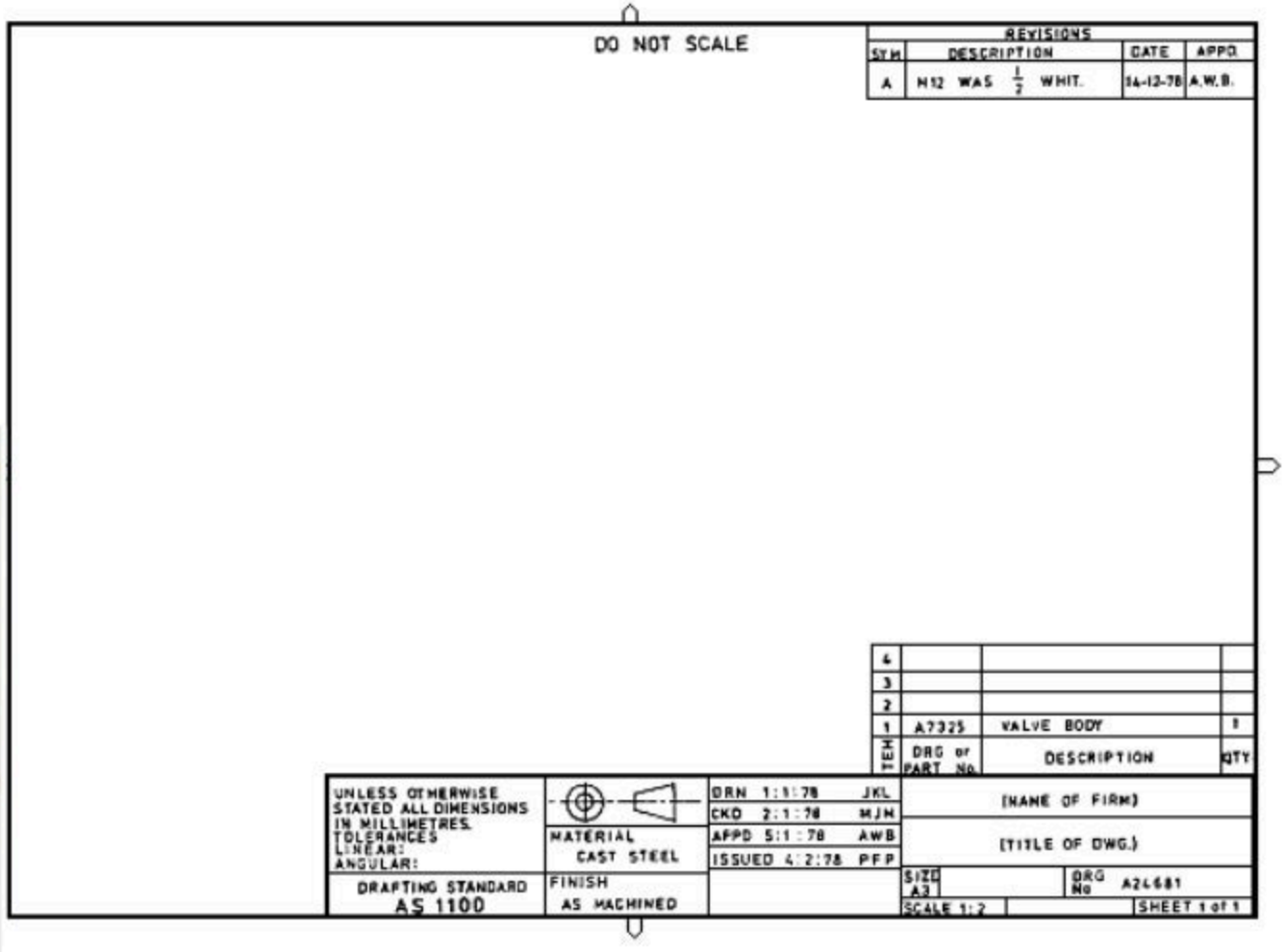
Drawing board



Drawing table

Drawing sheet/paper

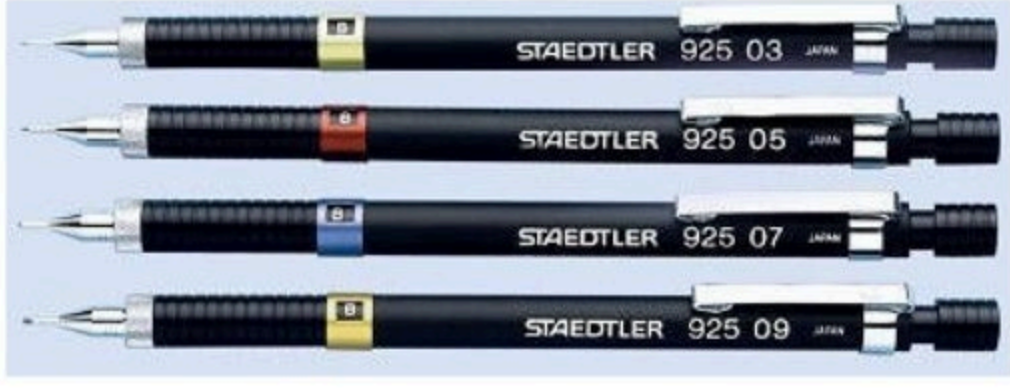
- 216 X 280 mm
- 280 X 382 mm
- 382 X 560 mm
- **585 X 726 mm**



Drafting tape

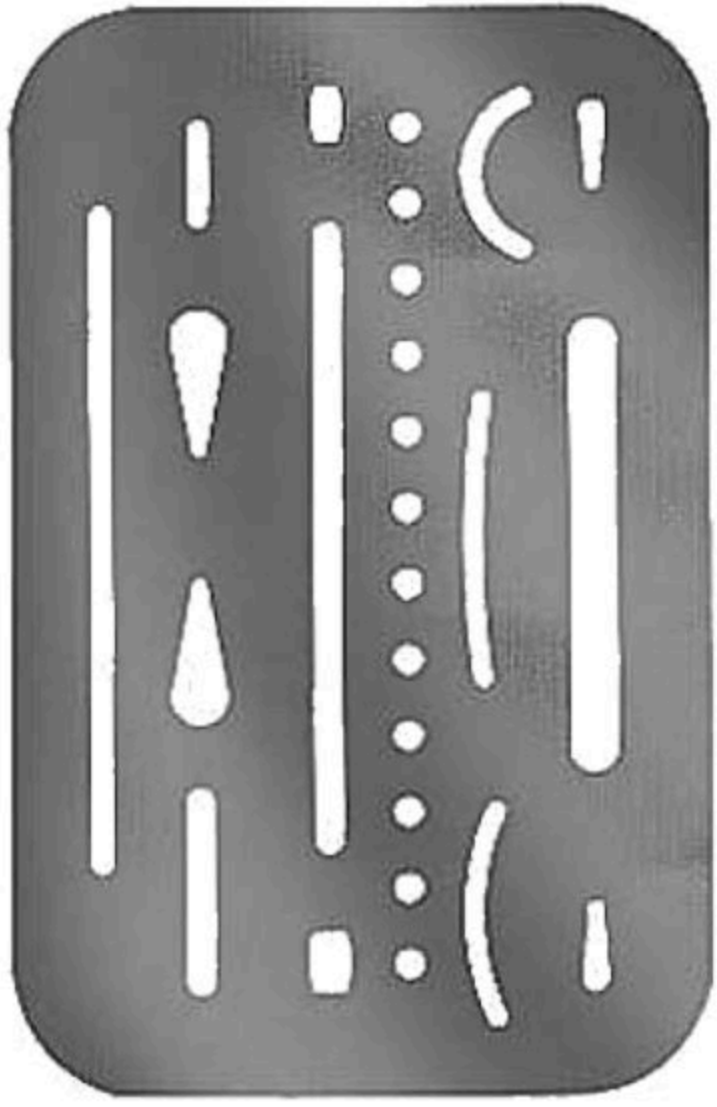
Pencils

- Wood pencils: H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H, B, HB, 2B, 3B, 4B, 5B, 6B.
- Semiautomatic Pencils (lead holder) are more convenient then ordinary wood pencils.

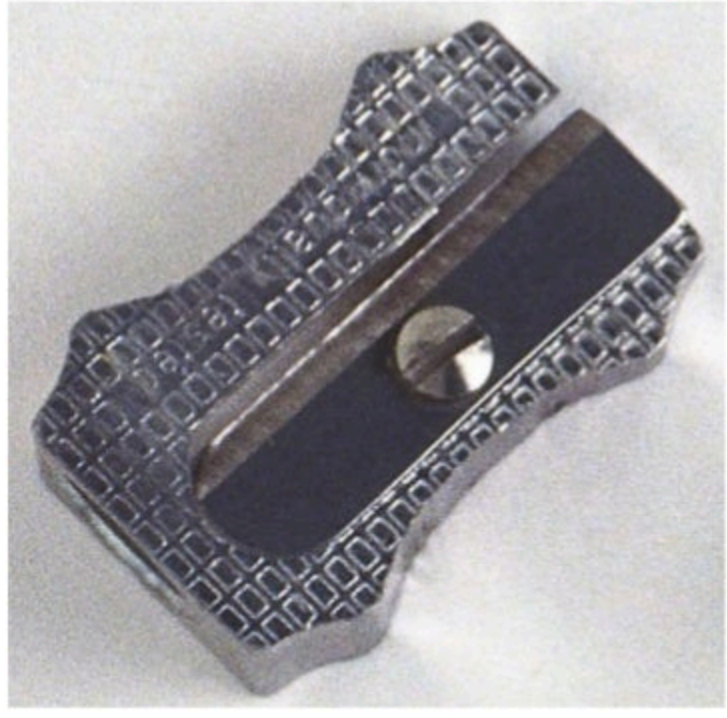


Eraser

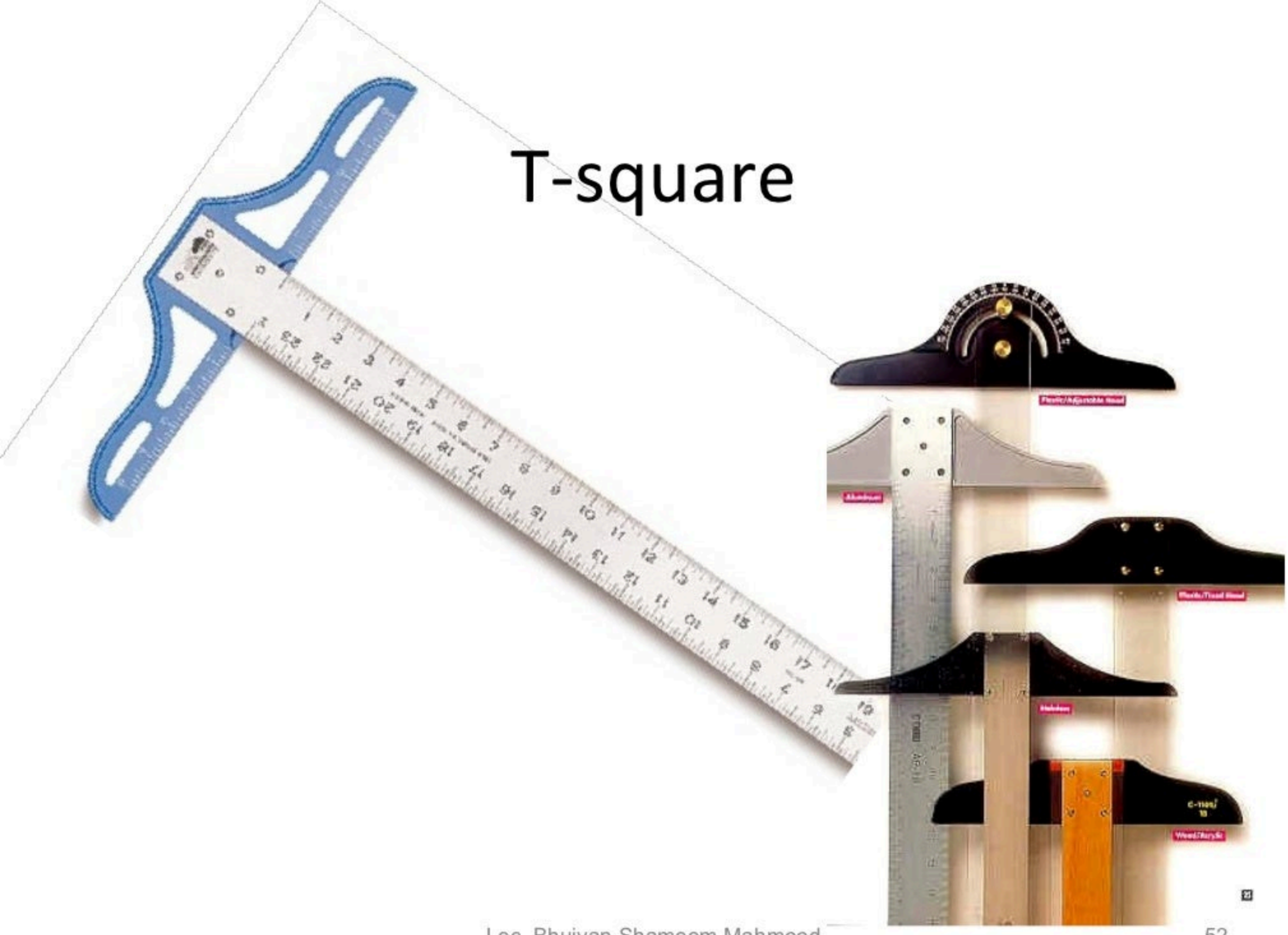
Erasing Shield

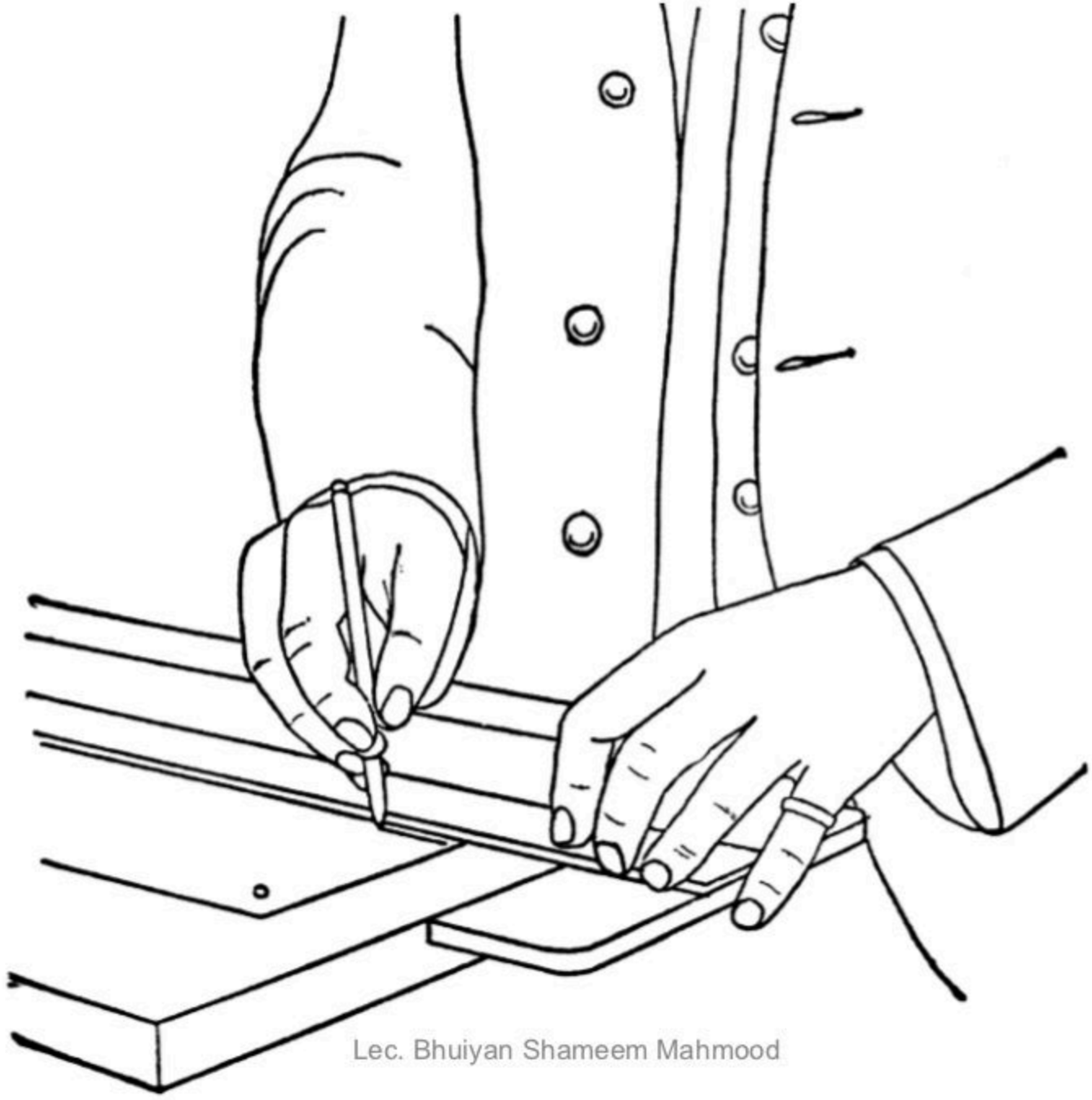


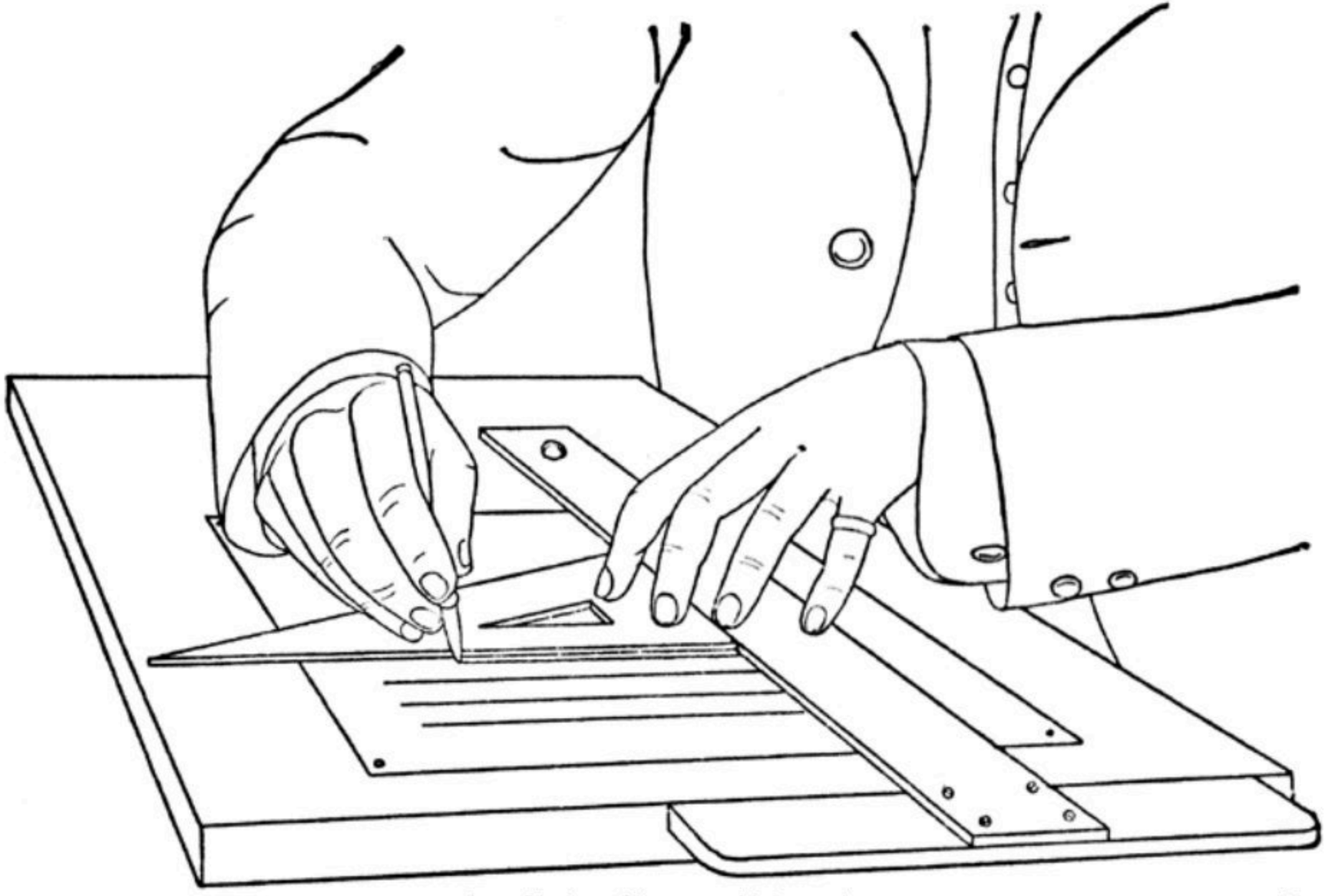
Sharpener

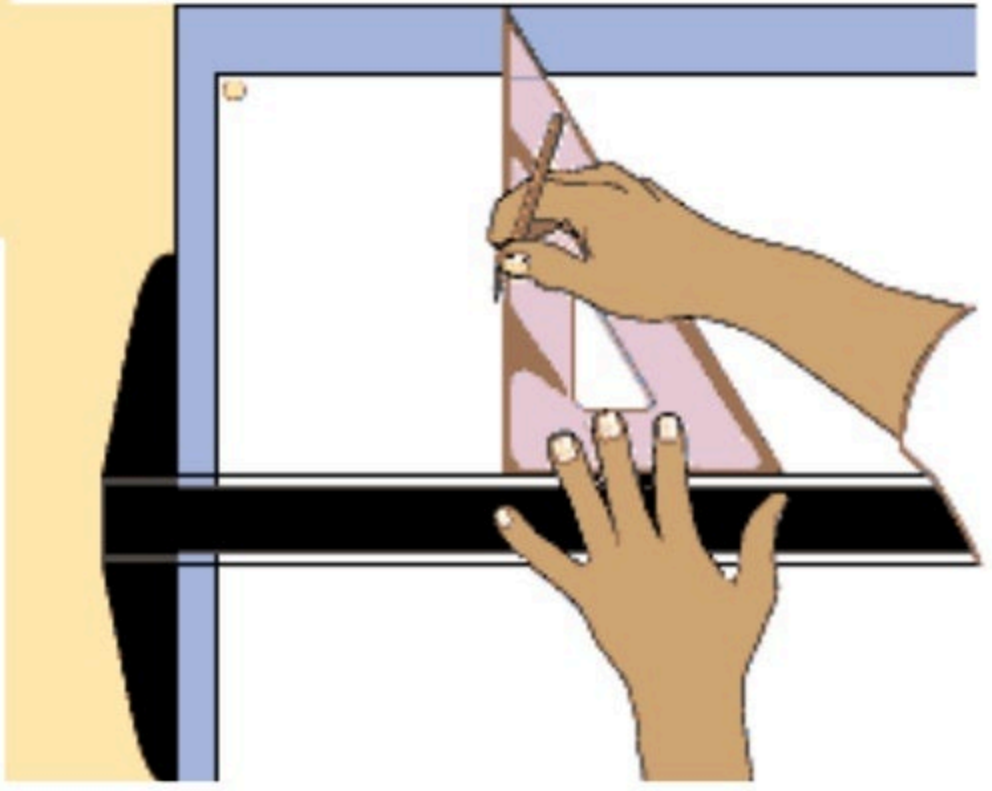


T-square

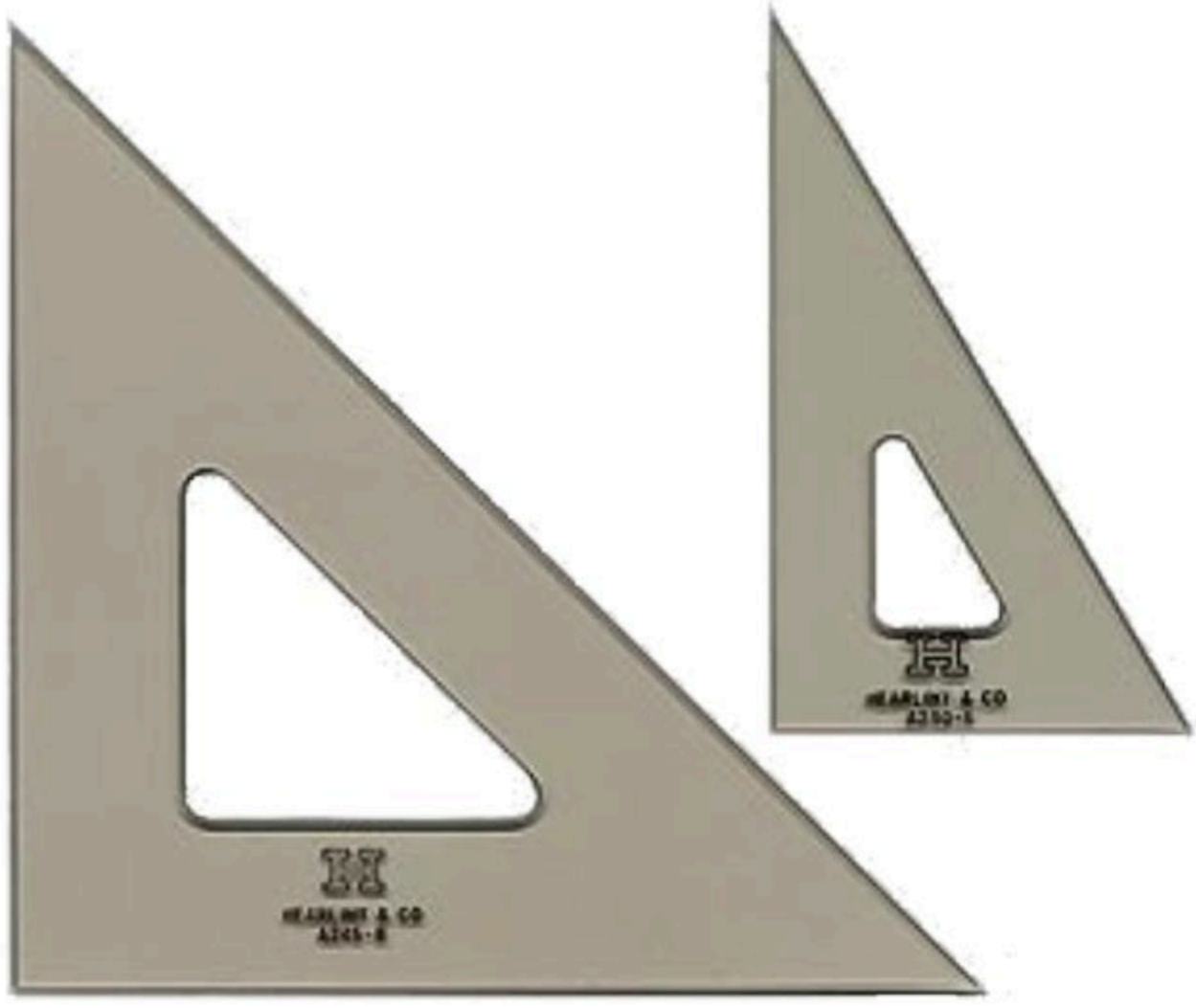


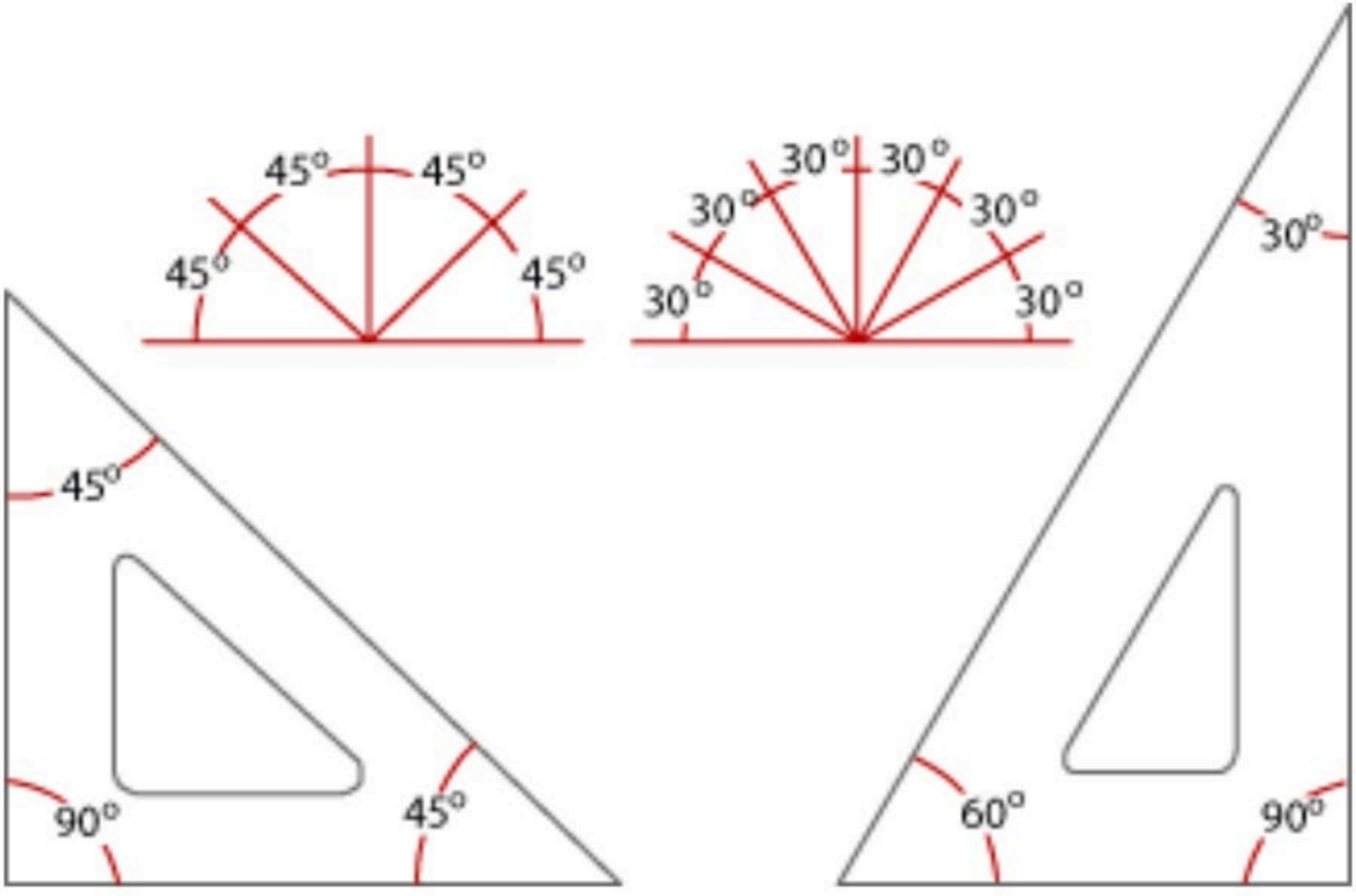




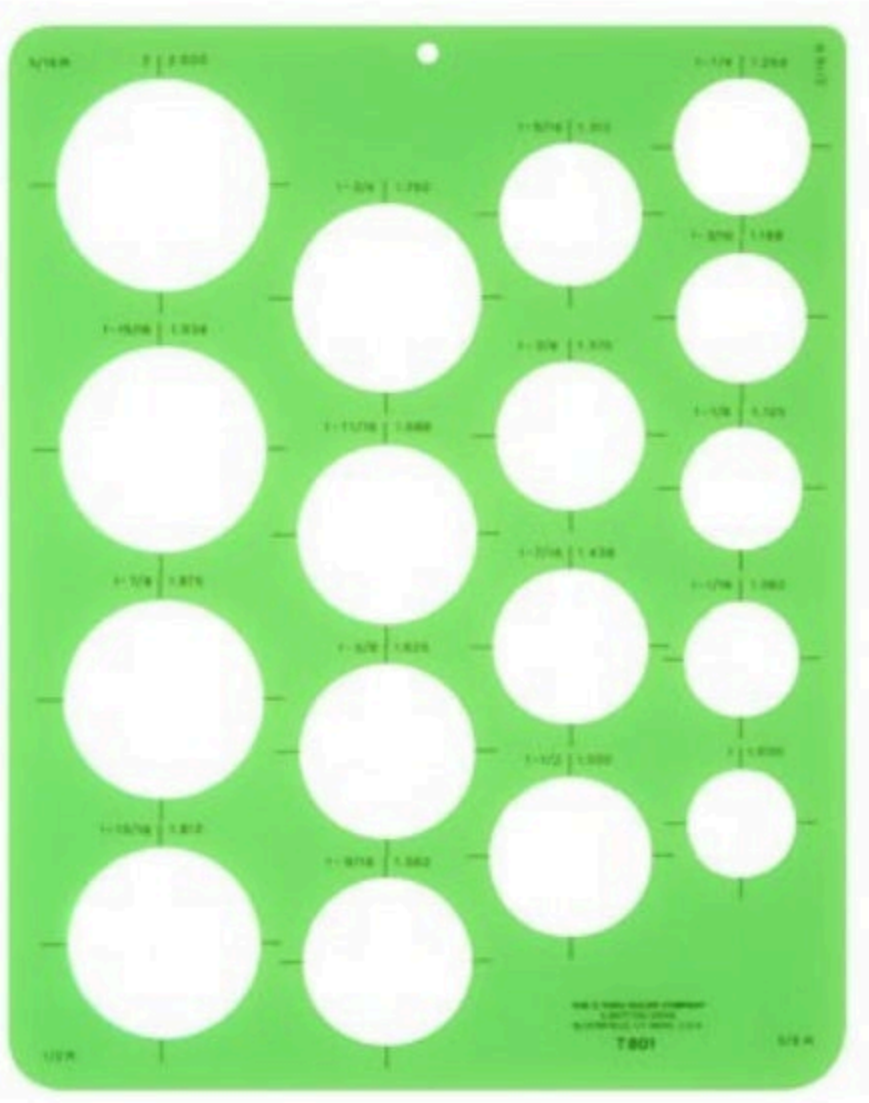


Set-squares/triangles

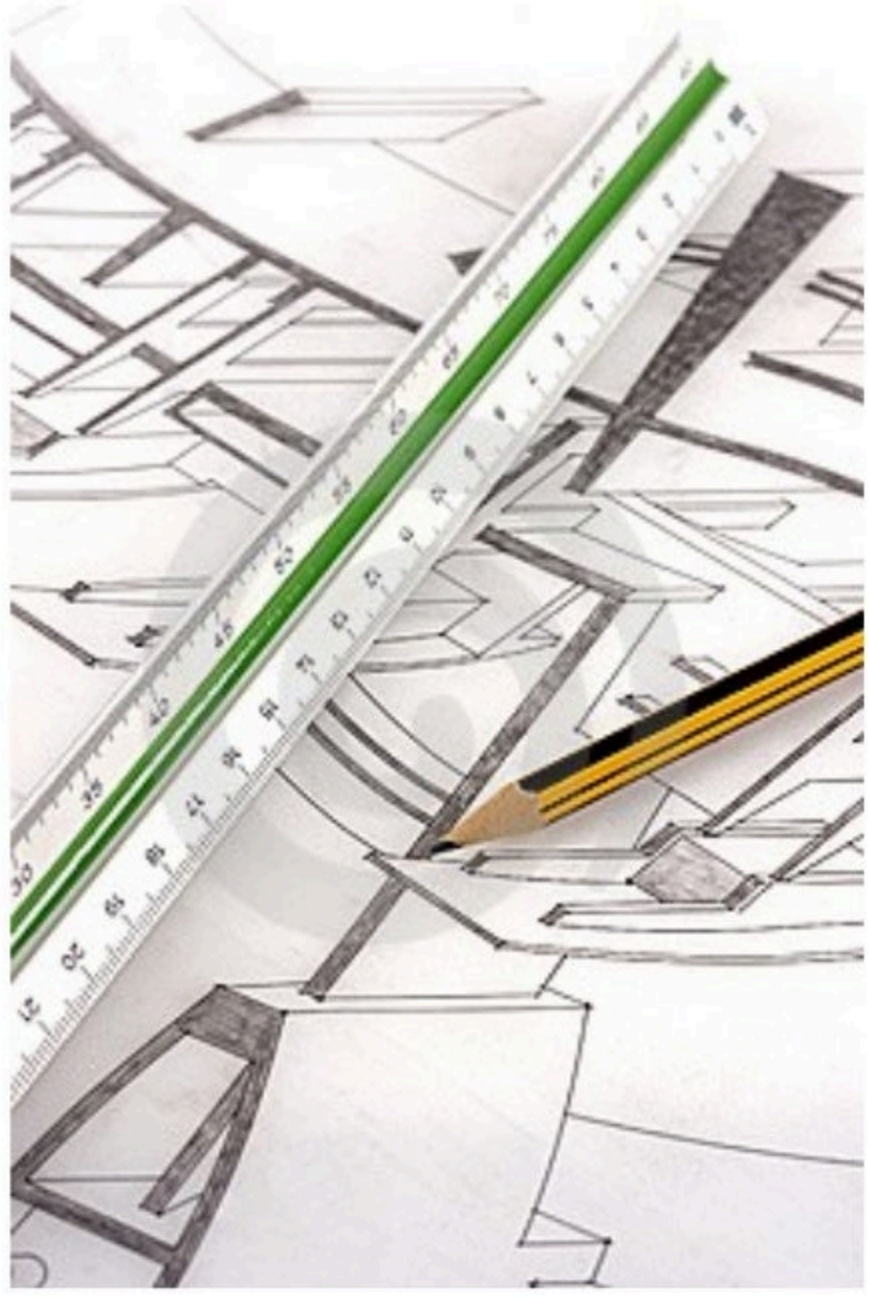



45°
45°
45°
45°
30°
30°
30°
30°
30°
30°
45°
90°
45°
30°
60°
90°

Circle Template



Scales

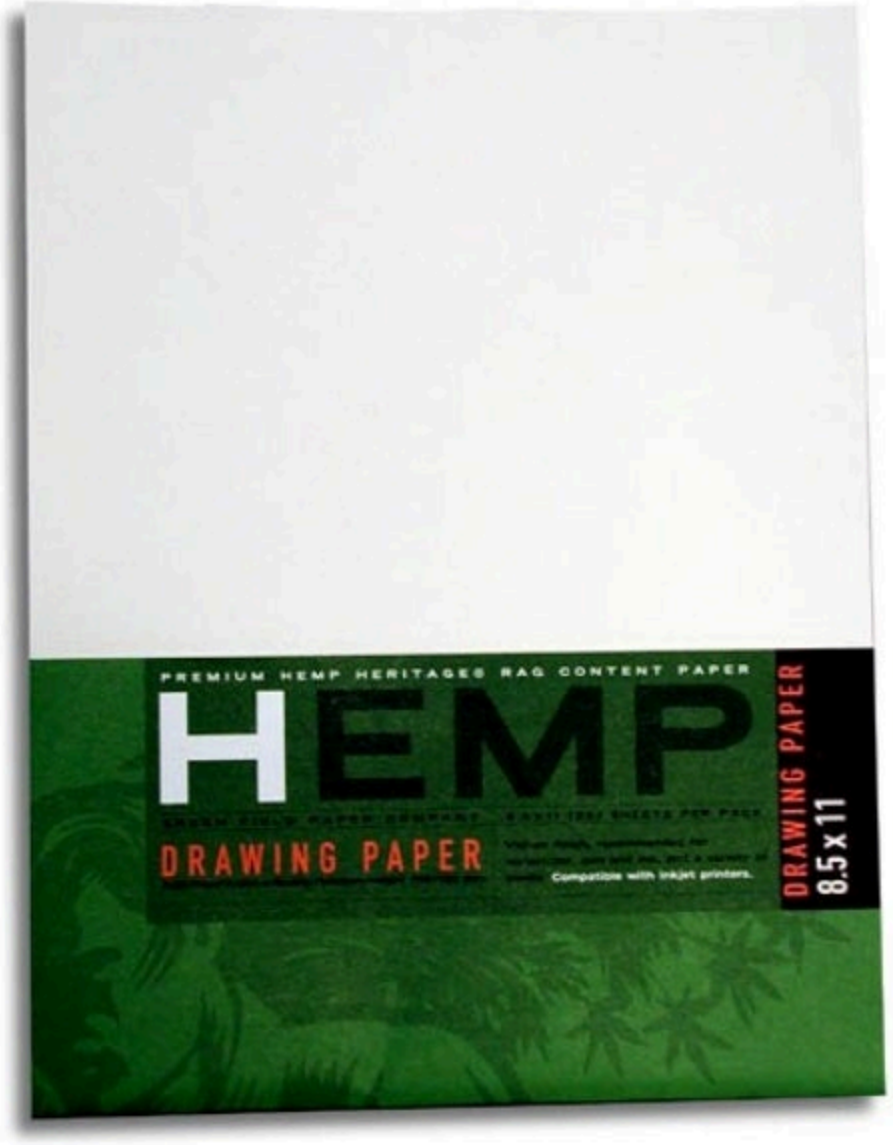


Compass and divider

Sandpaper

Tissue paper

Clean paper


PREMIUM HEMP HERITAGES RAG CONTENT PAPER
HEMP
DRAWING PAPER
Compatible with inkjet printers.
DRAWING PAPER
8.5 x 11

Drawing Standard

Introduction

Standards are set of rules that govern how technical drawings are represented.

- Drawing standards are used so that drawings convey the same meaning to everyone who reads them.

Standard Code

Country	Code	Full name
Thailand		**มอก. สำนักงานมาตรฐานผลิตภัณฑ์อุตสาหกรรม**
USA	ANSI	**A**merican **N**ational **S**tandard **I**nstitute
Japan	JIS	**J**apanese **I**ndustrial **S**tandard
UK	BS	**B**ritish **S**tandard
Australia	AS	**A**ustralian **S**tandard
Germany	DIN	**D**eutsches **I**nstitut *für* **N**ormung
	ISO	**I**nternational **S**tandards **O**rganization

Partial List of Drawing Standards

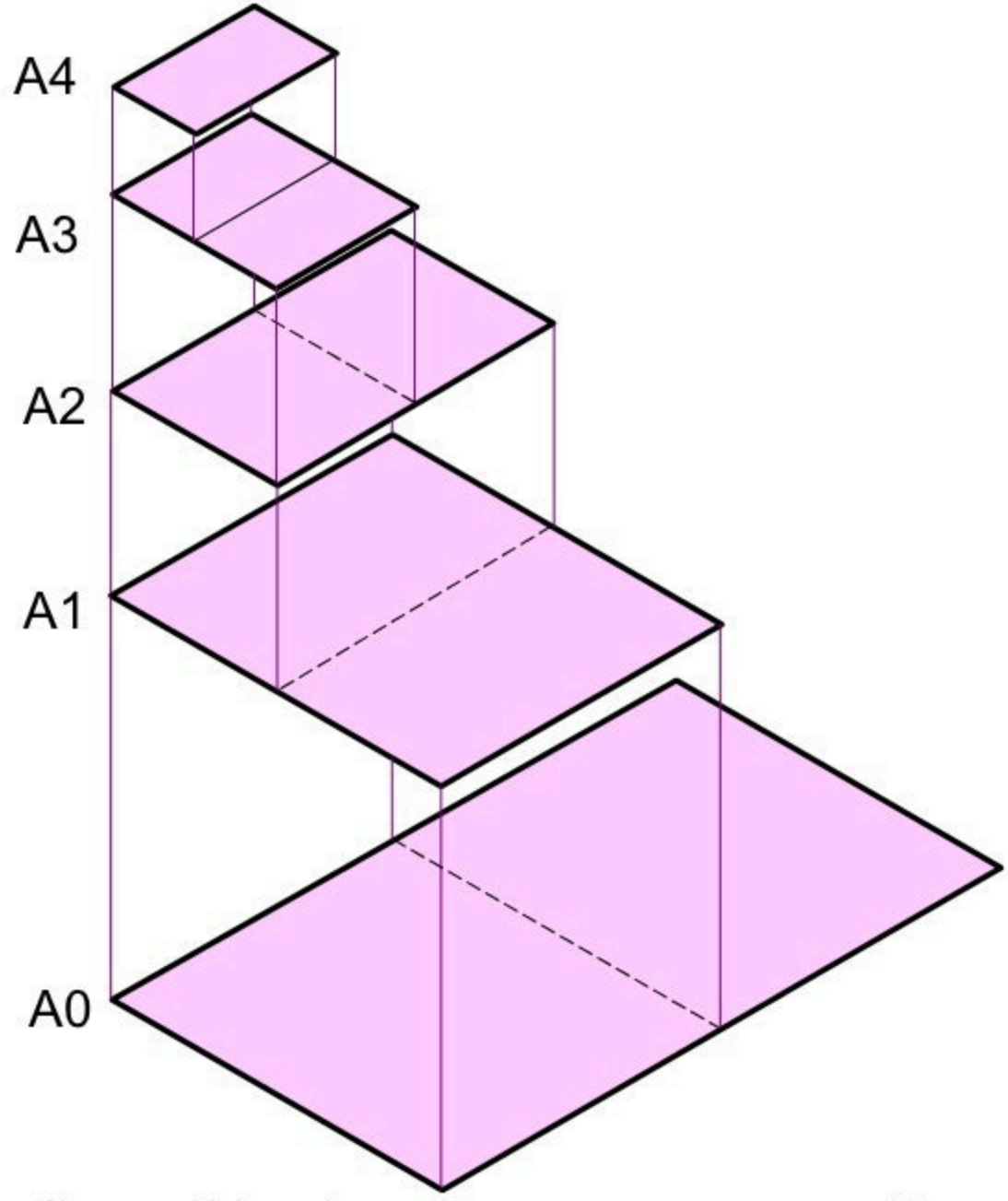
Code number	Contents
JIS Z 8311	***Sizes and Format of Drawings***
JIS Z 8312	***Line Conventions***
JIS Z 8313	***Lettering***
JIS Z 8314	***Scales***
JIS Z 8315	Projection methods
JIS Z 8316	Presentation of Views and Sections
JIS Z 8317	Dimensioning

Drawing Sheet

- Trimmed paper of a size A0 ~ A4.
- Standard sheet size (**JIS**)

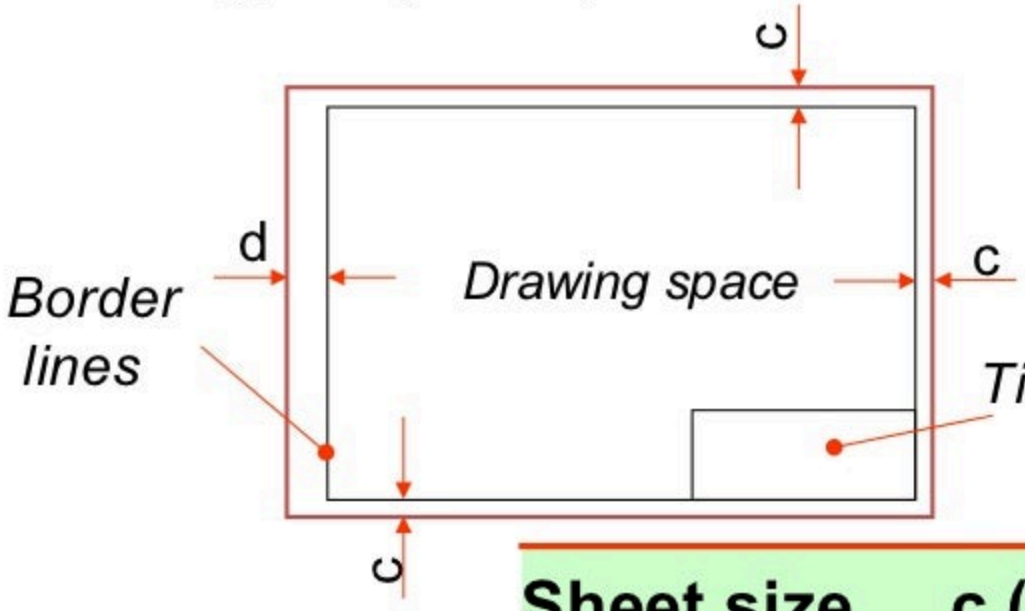
A4	210 x 297
A3	297 x 420
A2	420 x 594
A1	594 x 841
A0	841 x 1189

(Dimensions in millimeters)

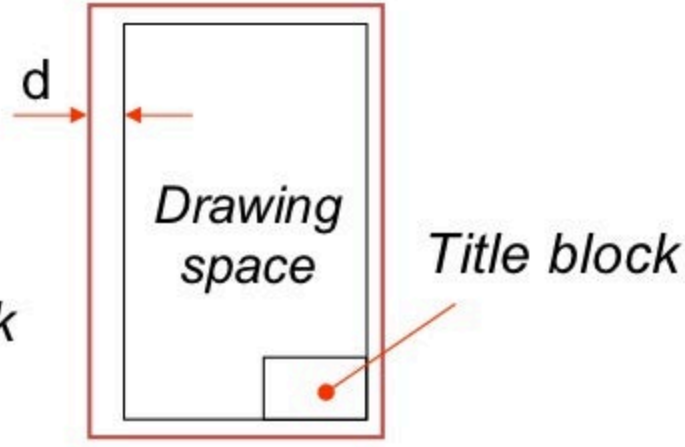


Orientation of drawing sheet

1. Type X (A0~A4)



2. Type Y (A4 only)

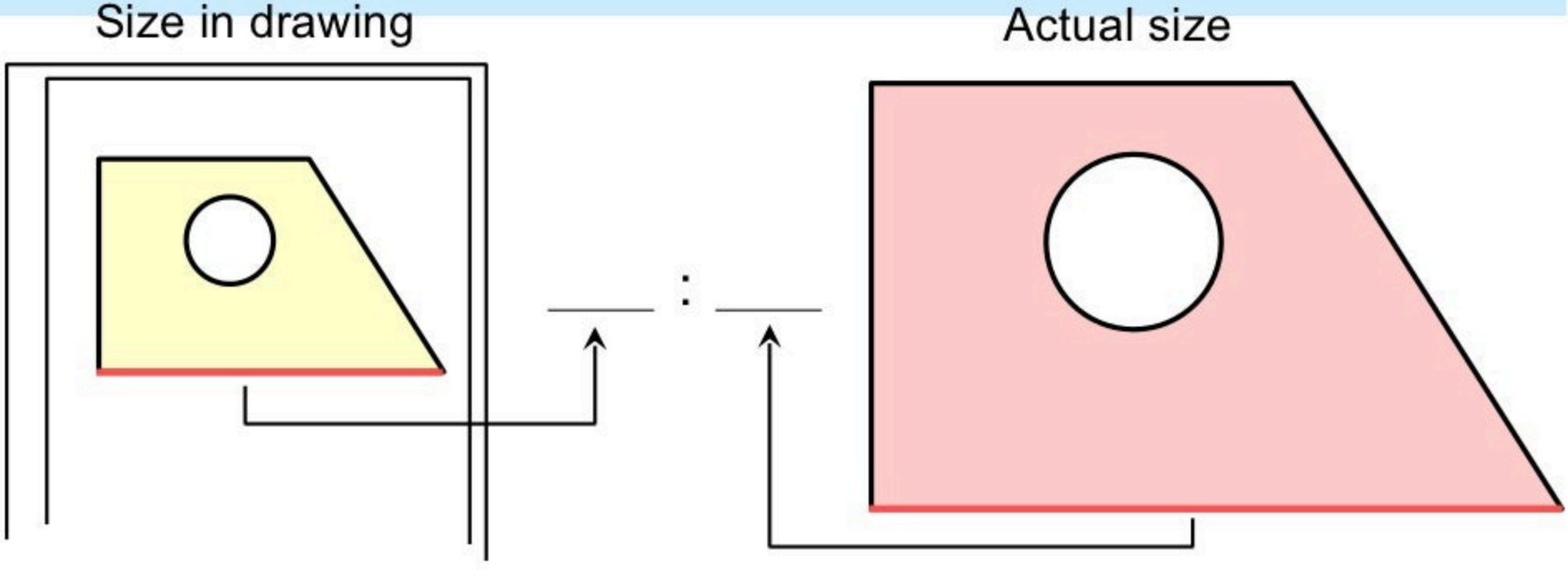


Sheet size	c (min)	d (min)
A4	10	25
A3	10	25
A2	10	25
A1	20	25
A0	20	25

Drawing Scales

Length, size

Scale is the ratio of the linear dimension of an element of an object shown in the drawing to the real linear dimension of the same element of the object.



Drawing Scales

- Designation of a scale consists of the word "SCALE" followed by the indication of its ratio, as follow

SCALE 1:1	for full size	
SCALE **X**:1	for ***enlargement*** scales	(X > 1)
SCALE 1:**X**	for ***reduction*** scales	(X > 1)

- Dimension numbers shown in the drawing are correspond to "true size" of the object and they are independent of the scale used in creating that drawing.

Basic Line Types

Types of Lines	Appearance	Name according to application
Continuous thick line		Visible line
Continuous thin line		Dimension line Extension line Leader line
Dash thick line		Hidden line
Chain thin line		Center line

NOTE : We will learn other types of line in later chapters.

Meaning of Lines

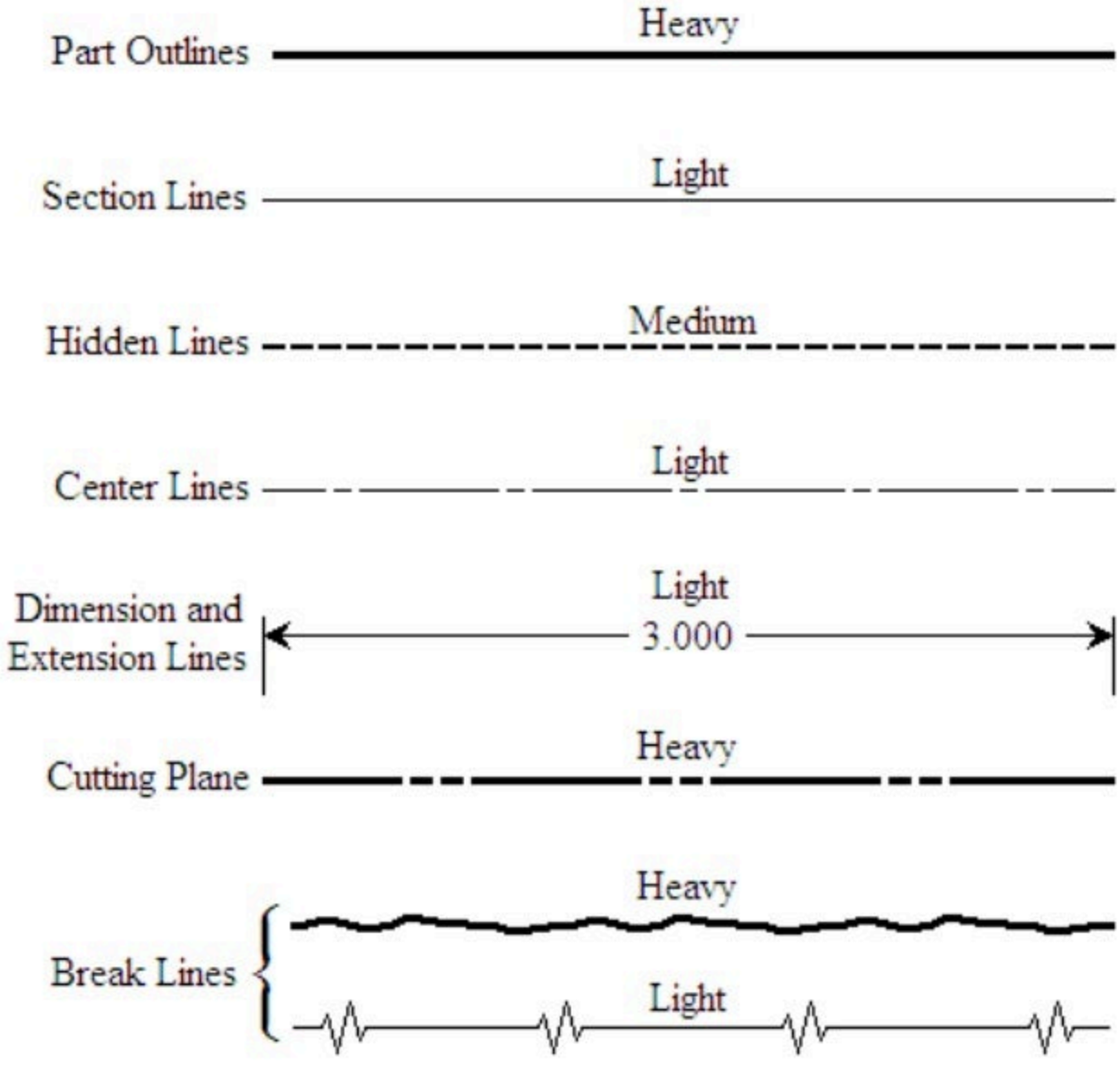
Visible lines represent features that can be seen in the current view

Hidden lines represent features that can not be seen in the current view

Center line represents symmetry, path of motion, centers of circles, axis of axisymmetrical parts

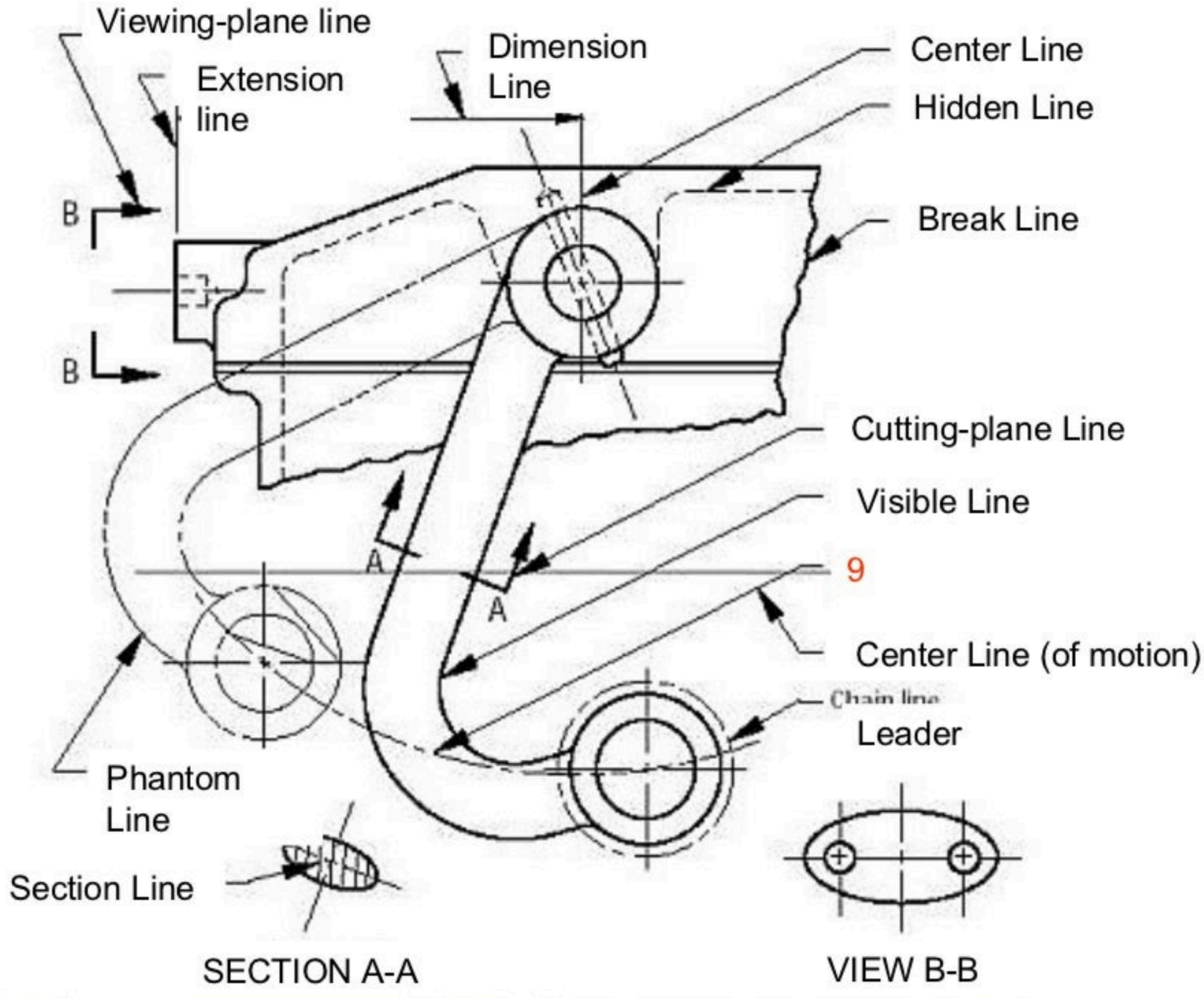
Dimension and Extension lines indicate the sizes and location of features on a drawing

Types of Line



Line Conventions

- Visible Lines – solid thick lines that represent visible edges or contours
- Hidden Lines – short evenly spaced dashes that depict hidden features
- Section Lines – solid thin lines that indicate cut surfaces
- Center Lines – alternating long and short dashes
- Dimensioning
  - Dimension Lines - solid thin lines showing dimension extent/direction
  - Extension Lines - solid thin lines showing point or line to which dimension applies
  - Leaders – direct notes, dimensions, symbols, part numbers, etc. to features on drawing
- Cutting-Plane and Viewing-Plane Lines – indicate location of cutting planes for sectional views and the viewing position for removed partial views
- Break Lines – indicate only portion of object is drawn. May be random "squiggled" line or thin dashes joined by zigzags.
- Phantom Lines – long thin dashes separated by pairs of short dashes indicate alternate positions of moving parts, adjacent position of related parts and repeated detail
- Chain Line – Lines or surfaces with special requirements


Viewing-plane line
Extension line
Dimension Line
Center Line
Hidden Line
Break Line
B
B
Cutting-plane Line
Visible Line
A
A
9
Center Line (of motion)
Chain line
Leader
Phantom Line
Section Line
SECTION A-A
VIEW B-B

Lettering

Text on Drawings

Text on engineering drawing is used :

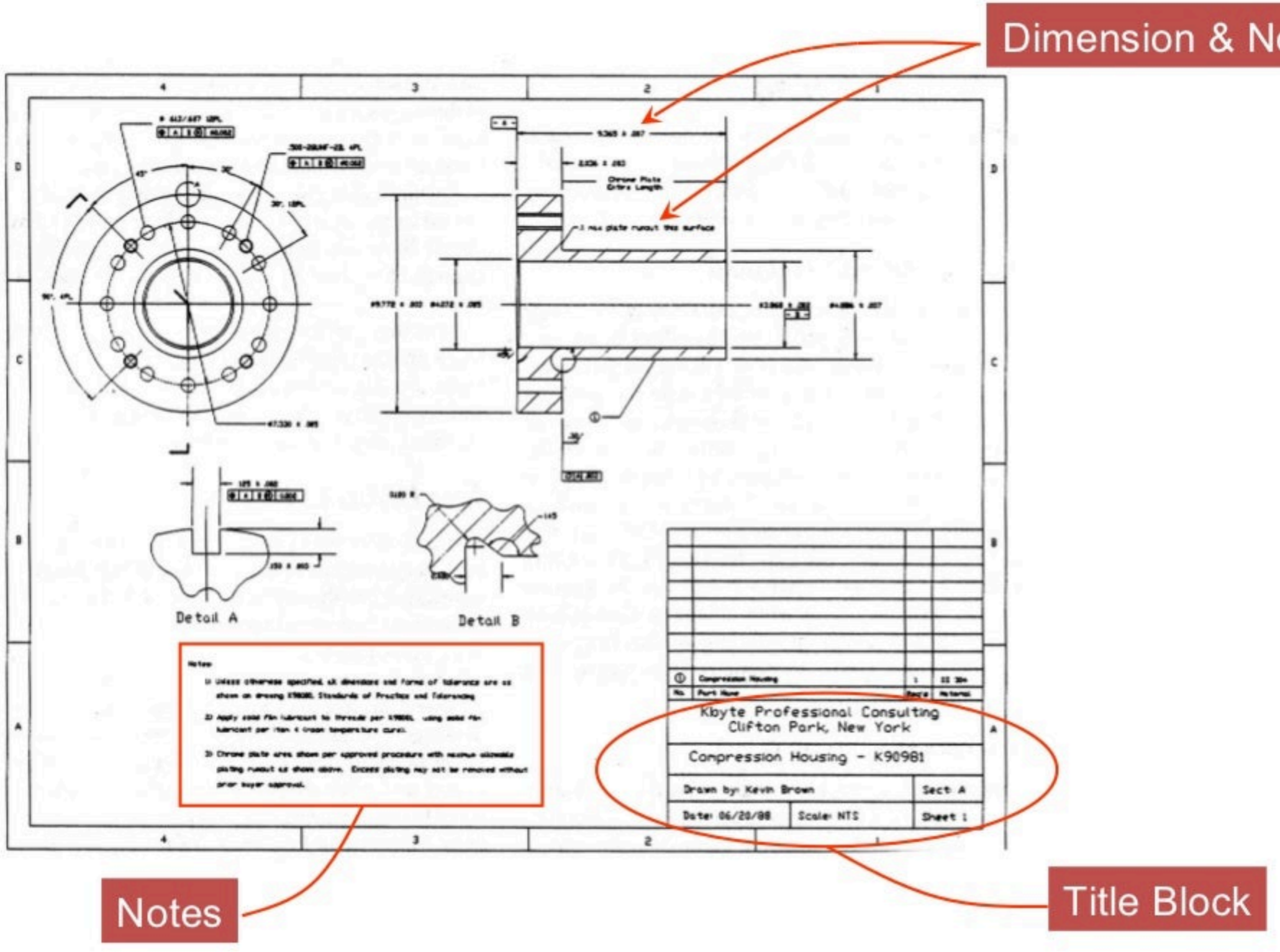
- To communicate nongraphic information.
- As a substitute for graphic information, in those instance where text can communicate the needed information more clearly and quickly.

Thus, it must be written with

Legibility - shape
- space between letters and words

Uniformity - size
- line thickness

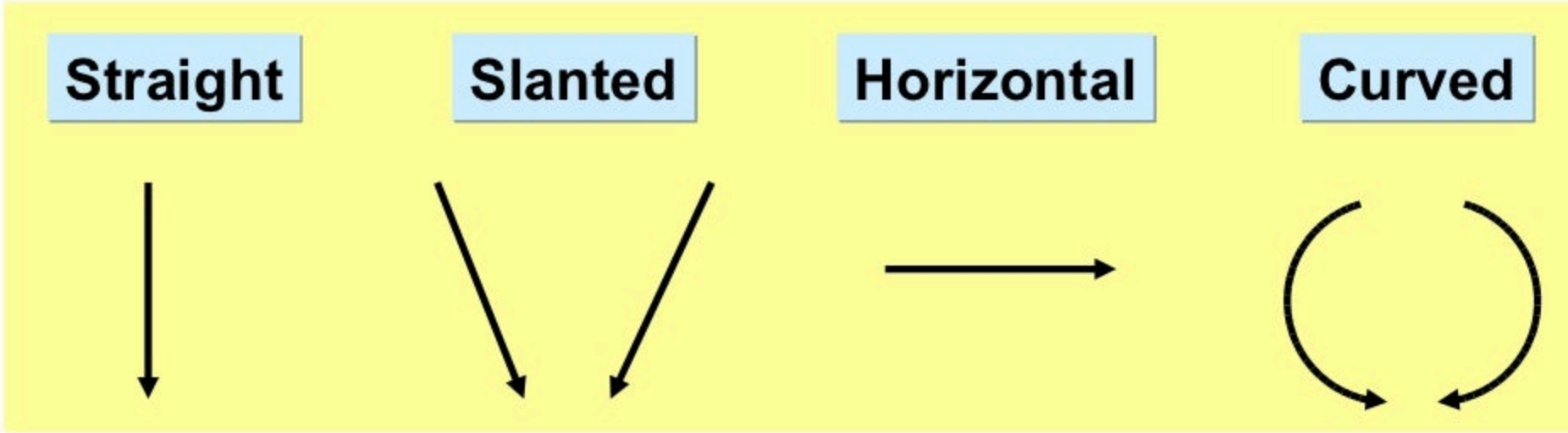
Example *Placement of the text on drawing*



Lettering Standard

ANSI Standard	**This course**
Use a Gothic text style, either inclined or vertical.	Use only a vertical Gothic text style.
Use all capital letters.	Use both capital and lower-case letters.
Use 3 mm for most text height.	Same. For letters in title block it is recommend to use 5~8 mm text height
Space between lines of text is **at least** 1/3 of text height.	N/A. Follows ANSI rule.

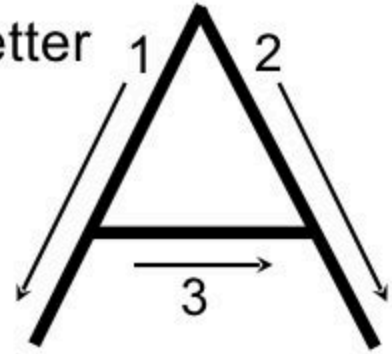
Basic Strokes



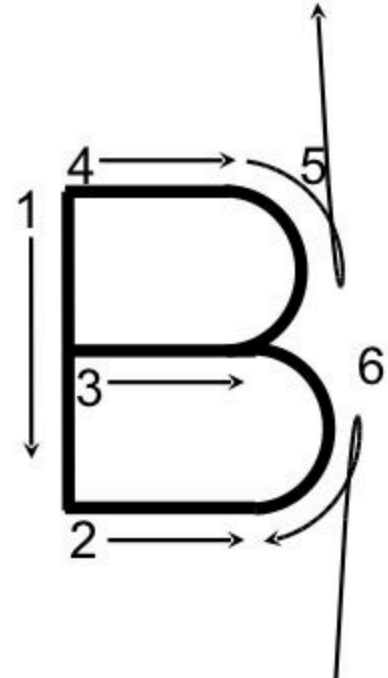
Examples : *Application of basic stroke*

"**I**" letter

"**A**" letter



"**B**" letter

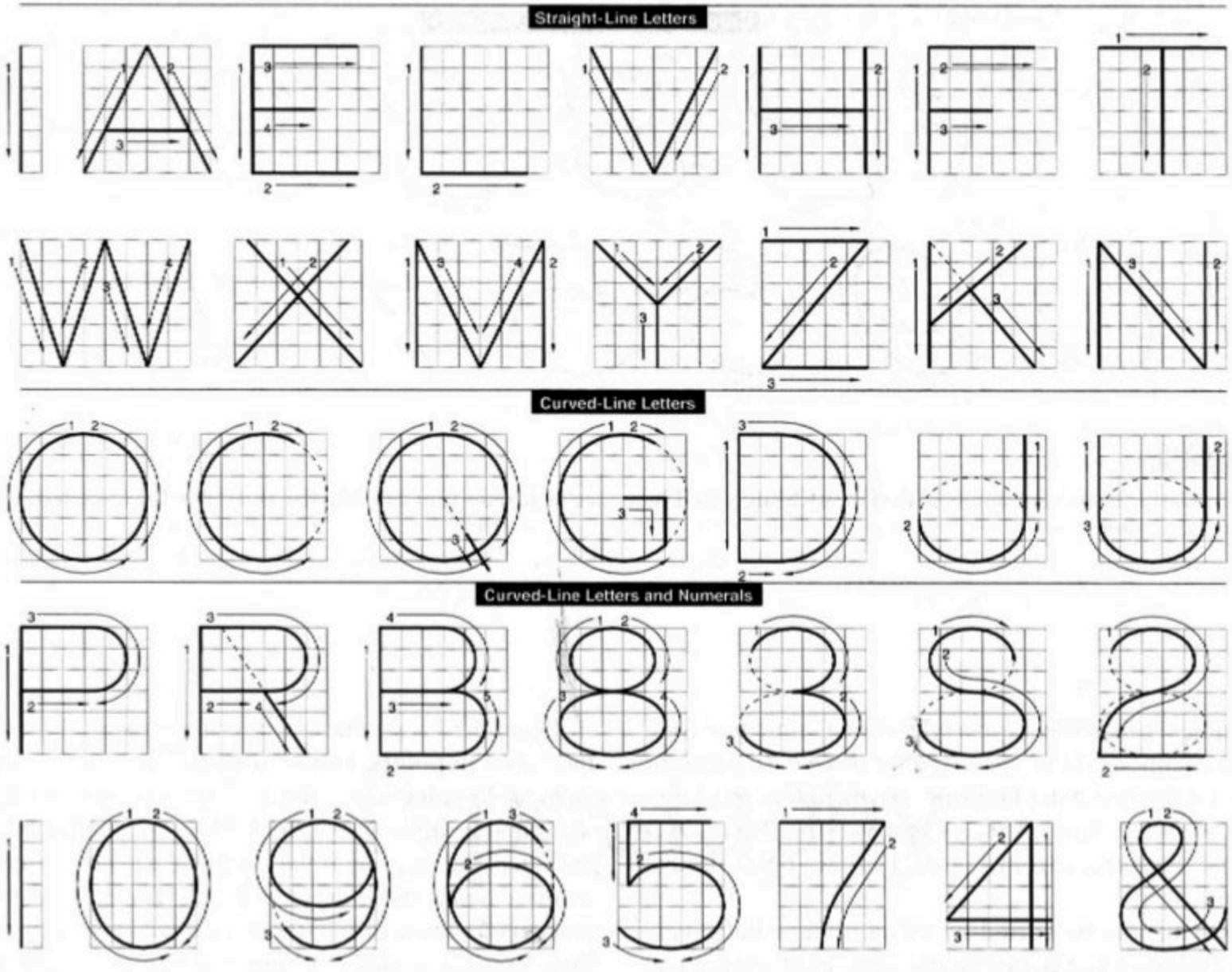


Upper-case letters & Numerals

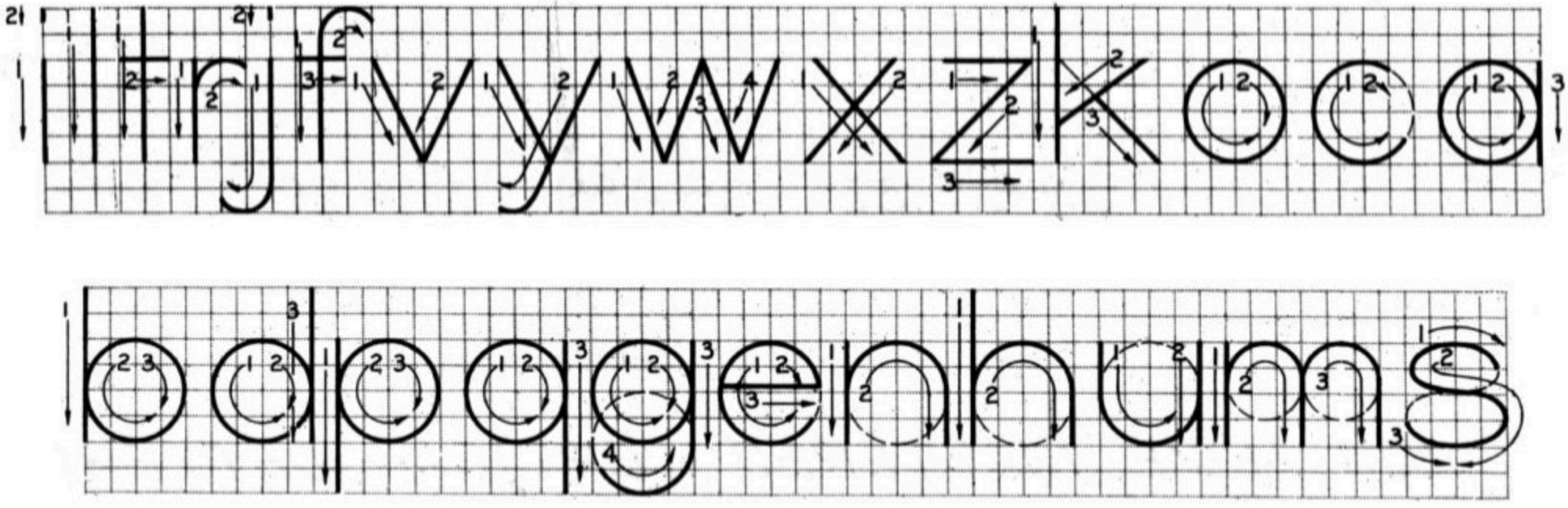
Straight line letters

Curved line letters

Curved line letters & Numerals



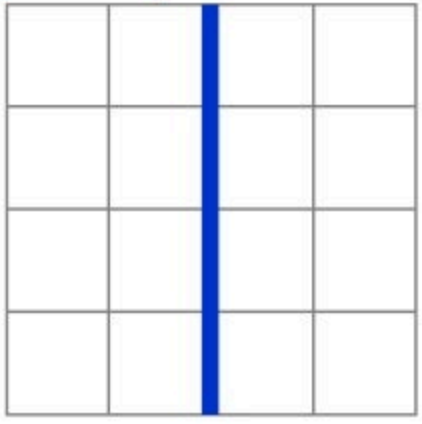
Lower-case letters



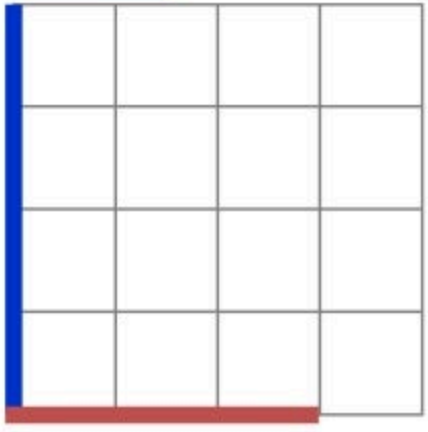
- The text' s body height is about 2/3 the height of a capital letter.

Stroke Sequence

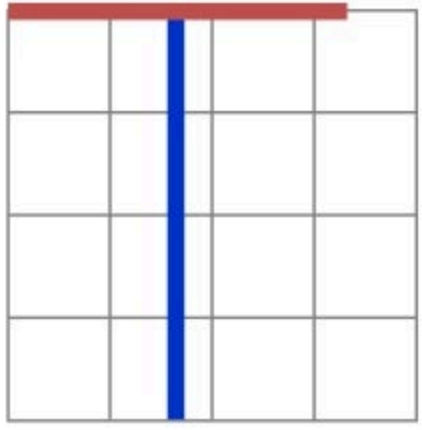
I



L



T



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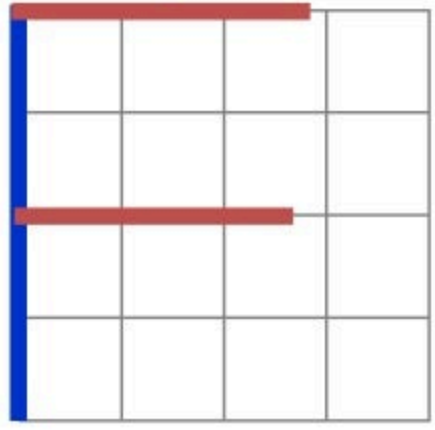
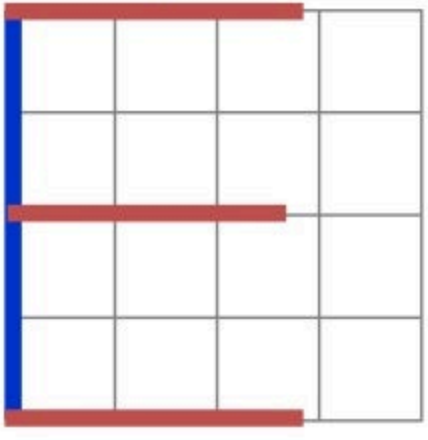
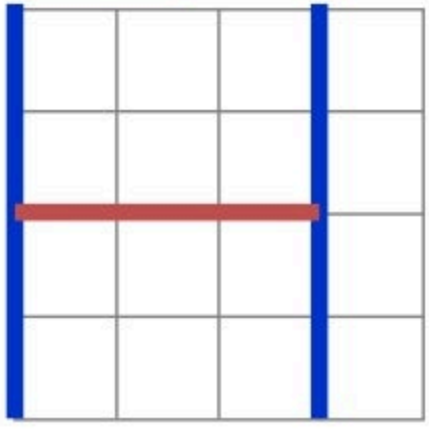


E

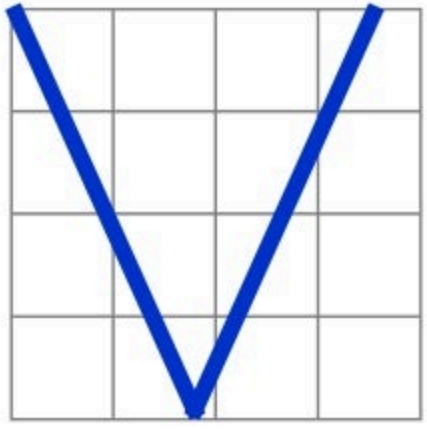


H

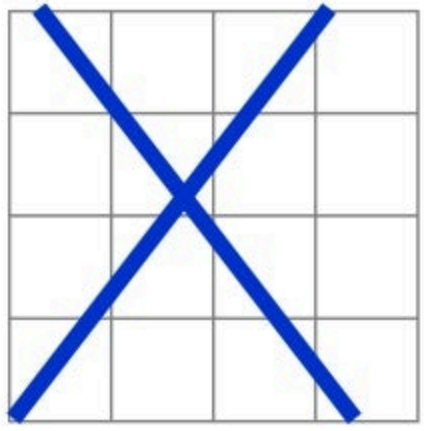


Stroke Sequence

V



X



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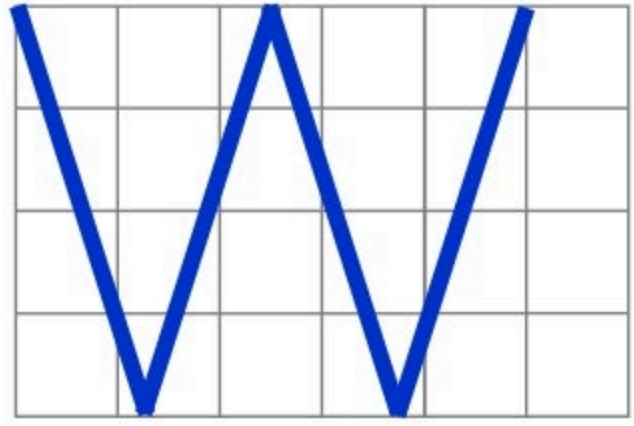
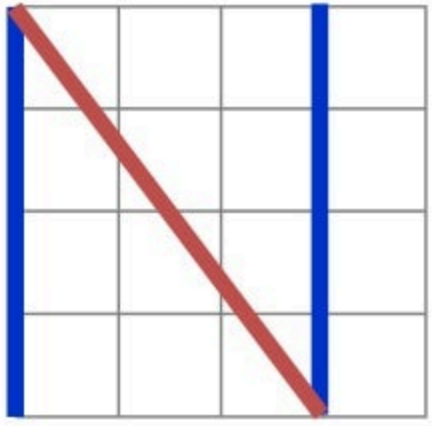


Stroke Sequence

N



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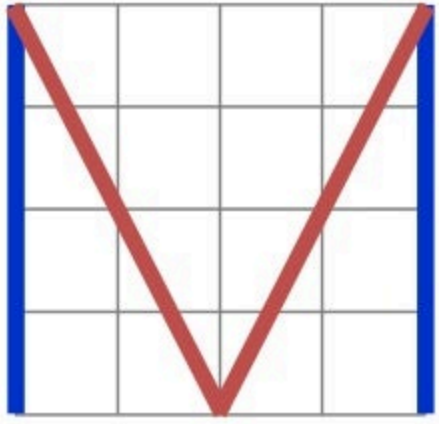

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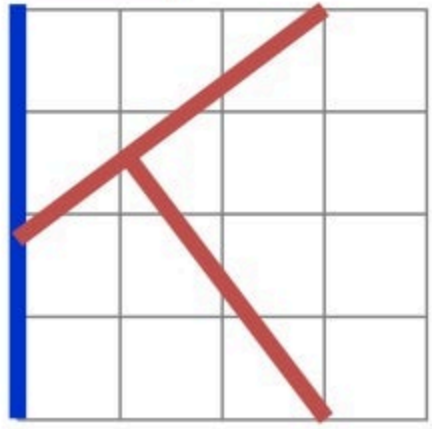

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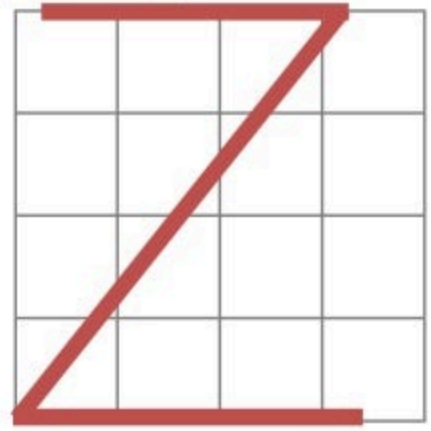

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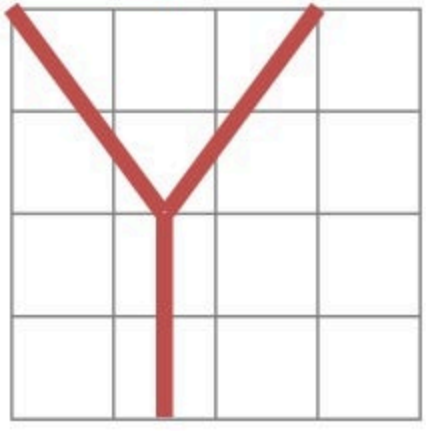
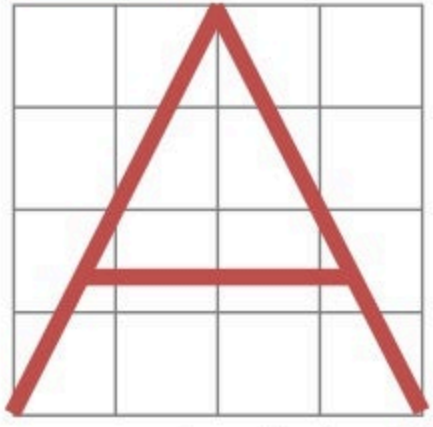
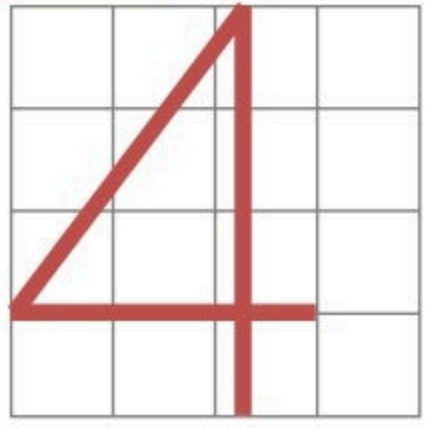


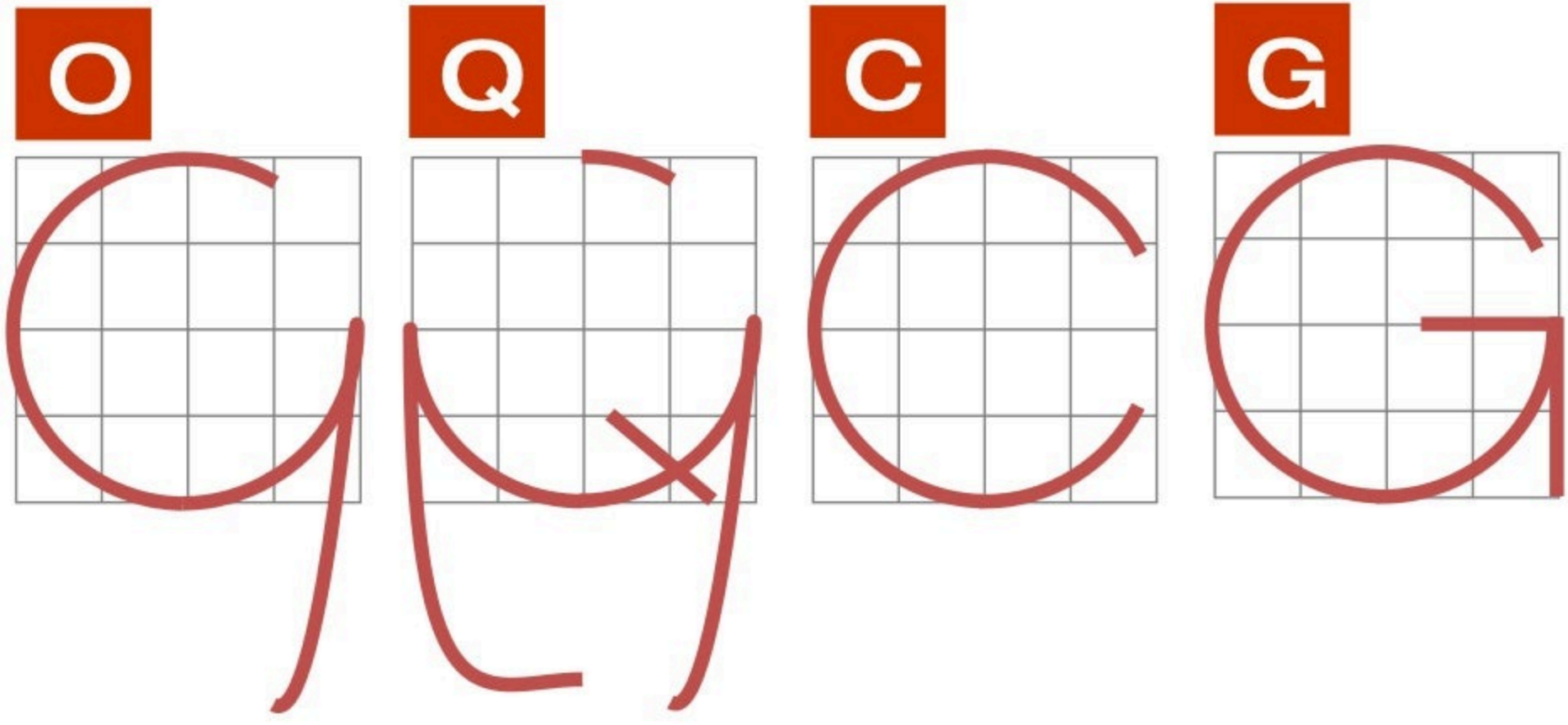
A



4

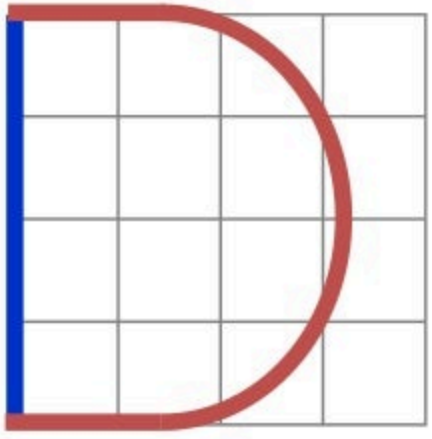


Stroke Sequence



Stroke Sequence

D



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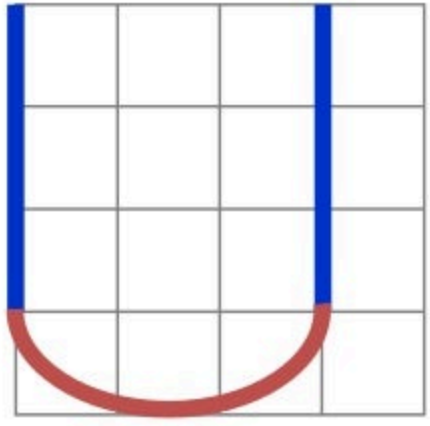

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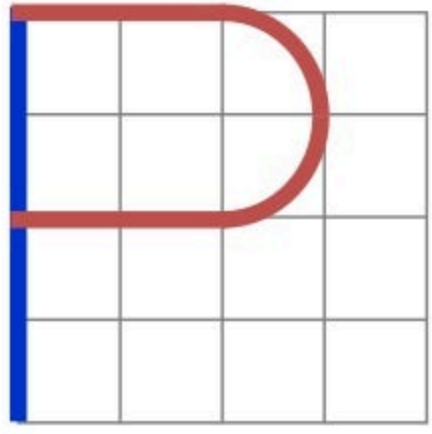
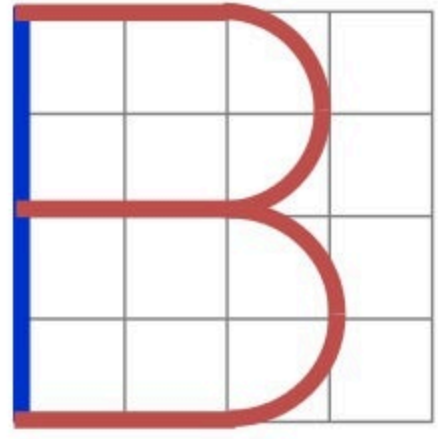
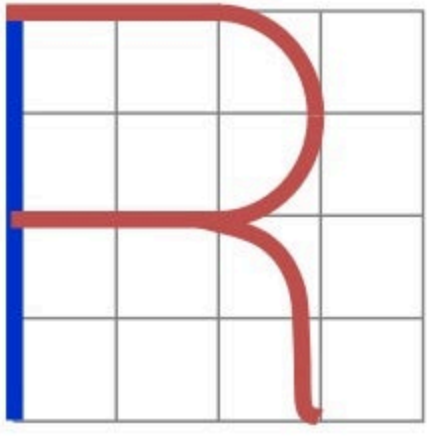


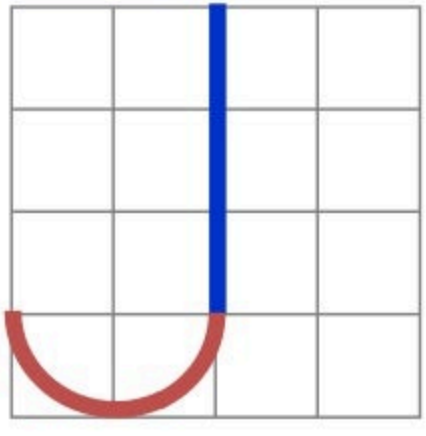
B



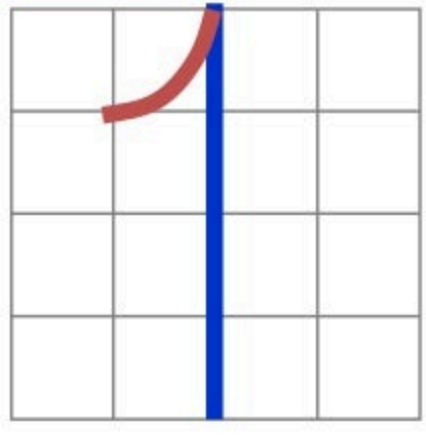
R



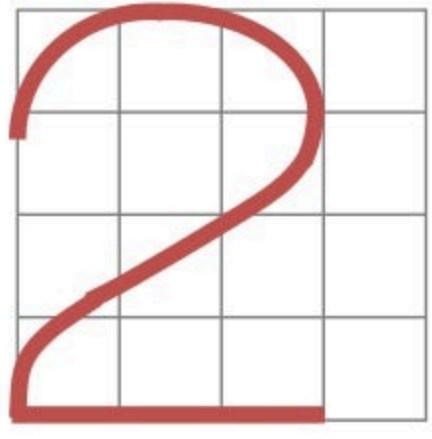
J



1

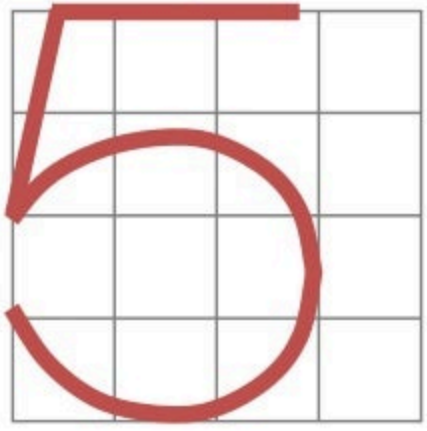


2



Stroke Sequence

5



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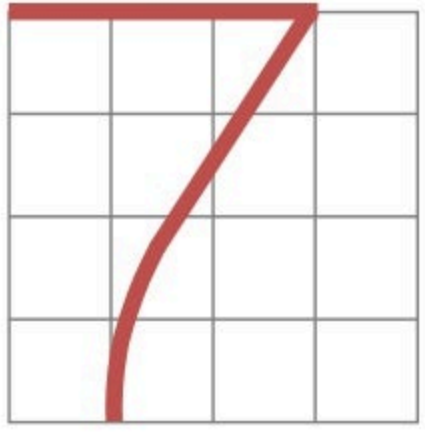
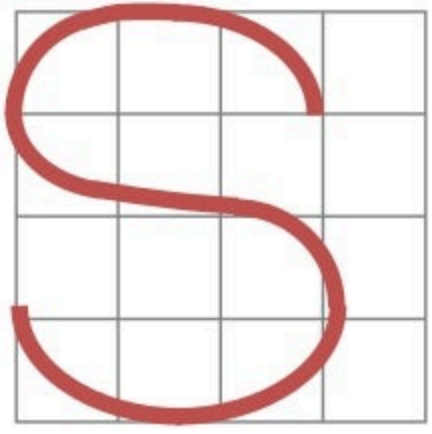


Stroke Sequence

S



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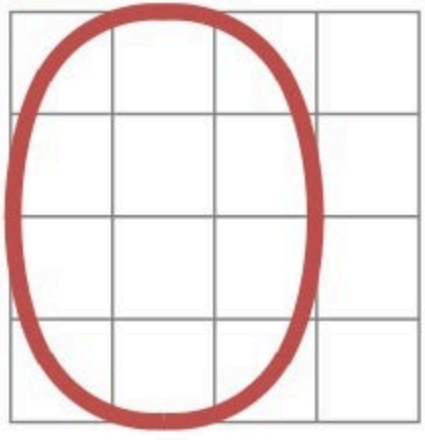

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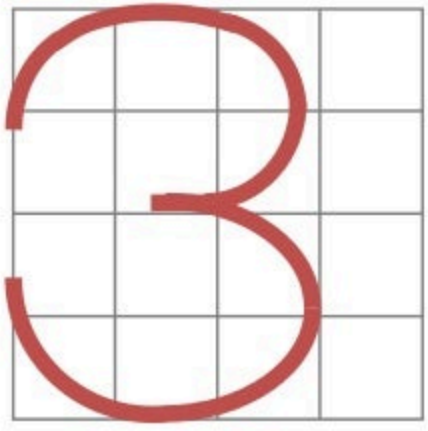

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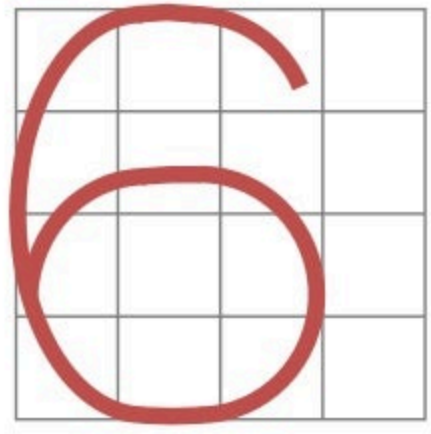

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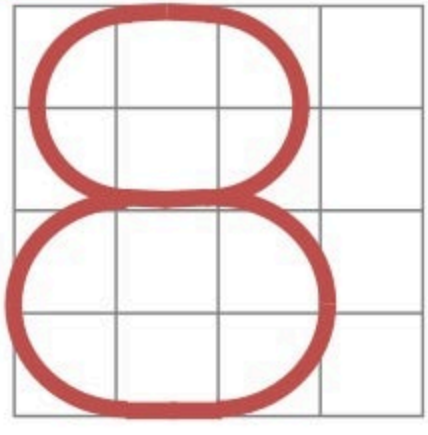

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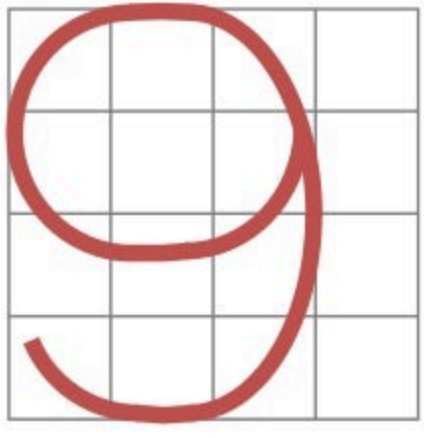
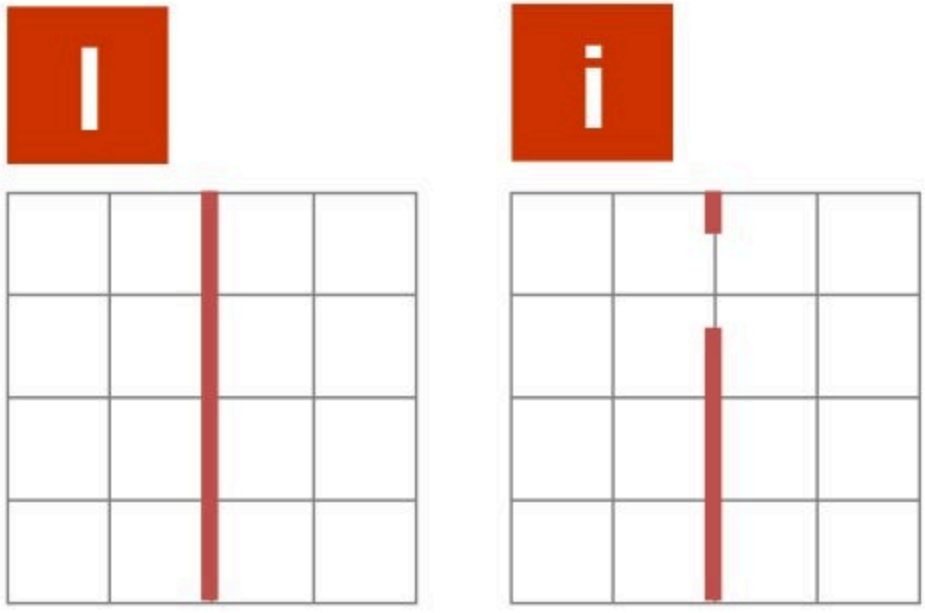


Stroke Sequence



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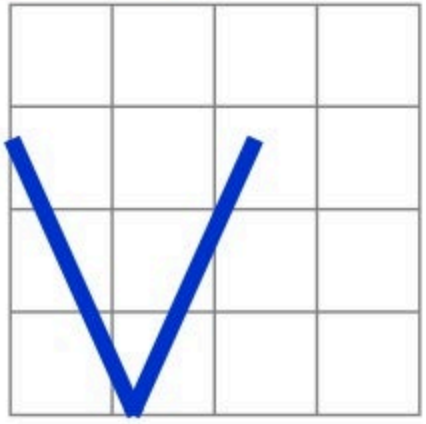

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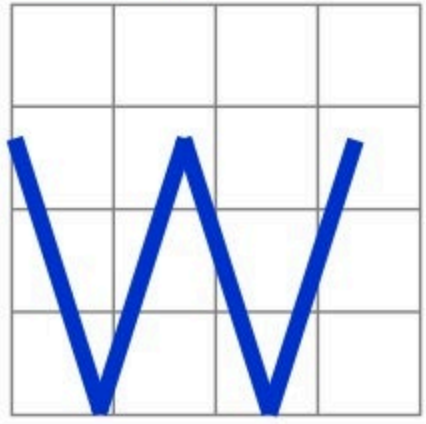

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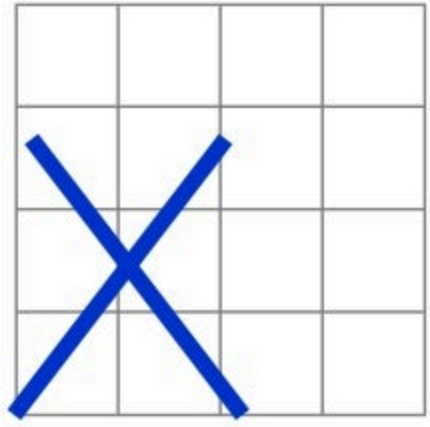

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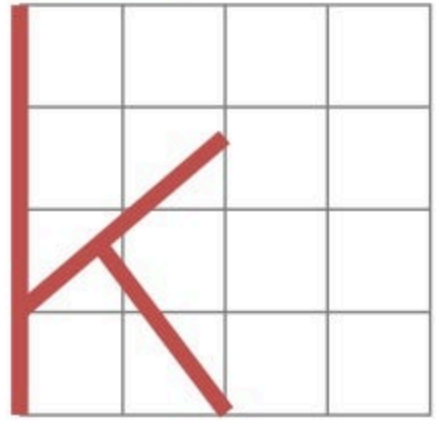

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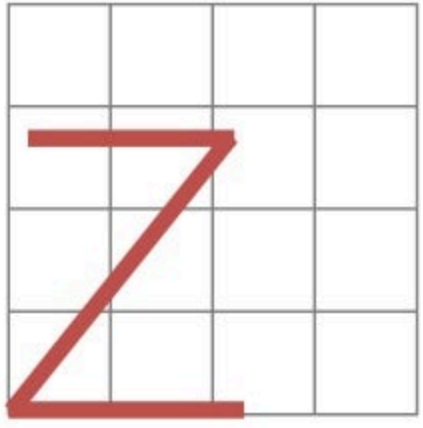

Stroke Sequence

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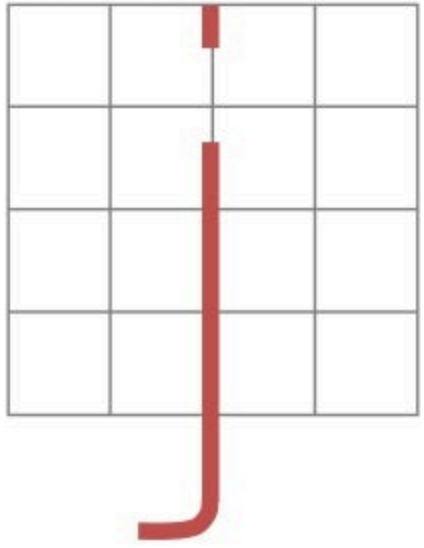

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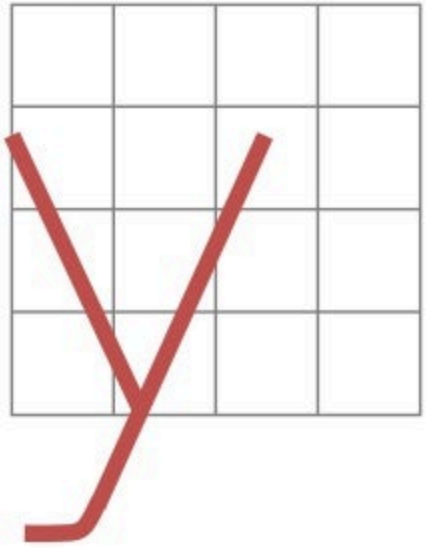

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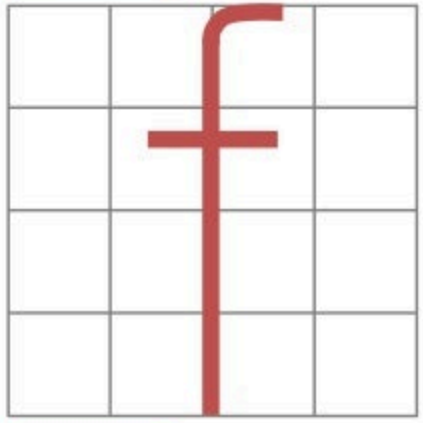

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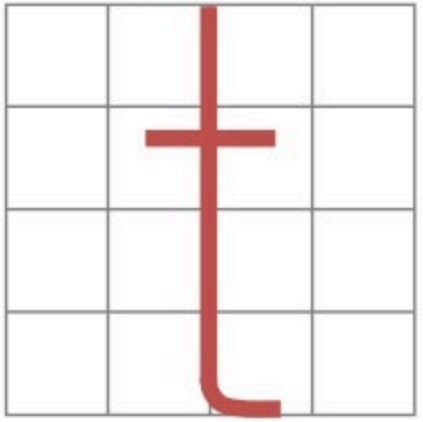

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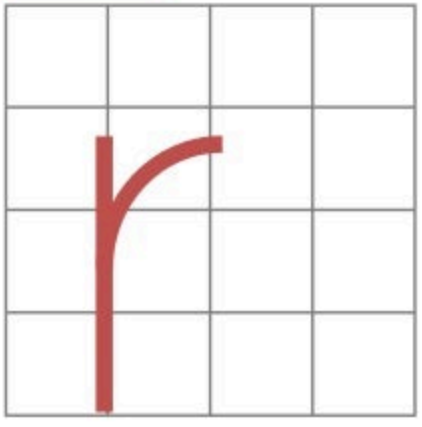

Stroke Sequence

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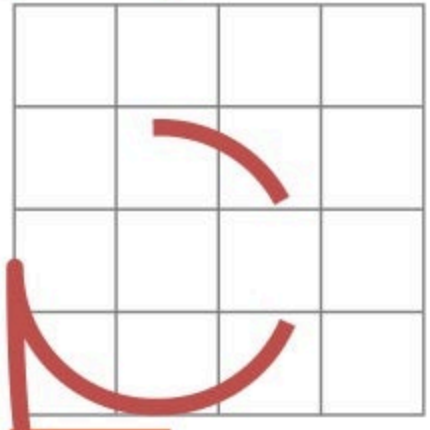

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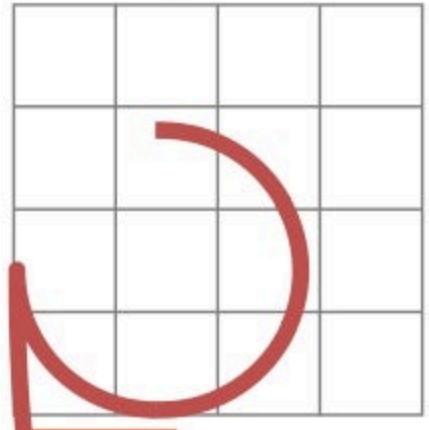

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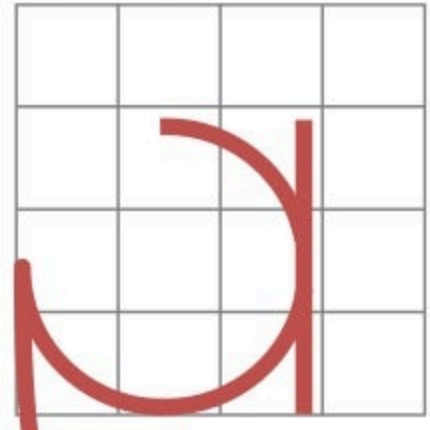

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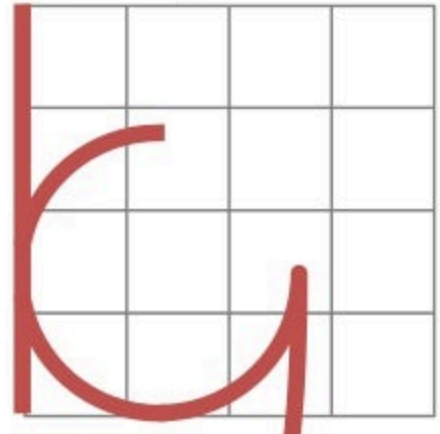

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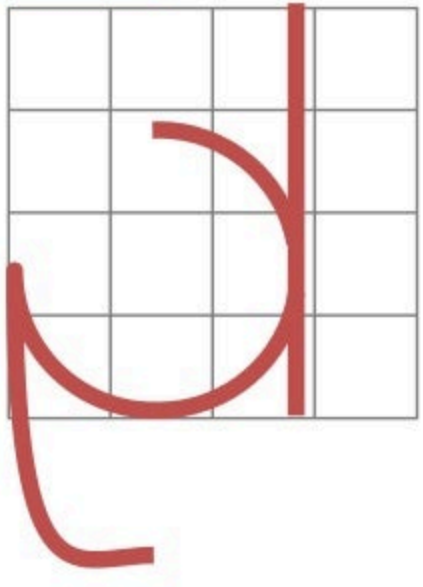

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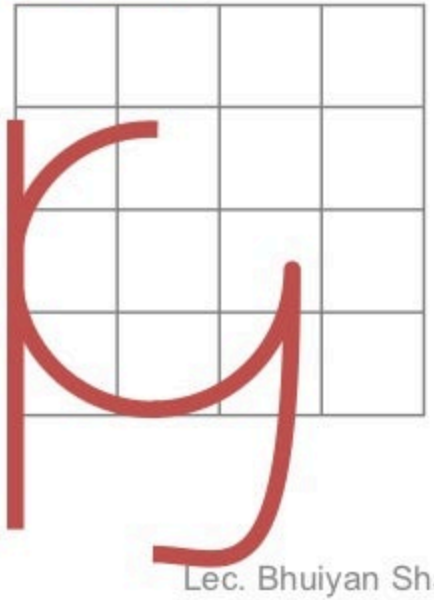

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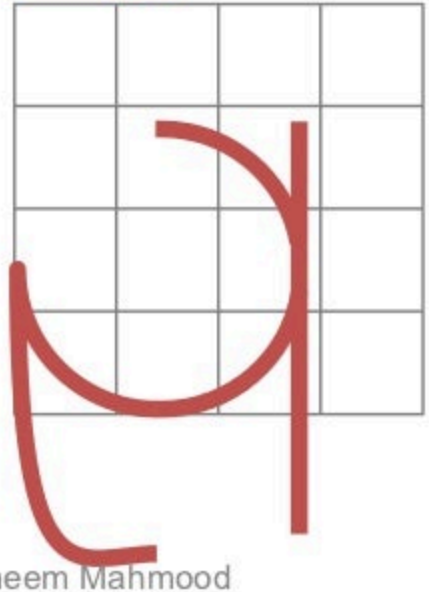

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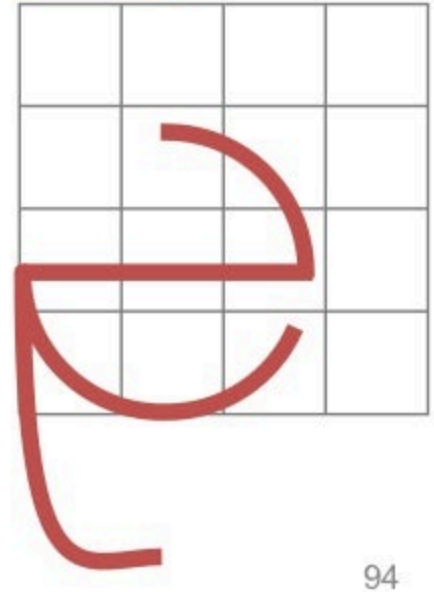
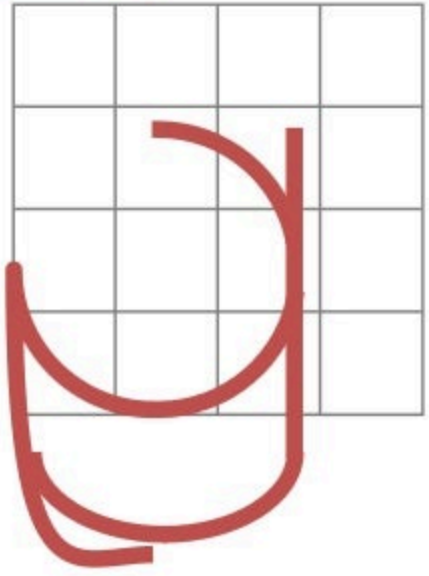


Stroke Sequence

g



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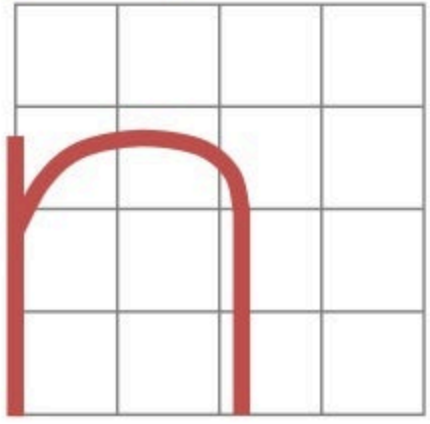

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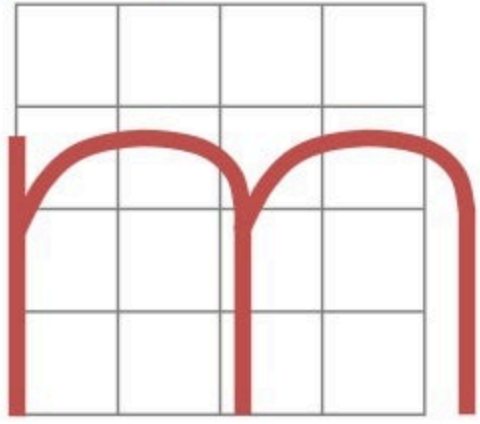

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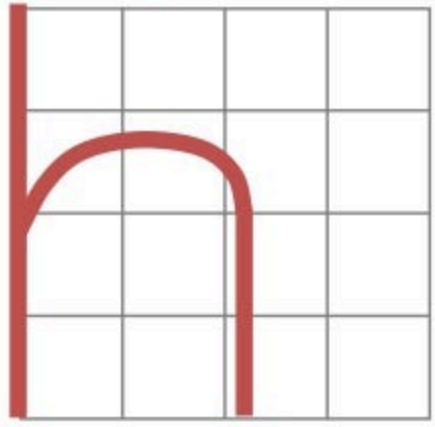

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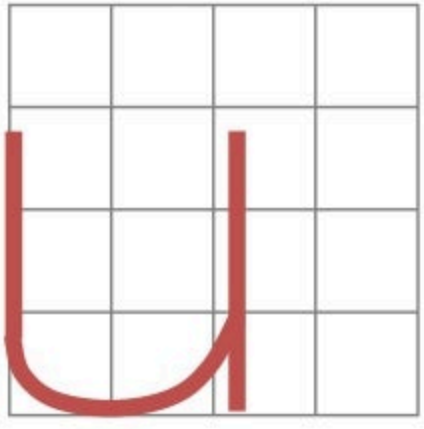

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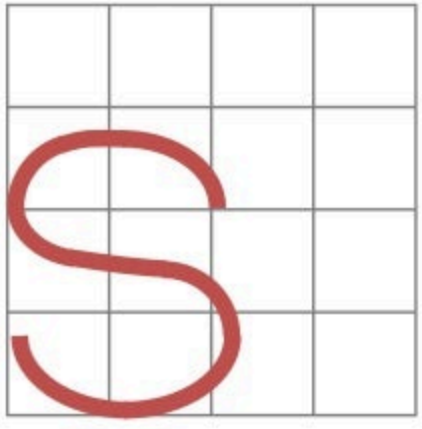
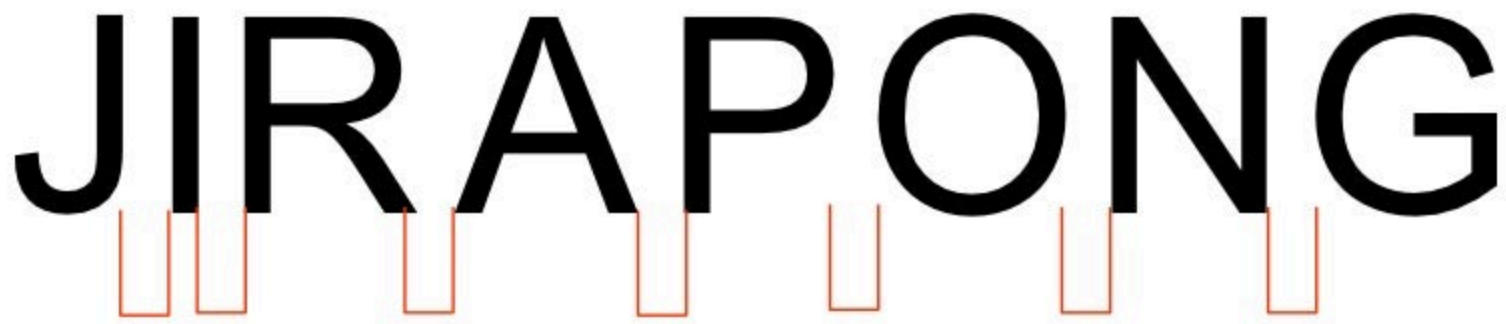


Word Composition

Look at the same word having different spacing between letters.

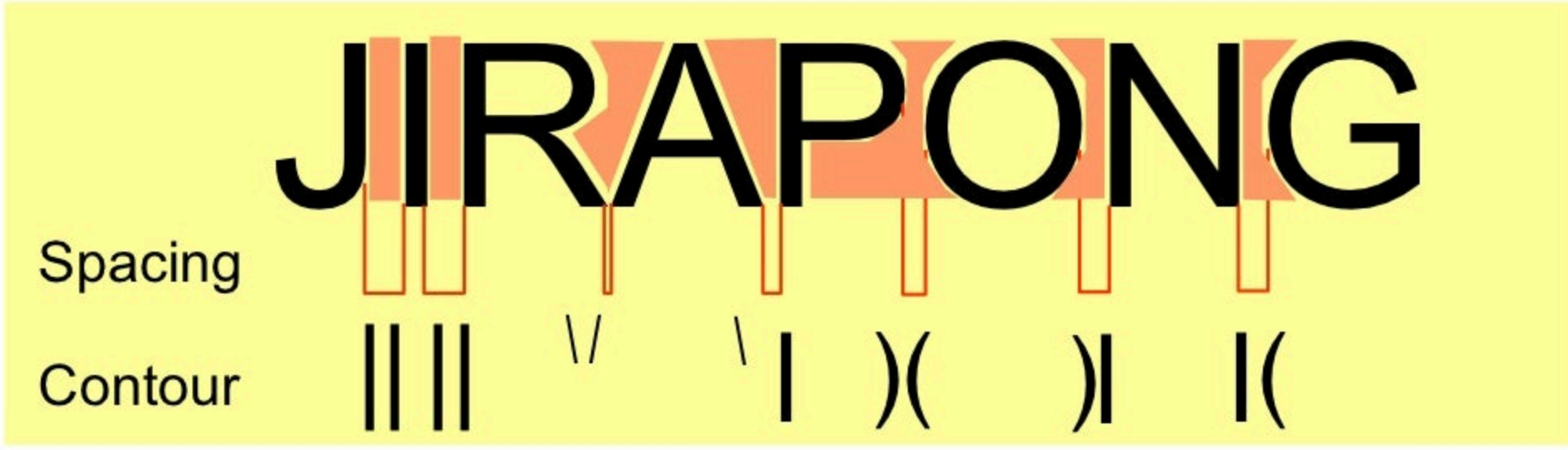
A) Non-uniform spacing

B) Uniform spacing



Which one is easier to read ?

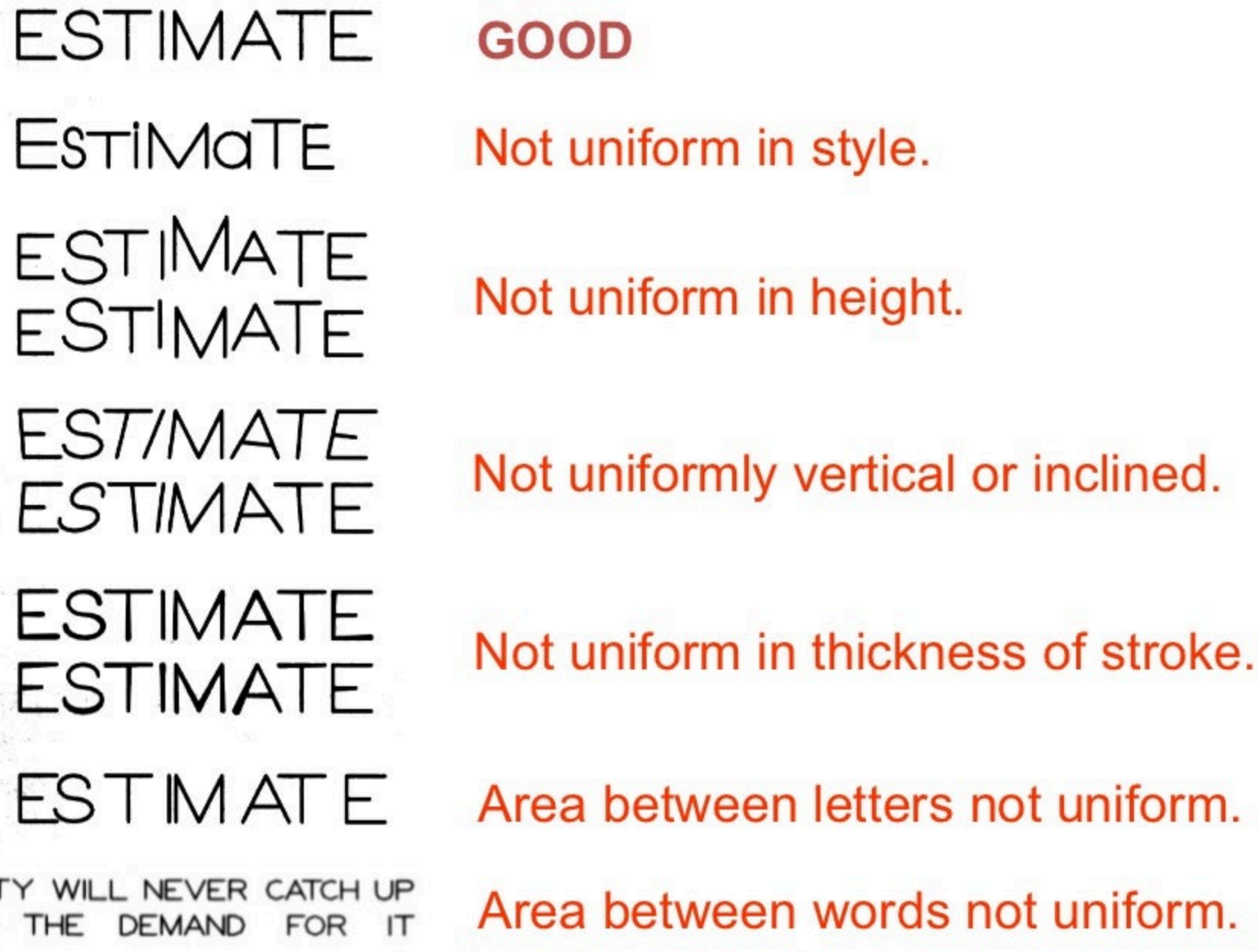
Word Composition



General conclusions are:

- Space between the letters depends on the contour of the letters at an adjacent side.
- Good spacing creates approximately equal ***background area*** between letters.

Example : *Good and Poor Lettering*

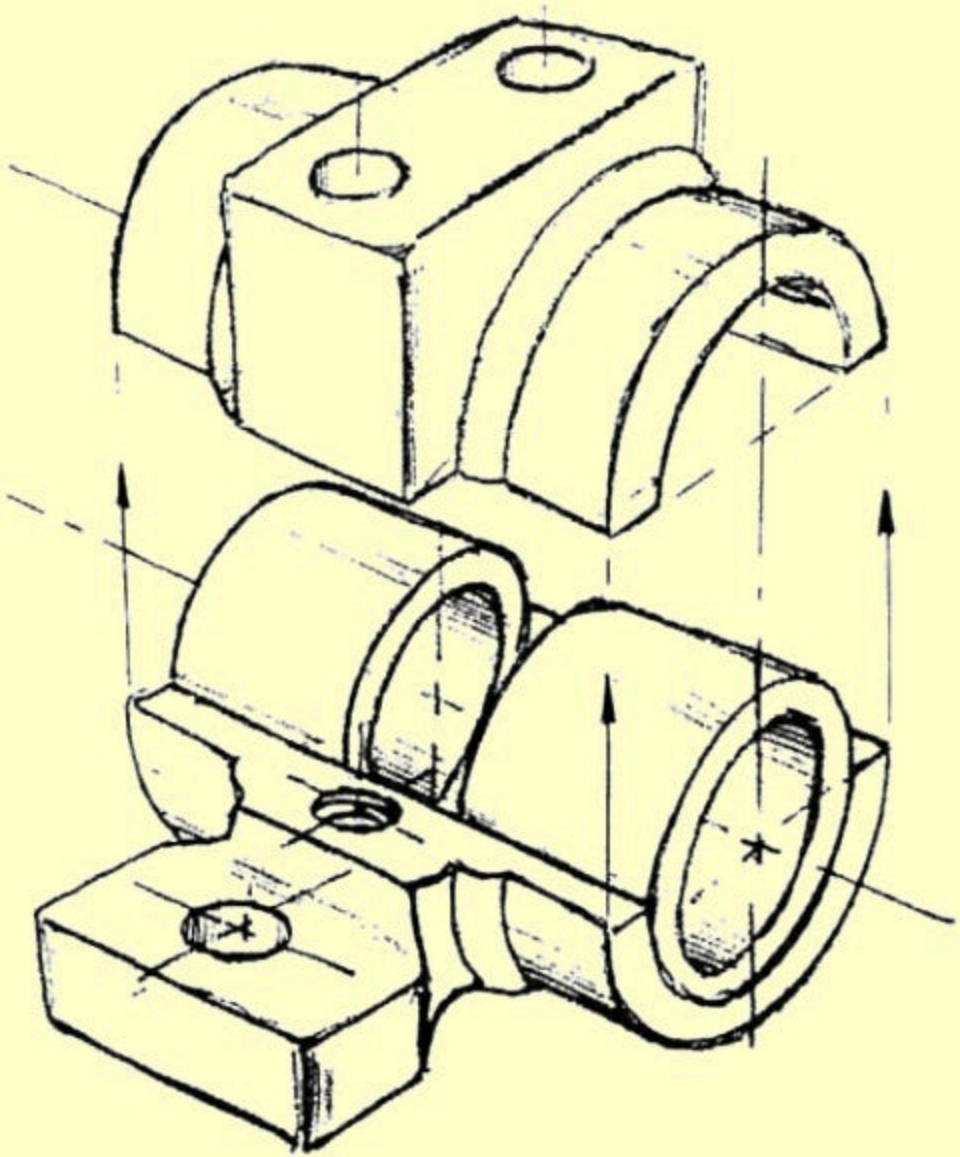


Sentence Composition

- Leave the space between words equal to the space requires for writing a letter “O”.

Example

ALL O DIMENSIONS O ARE O IN
MILLIMETERS O UNLESS
OTHERWISE O SPECIFIED.



Dimensioning

Dimensioning Guidelines

The term “feature” refers to surfaces, faces, holes, slots, corners, bends, arcs and fillets that add up to form an engineering part.

Dimensions define the **size** of a feature or its **location** relative to other features or a frame of reference, called a datum.

The basic rules of dimensioning are:

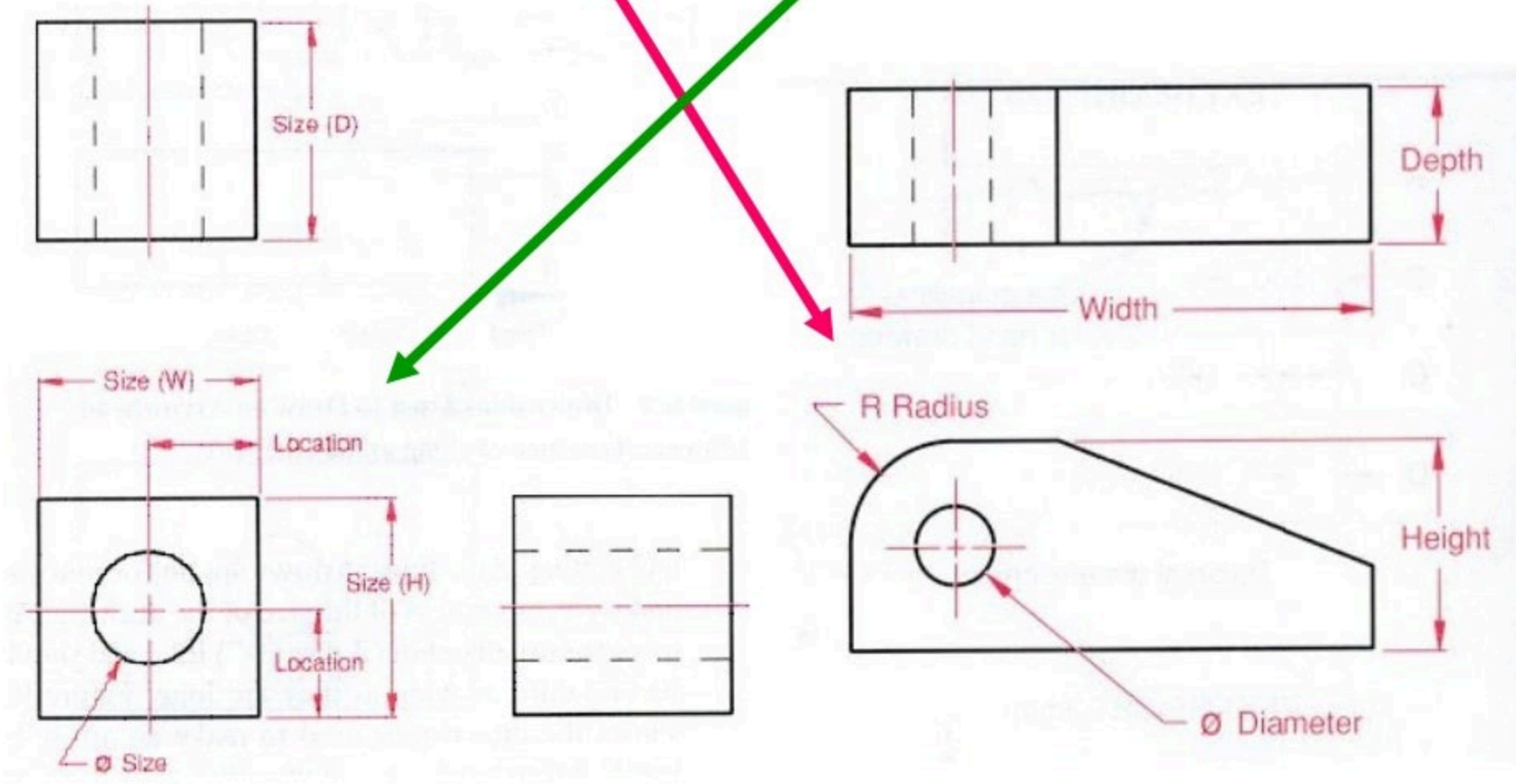
1. Dimension where the feature contour is shown;
2. Place dimensions between the views;
3. Dimension off the views;
4. Dimension mating features for assembly;
5. Do not dimension to hidden lines;
6. Stagger dimensioning values;
7. Create a logical arrangement of dimensions;
8. Consider fabrication processes and capabilities;
9. Consider inspection processes and capabilities.

GENERAL DIMENSIONING SYMBOLS

CURRENT PRACTICE	ABBREVIATION IN NOTES	PARAMETER
Ø	DIA	DIAMETER
SØ	SPHER DIA	SPHERICAL DIAMETER
R	R	RADIUS
CR	CR	CONTROLLED RADIUS
SR	SR	SPHERICAL RADIUS
⌴	CBORE or SFACE	COUNTERBORE SPOTFACE
⌵	CSK	COUNTERSINK
↧	DP	DEEP
○	—	DIMENSION ORIGIN
□	SQ	SQUARE
( )	REF	REFERENCE
X	PL	PLACES, TIMES
⌒	—	ARC LENGTH
	—	SLOPE
	—	CONICAL TAPER

Important elements of dimensioning

Two types of dimensioning: (1) Size and location dimensions and (2) Detail dimensioning



Geometrics

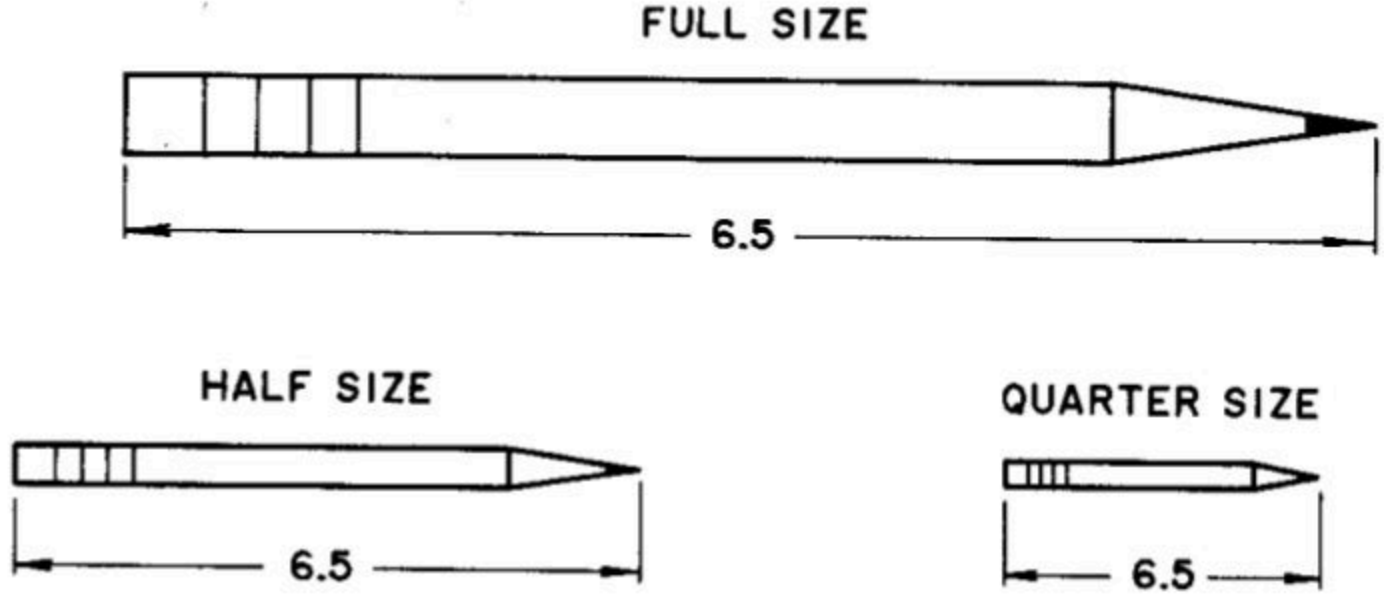
- The science of specifying and tolerancing shapes and locations of features of on objects

Geometrics

- It is important that all persons reading a drawing interpret it exactly the same way.
- Parts are dimensioned based on two criteria:
  - Basic size and locations of the features
  - Details of construction for manufacturing
- Standards from ANSI (American National Standards Institute)

Scaling vs. Dimensioning

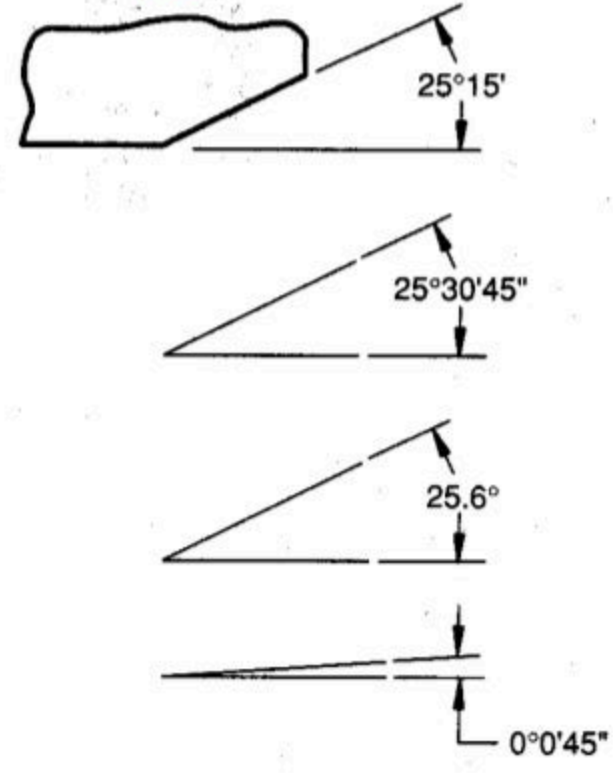
- Drawings can be a different scales, but dimensions are ALWAYS at full scale.



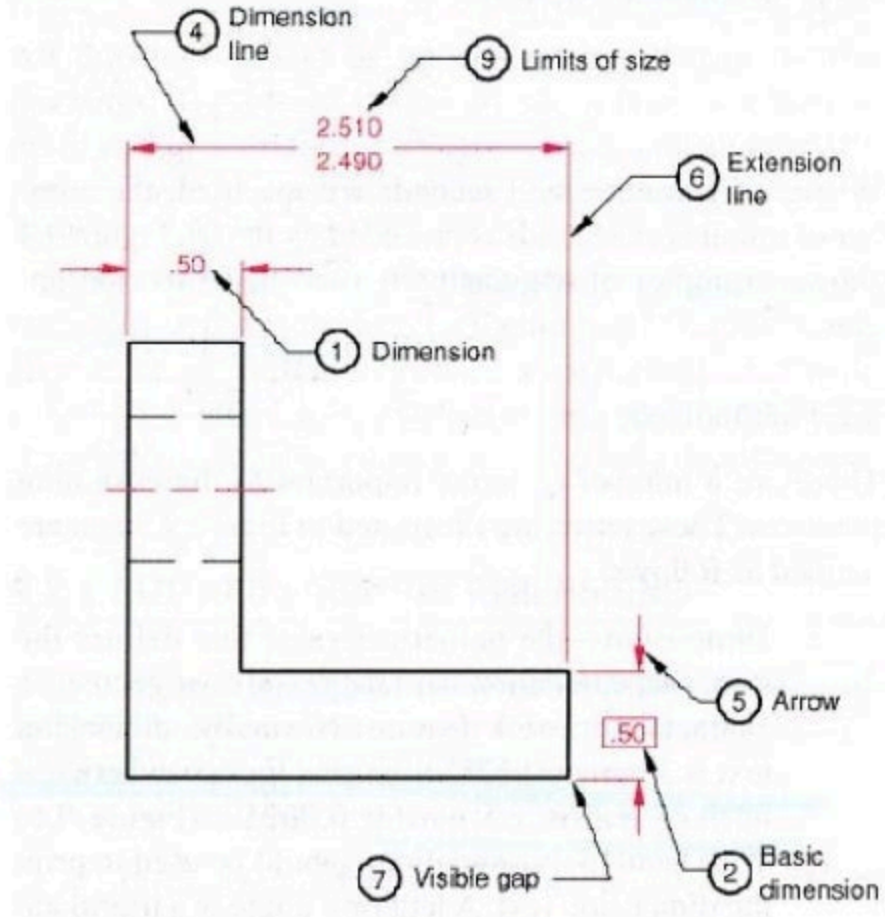
Units of Measure

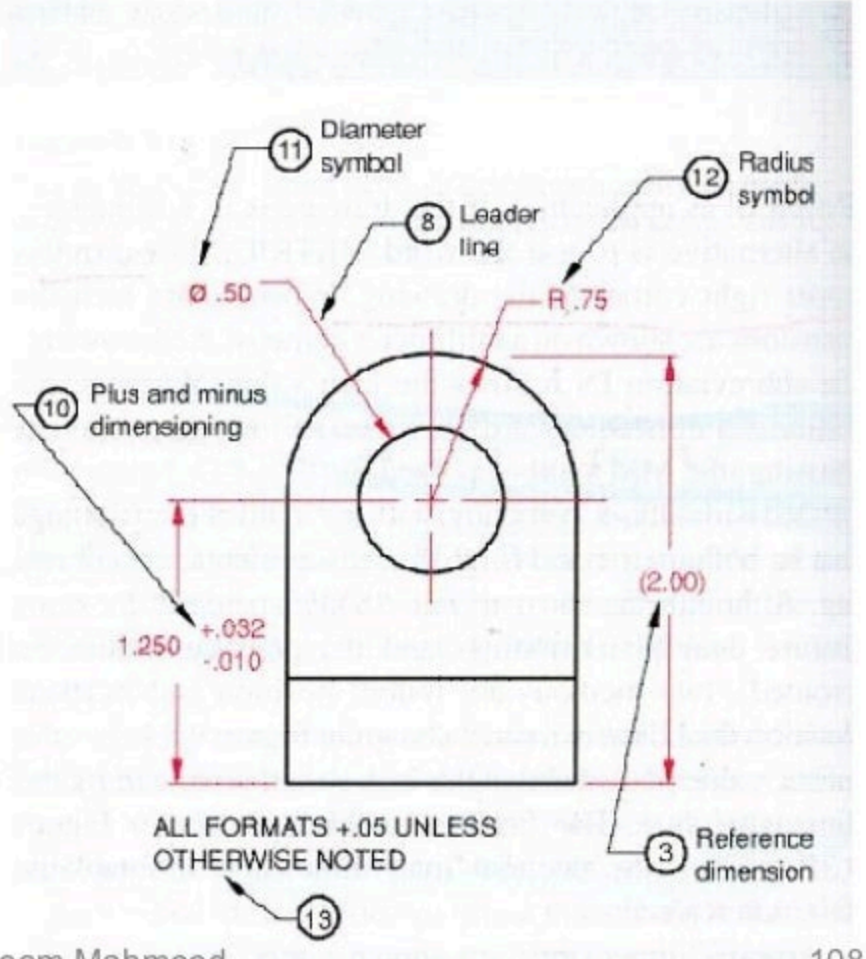
- Length
  - English - Inches, unless otherwise stated
    - Up to 72 inches – feet and inches over
  - SI – millimeter, mm
- Angle
  - degrees, minutes, seconds

Angle Dimensions



Elements of a dimensioned drawing (Be familiar with these terms





Arrangement of Dimensions

- Keep dimension off of the part where possible.
- Arrange extension lines so the larger dimensions are outside of the smaller dimensions.
- Stagger the dimension value labels to ensure they are clearly defined.

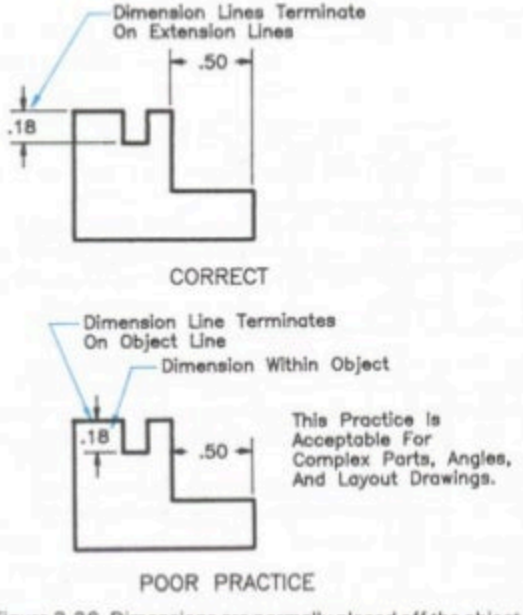


Figure 3-26. Dimensions are normally placed off the object. Avoid placing dimensions on the object.

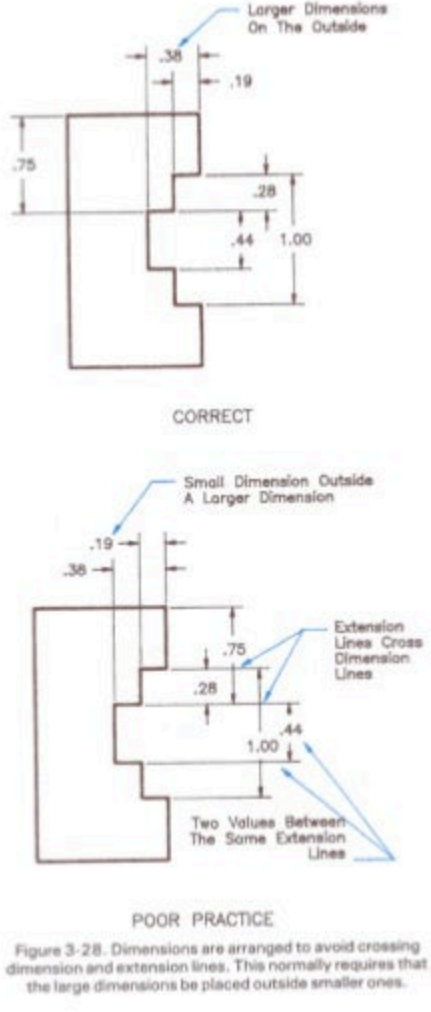


Figure 3-28. Dimensions are arranged to avoid crossing dimension and extension lines. This normally requires that the large dimensions be placed outside smaller ones.

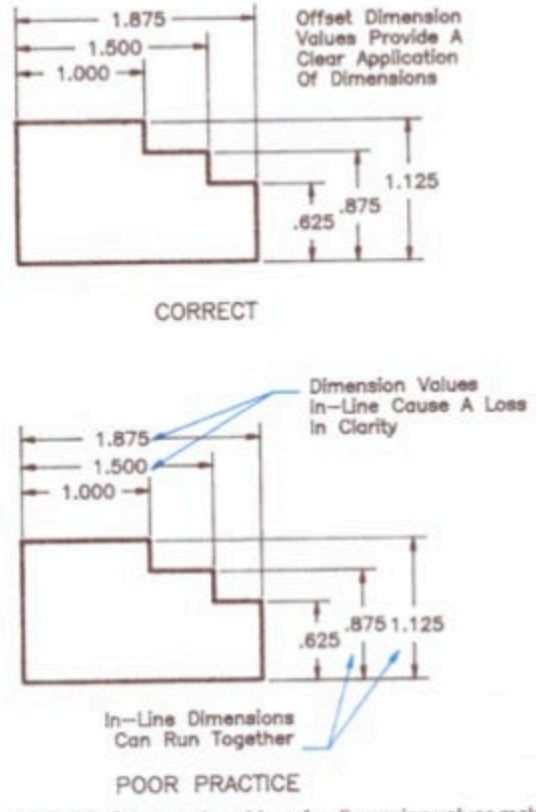


Figure 3-29. Staggered positions for dimension values make it easier to read the dimensions.

Dimensioning Holes

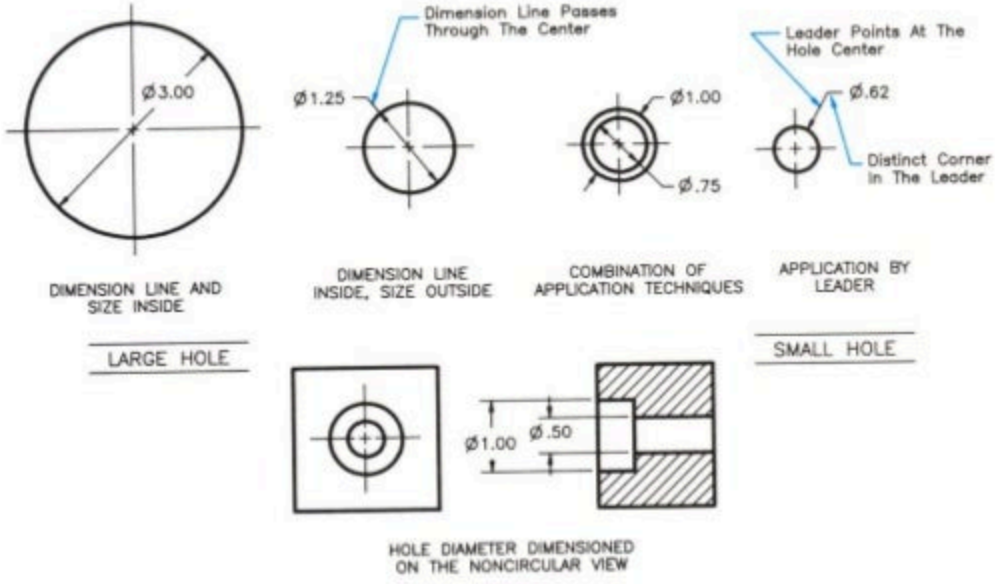


Figure 4-6. The diameter must be specified for holes.

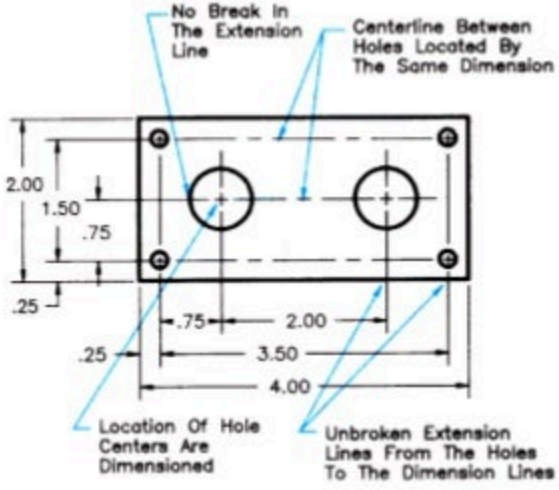


Figure 4-7. Hole locations must be dimensioned to the centers.

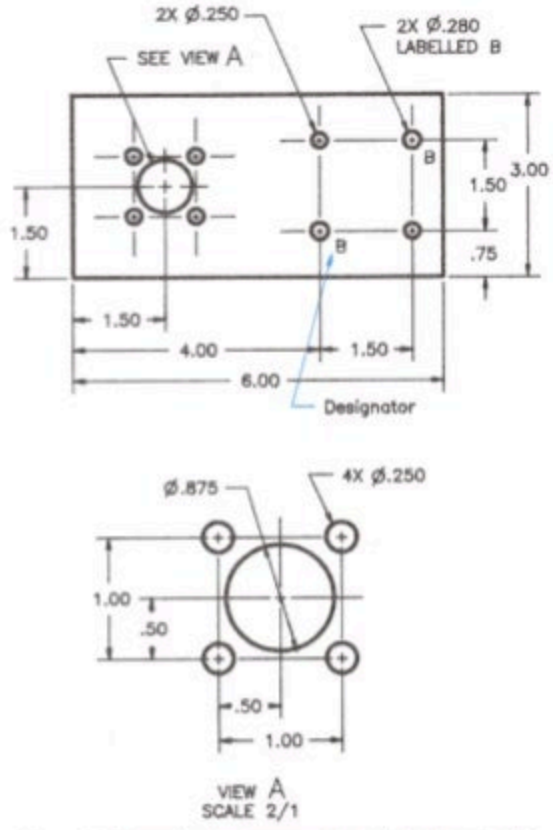
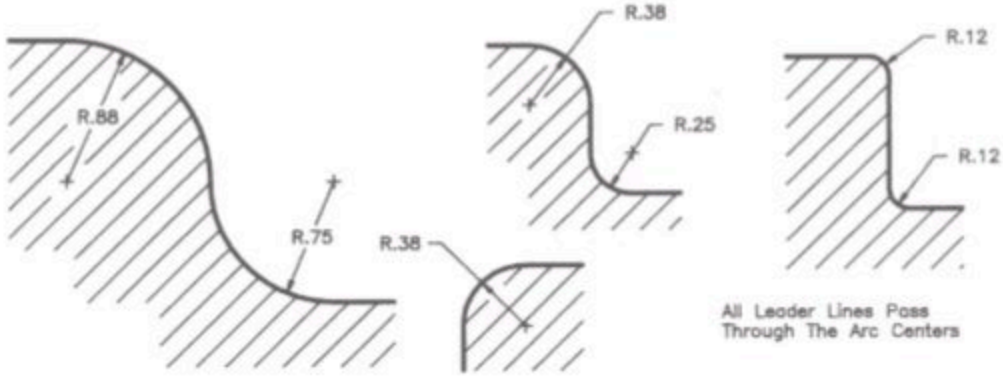


Figure 4-8. Complex features or patterns of features may be dimensioned in removed views.

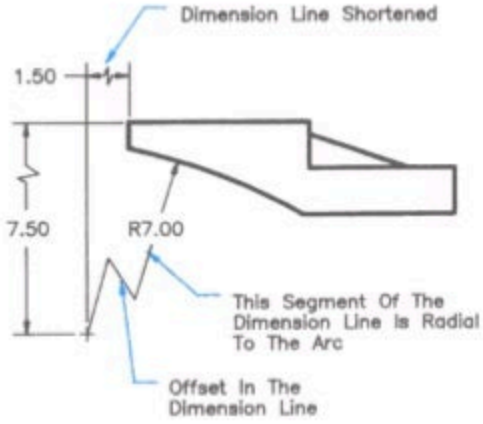
- Dimension the diameter of a hole.
- Locate the center-line.
- Use a notes and designators for repeated hole sizes

Dimensioning the Radius of an Arc



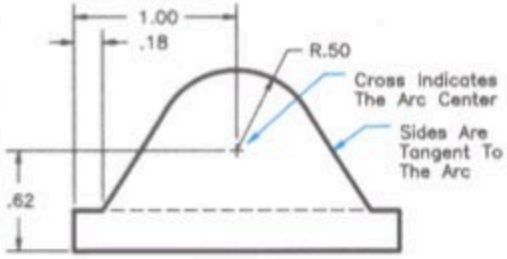
ARC DIMENSIONS

Figure 4-17. Arcs are always dimensioned by giving the radius.

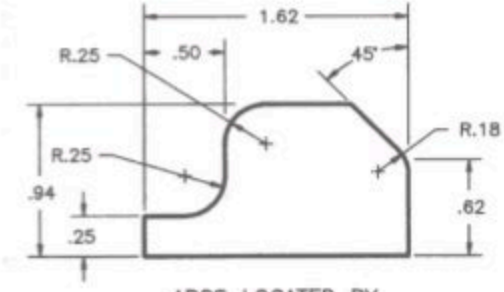


LARGE RADIUS ARC

Figure 4-19. The true dimensions defining arc center location must be shown even when the center point is not shown in its true location.



ARC CENTER LOCATED BY DIMENSIONS



ARCS LOCATED BY TANGENTS

Figure 4-18. Arc location must be defined.

Dimension an arcs by its radius.
Locate the center of the radius or two tangents to the arc.

Drilled Holes, Counter bores and Countersinks

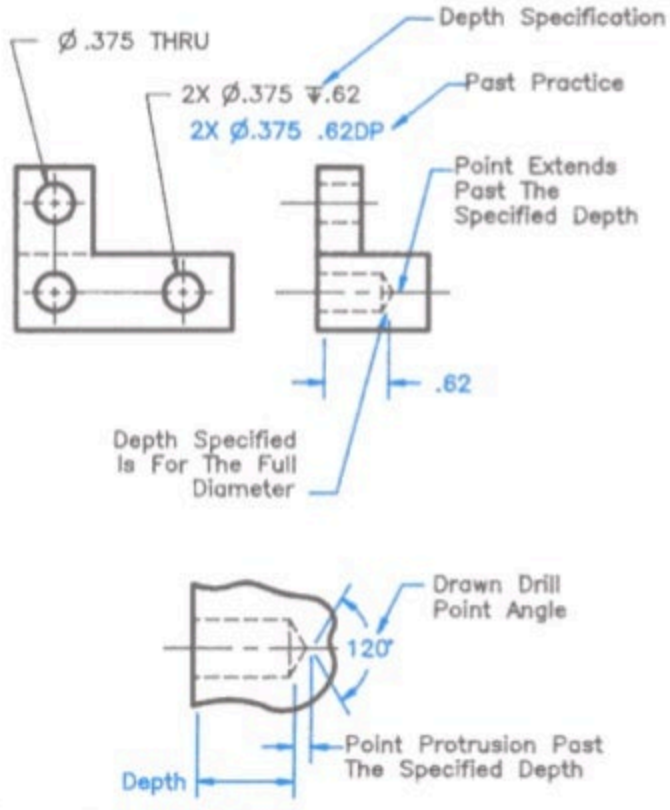


Figure 4-9. Hole depth must be specified if the hole does not go through the part.

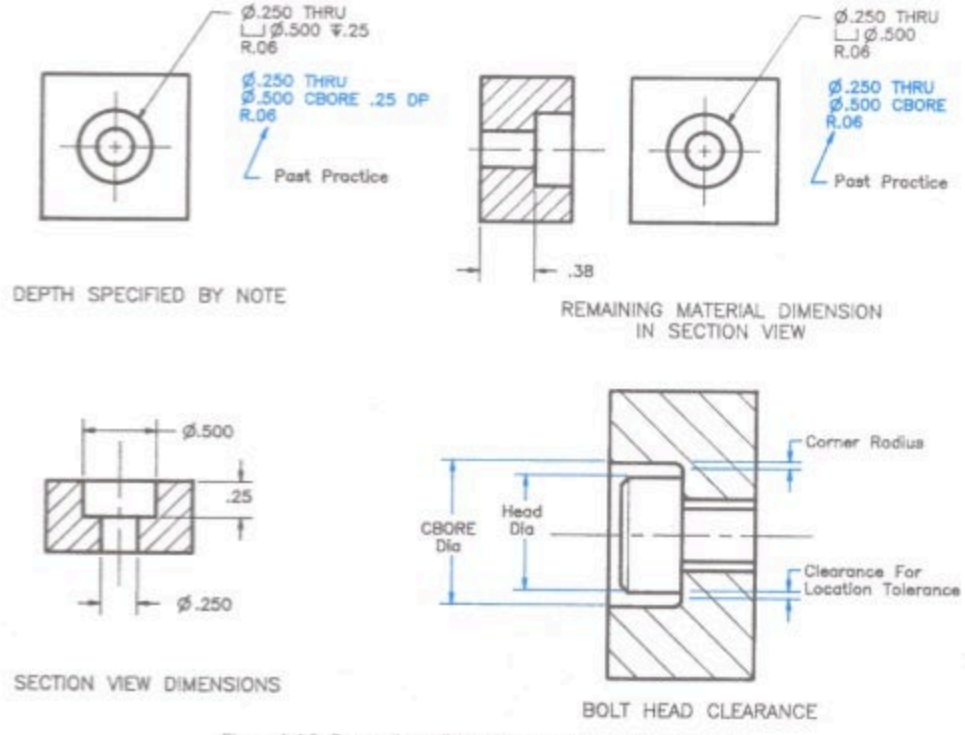
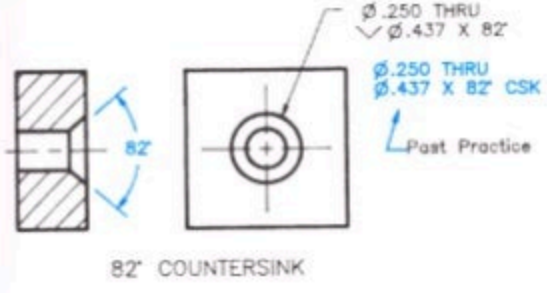
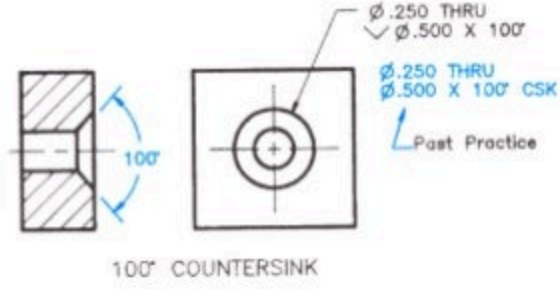


Figure 4-10. Counterbore dimensions provide a controlled depth.





- Use the depth symbol to define the depth of a drilled hole.
- Use the depth symbol or a section view to dimension a counter bore.
- Countersinks do not need a section view.

Angles, Chamfers and Tapers

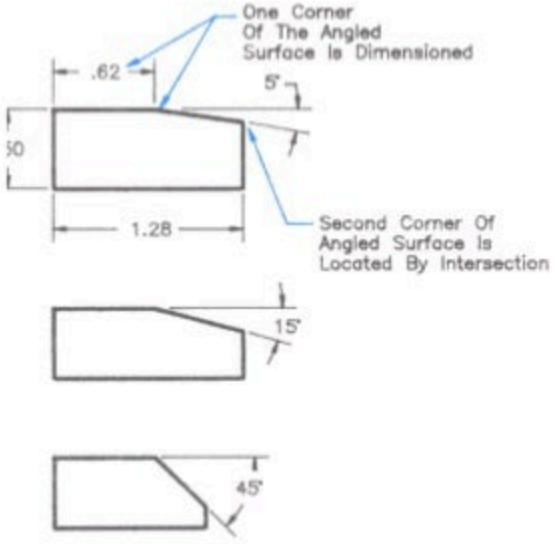


Figure 4-14. The arc used for a dimension line when imensioning an angle is centered on the vertex of the angle.

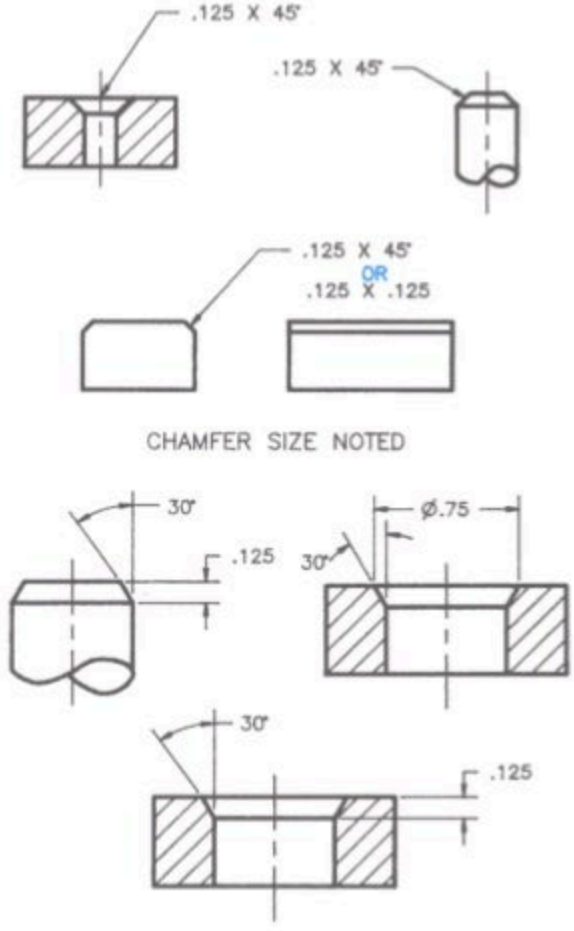
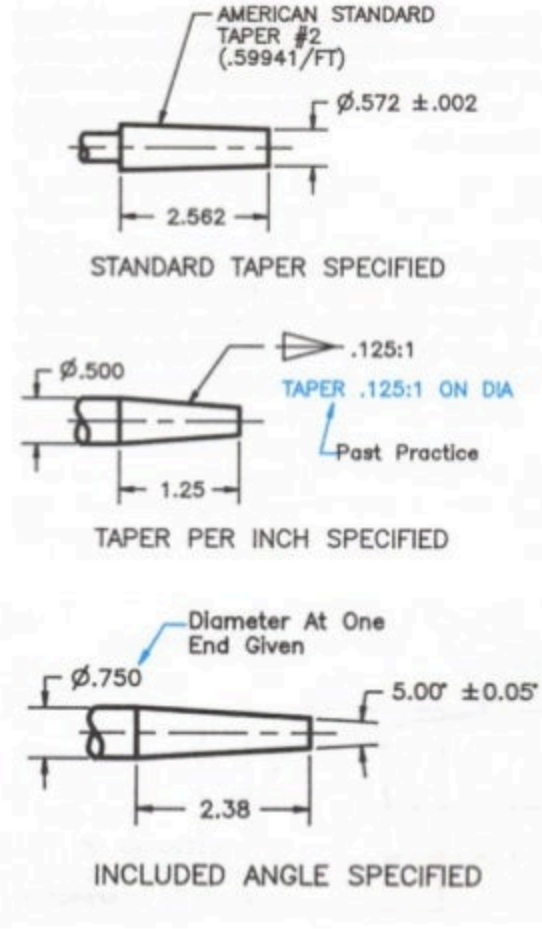


Figure 4-15. Chamfers eliminate sharp edges and facilitate assembly of close-fitting parts.



- Dimension the one vertex for an angled face, the other vertex is determined by an intersection.
- Chamfers are generally 45° with the width of the face specified.

Rounded Bars and Slots

- The rounded end of a bar or slot has a radius that is 1/2 its width.
- Use R to denote this radius, do not dimension it twice.
- Locate the center of the arc, or the center of the slot.

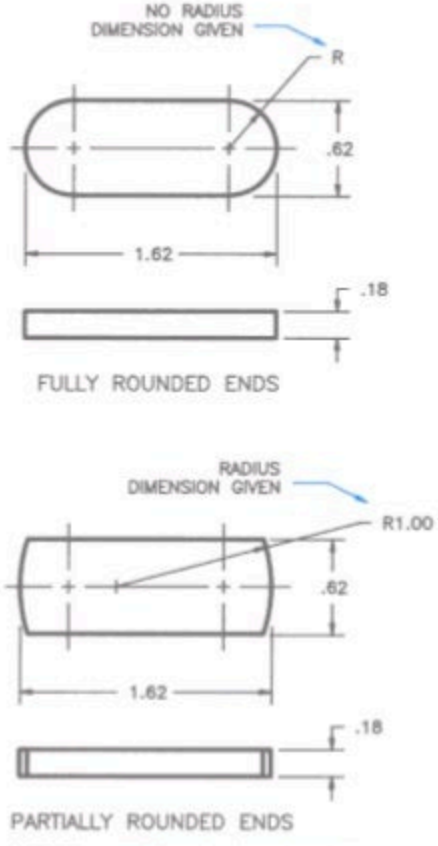


Figure 4-25. The overall length of round-ended bars is dimensioned.

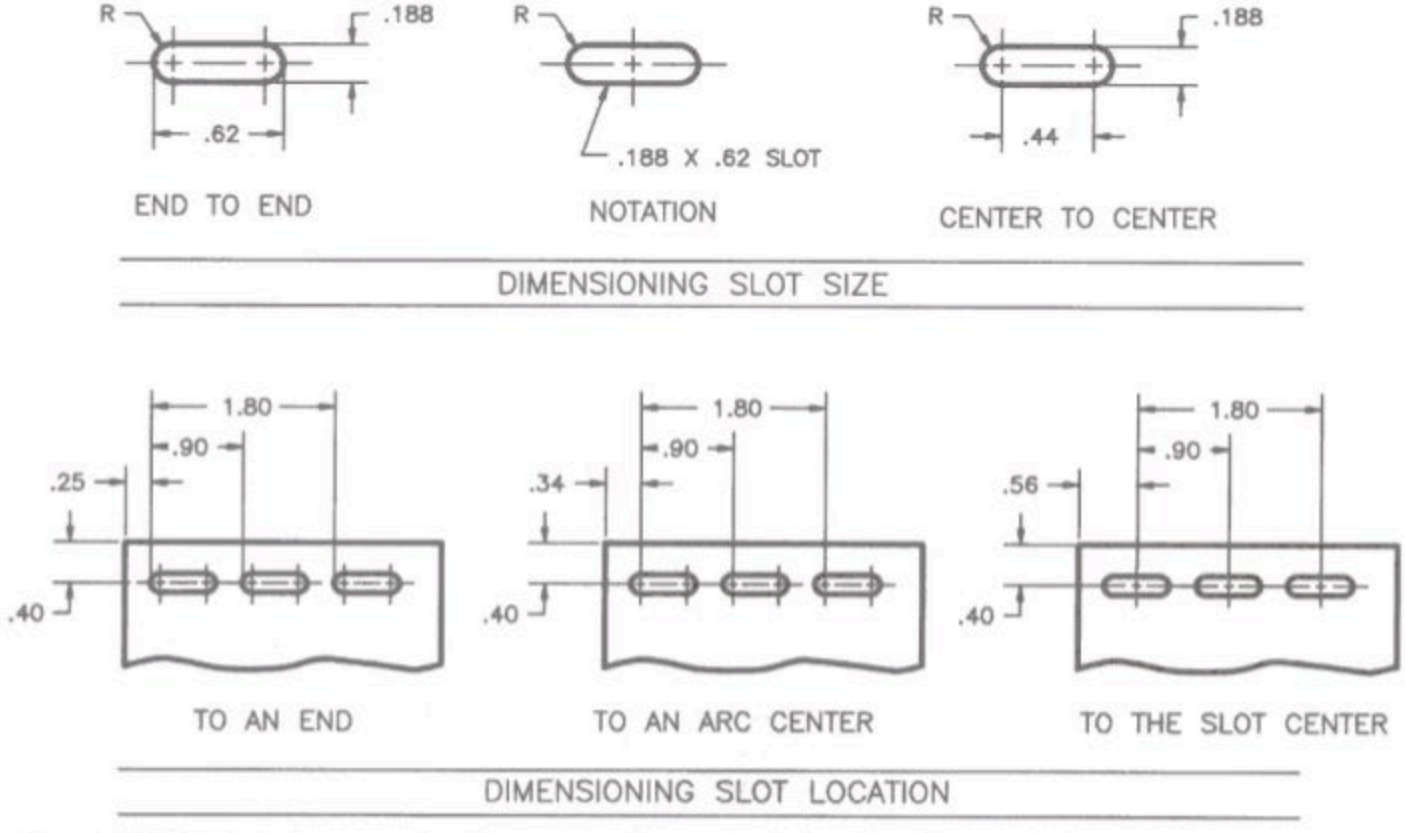


Figure 4-26. Slotted holes are used to allow greater tolerance for the location of fastener holes and to permit adjustment.

Limits of Size

- All dimensions have minimum and maximum values specified by the tolerance block.
- Tolerances accumulate in a chain of dimensions.
- Accumulation can be avoided by using a single baseline.

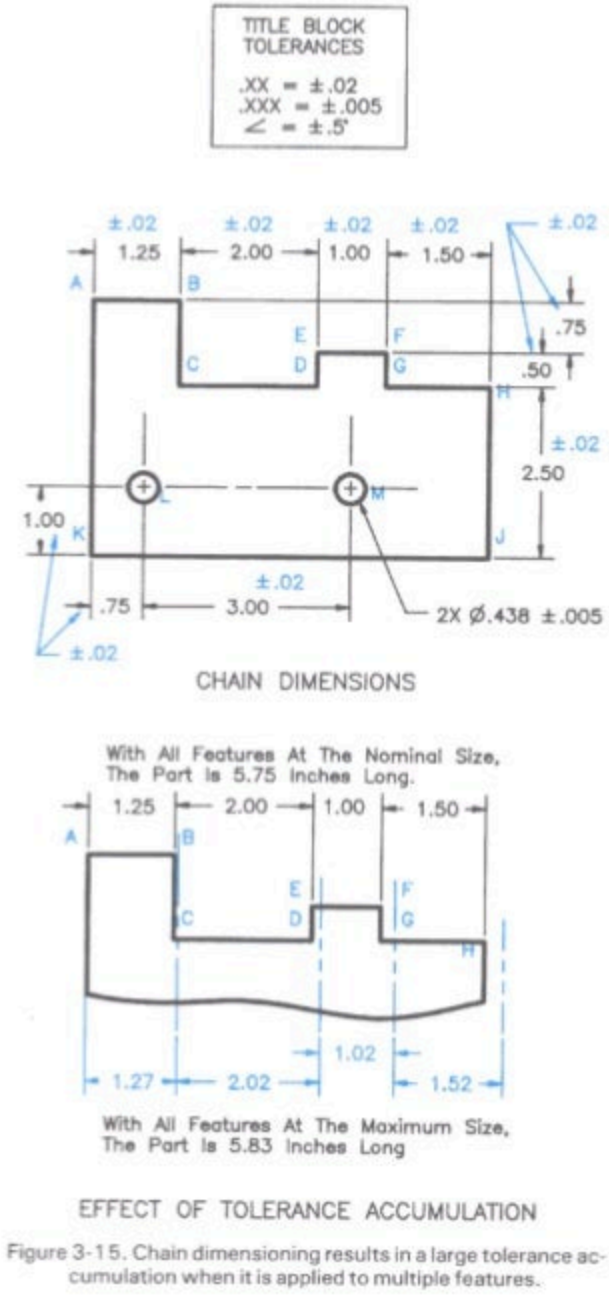


Figure 3-15. Chain dimensioning results in a large tolerance accumulation when it is applied to multiple features.

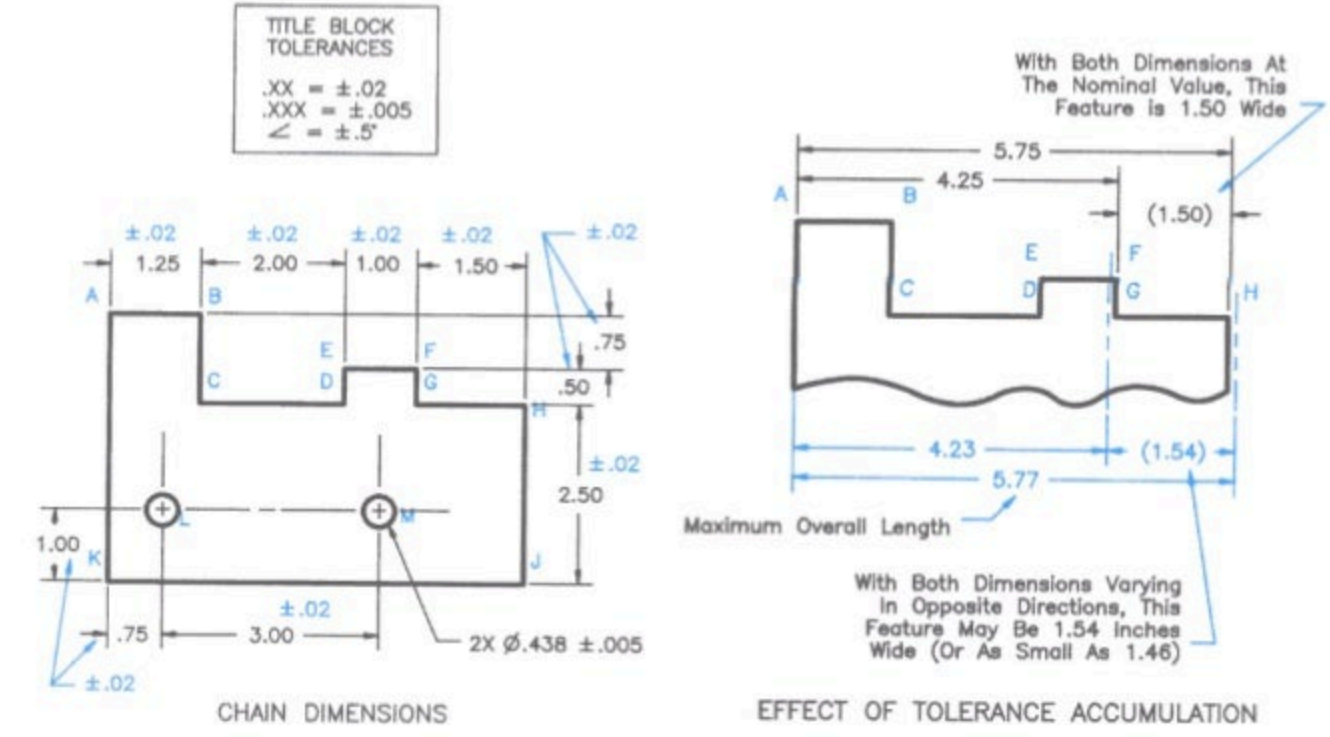
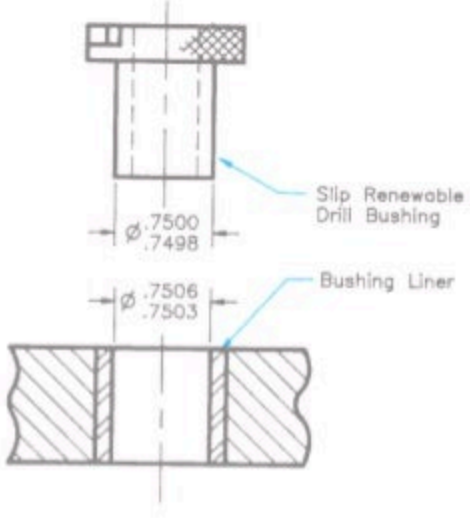


Figure 3-16. Baseline dimensioning can reduce the amount of tolerance accumulation on a drawing.

Fit Between Parts

1. Clearance fit: The shaft maximum diameter is smaller than the hole minimum diameter.
2. Interference fit: The shaft minimum diameter is larger than the hole maximum diameter.
3. Transition fit: The shaft maximum diameter and hole minimum have an interference fit, while the shaft minimum diameter and hole maximum diameter have a clearance fit

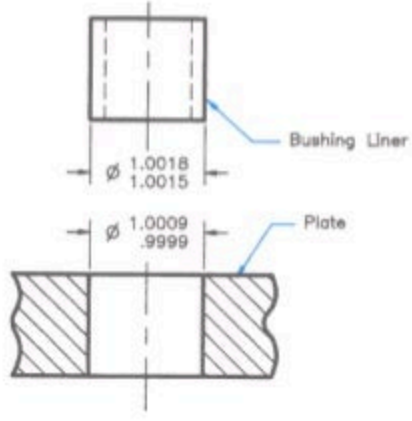
Clearance Fit



Smallest Hole	.7503
– Largest Shaft	.7500
Allowance	.0003

Figure 3-42. Proper calculation of a clearance fit will result in limits of size that provide clearance between the features for all possible size combinations.

Interference Fit



MAXIMUM INTERFERENCE

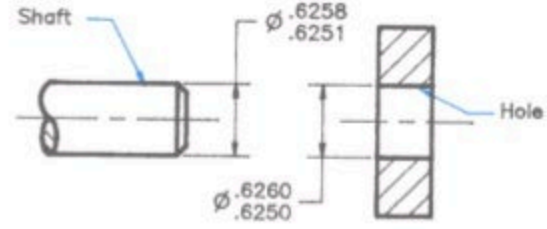
Smallest Hole	.9999
– Largest Shaft	1.0018
Allowance	–.0019

MINIMUM INTERFERENCE

Largest Hole	1.0009
– Smallest Shaft	1.0015
	–.0006

Figure 3-43. A negative allowance value between two features indicates that an interference fit exists.

Transition Fit



Smallest Hole	.6250
– Largest Shaft	.6258
Allowance	–.0008

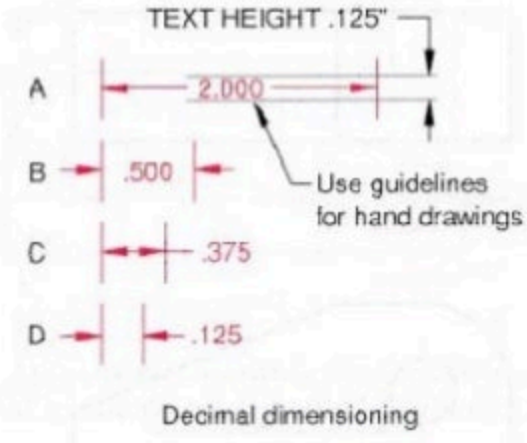
Interference

Largest Hole	.6260
Smallest Shaft	.6251
	.0009

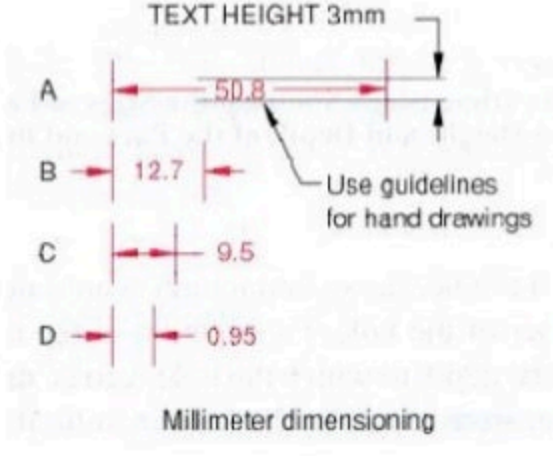
Clearance

Figure 3-44. A transition fit results in a clearance fit at one extreme of the applied tolerance limits, and an interference fit at the other extreme.

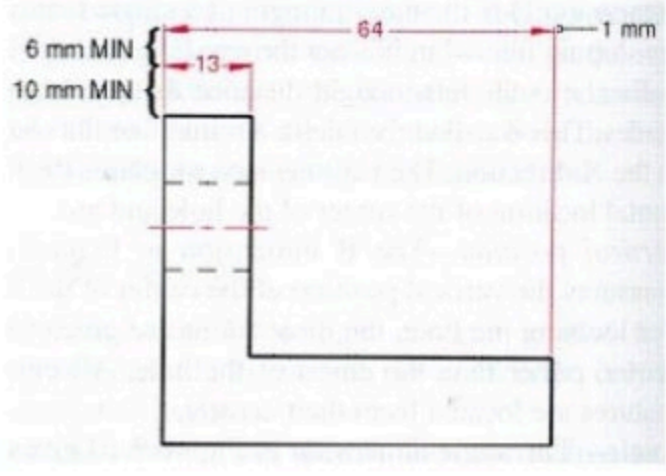
Dimensioning standards

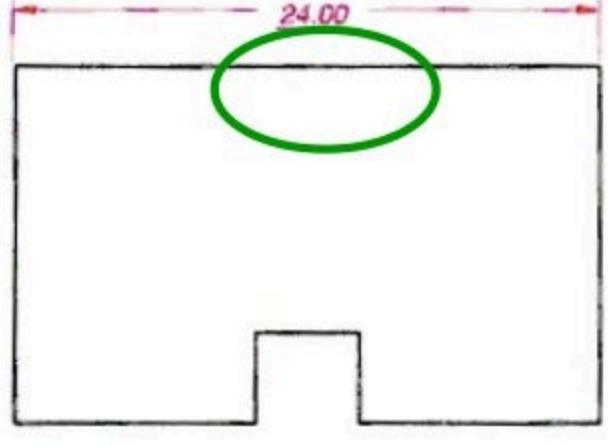


Decimal dimensioning

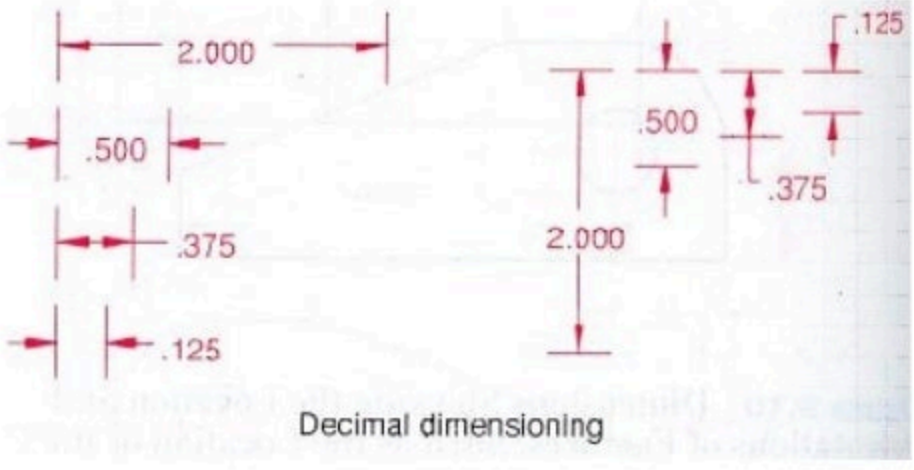


Millimeter dimensioning

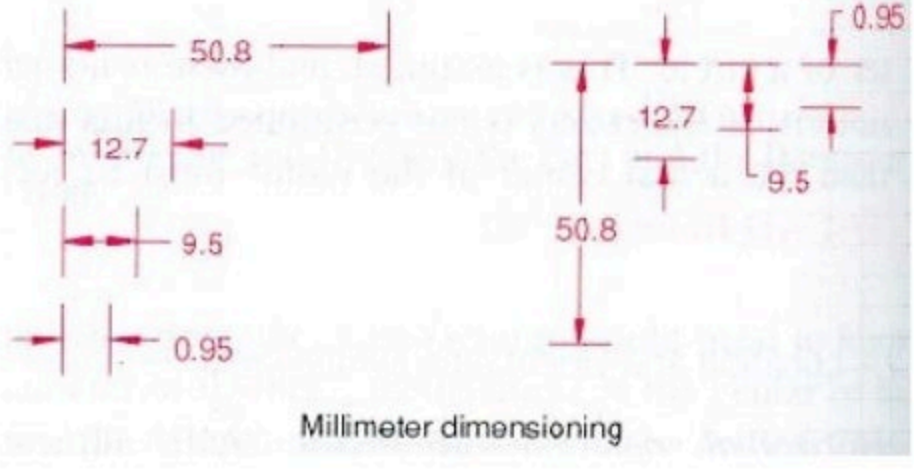




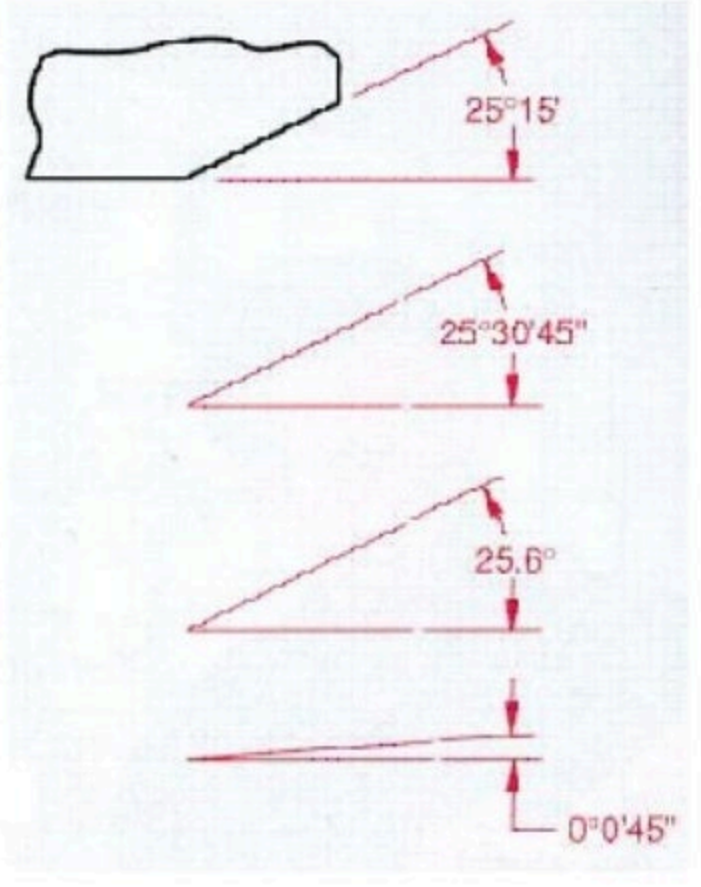
Dimension text placement



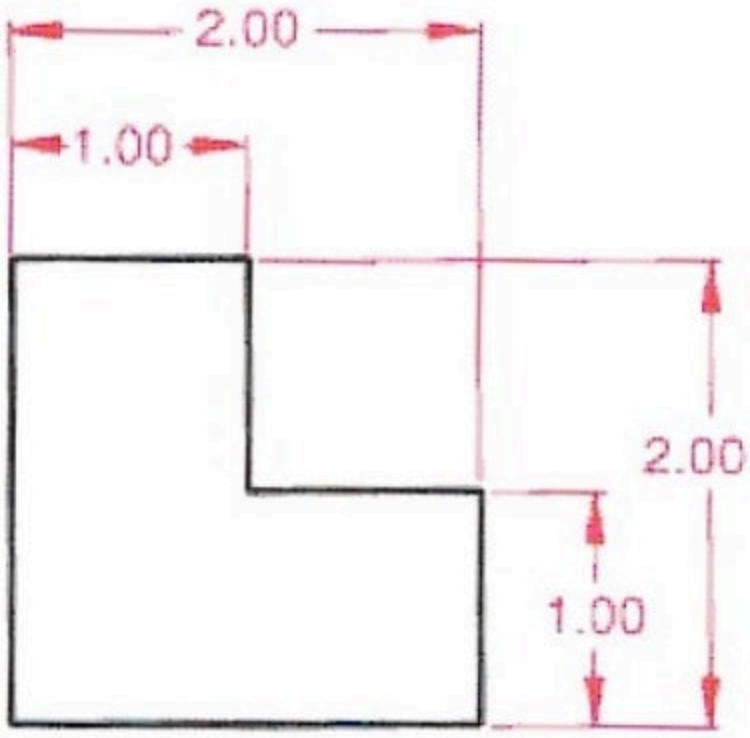
Decimal dimensioning



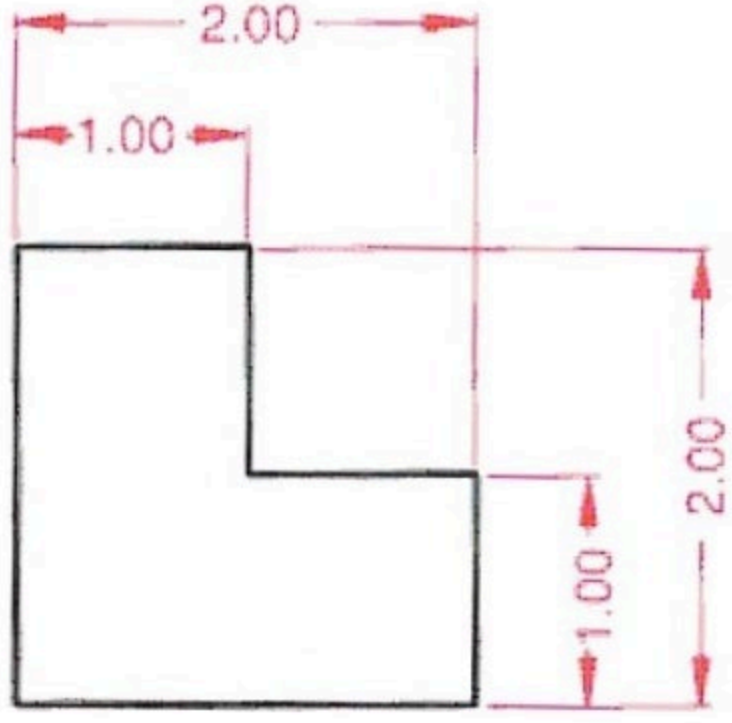
Millimeter dimensioning



Unidirectional or aligned dimensioning?

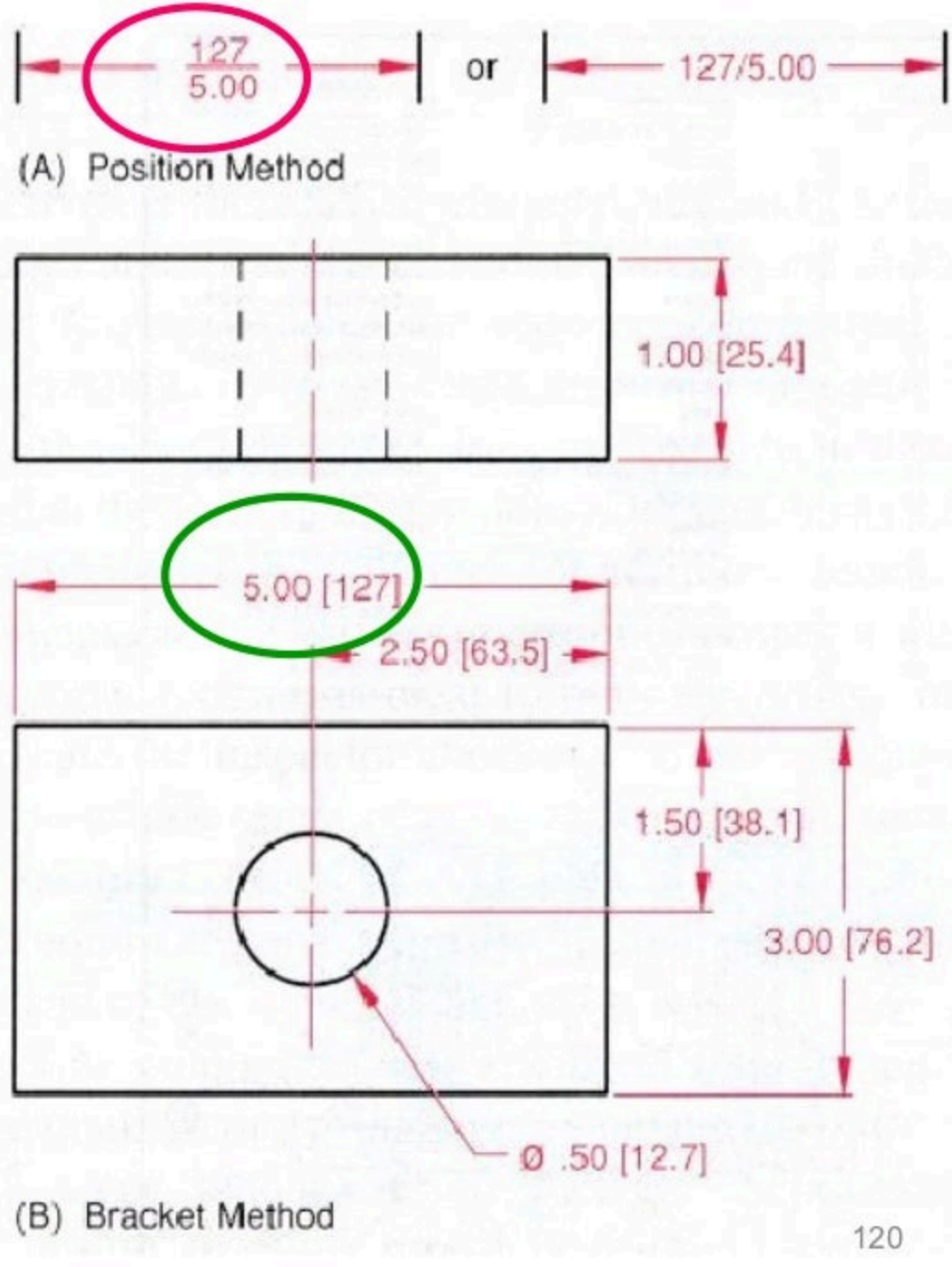


Unidirectional
Current standard



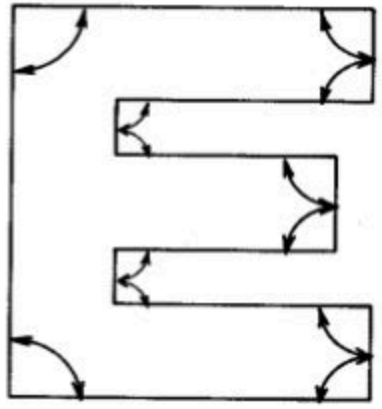
Aligned
Old standard

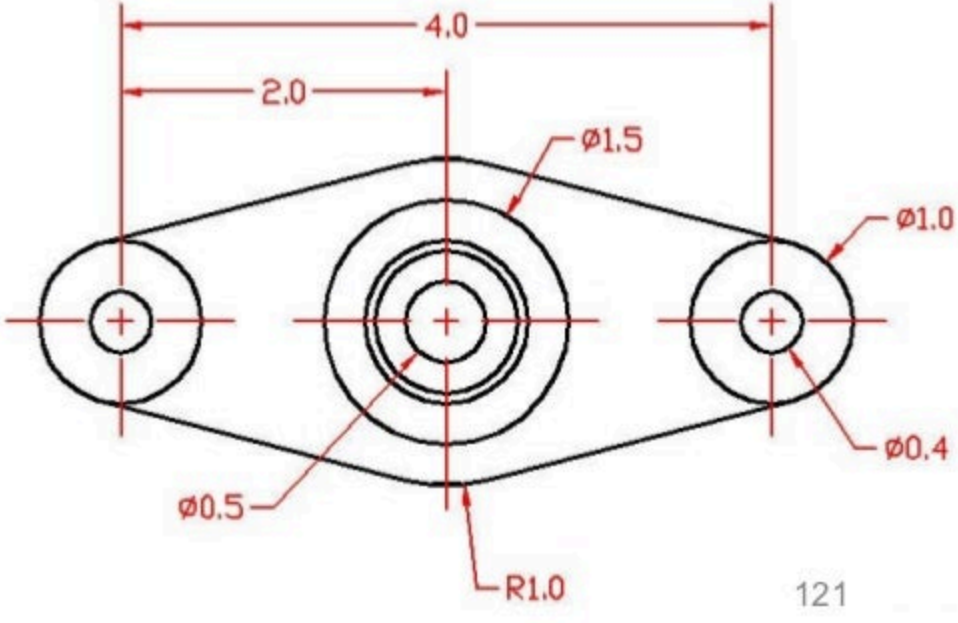
Dual dimensioning



Dimensioning Basic Shapes -Assumptions

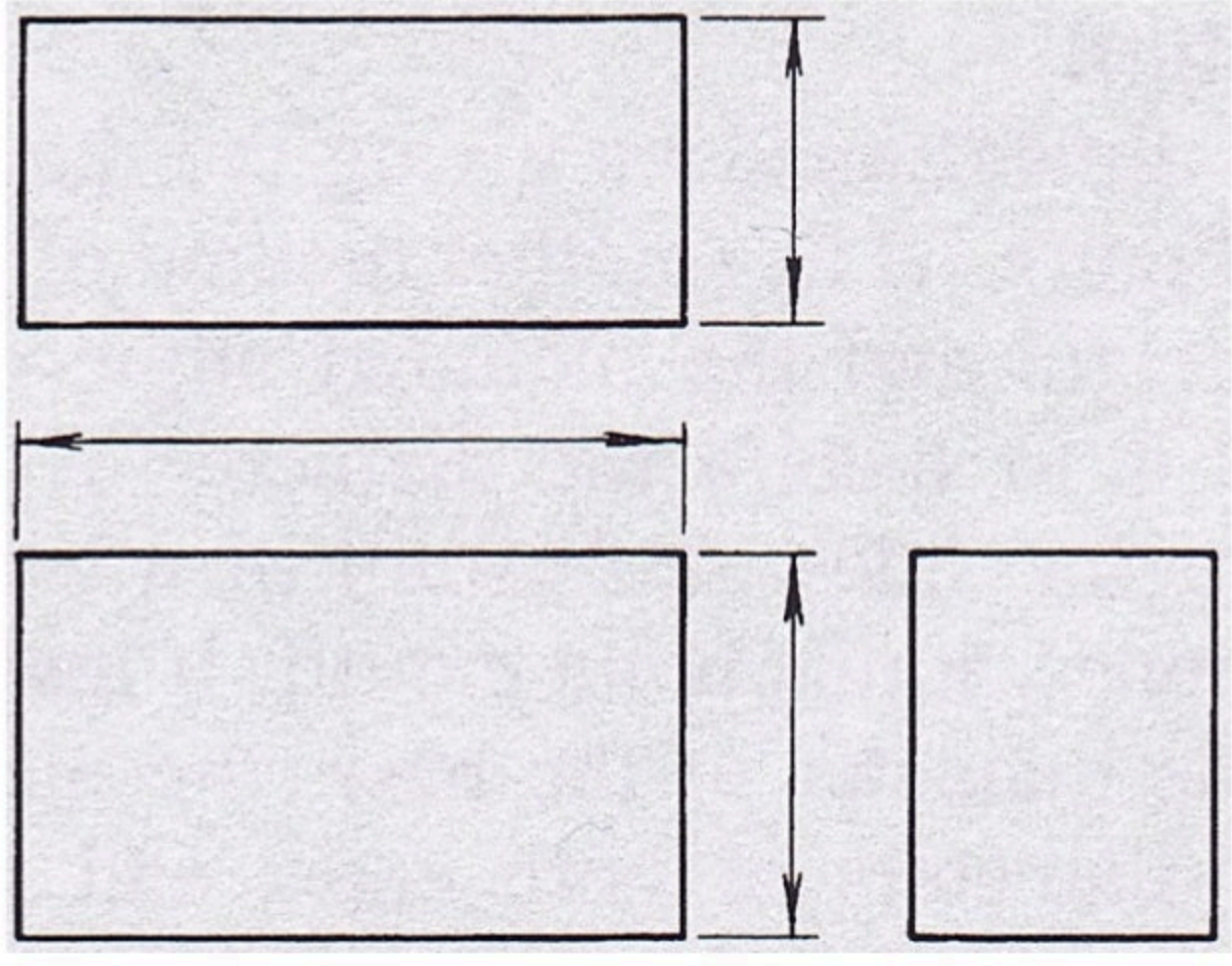
- **Perpendicularity**
  - Assume lines that appear perpendicular to be 90° unless otherwise noted
- **Symmetry**
  - If a part appears symmetrical – it is (unless it is dimensioned otherwise)
  - Holes in the center of a cylindrica object are automatically located



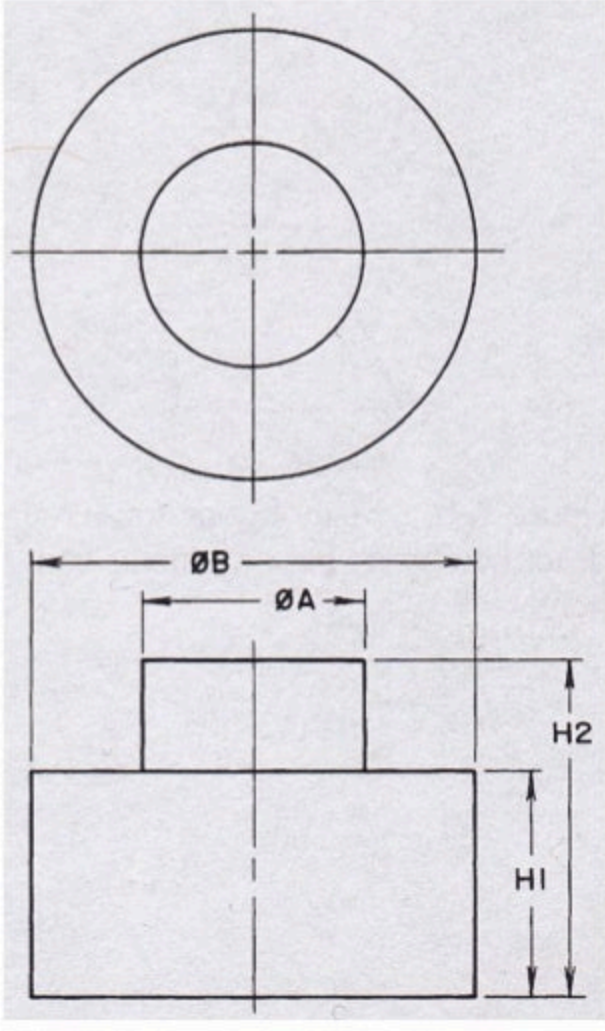


Dimensioning Basic Shapes

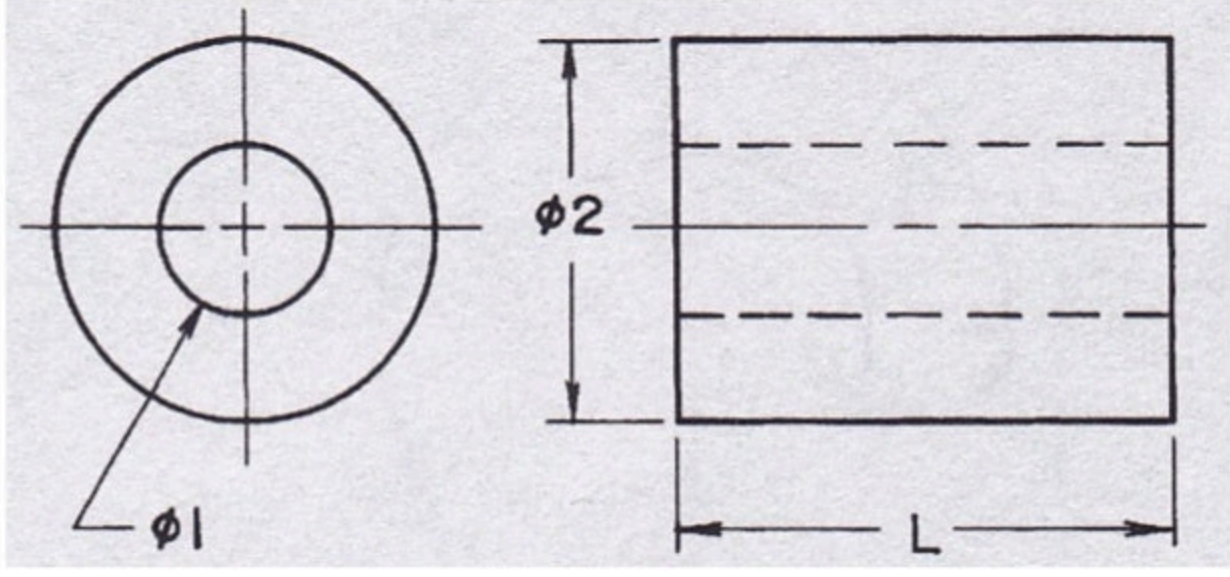
- Rectangular Prism



Dimensioning Basic Shapes

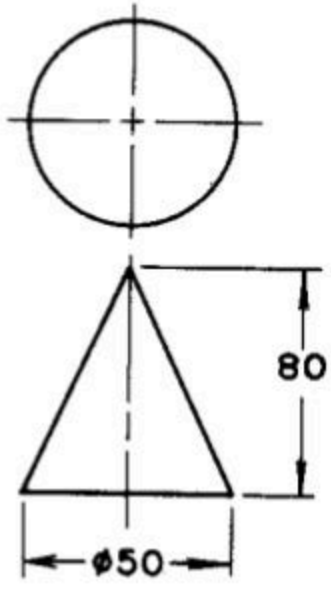


- Cylinders
  - Positive
  - Negative

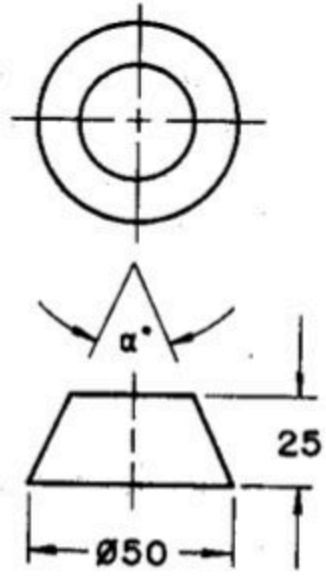


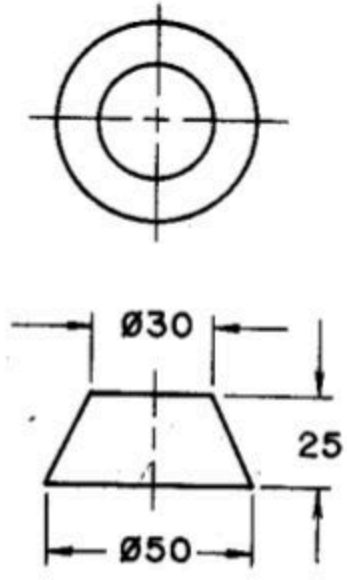
Dimensioning Basic Shapes

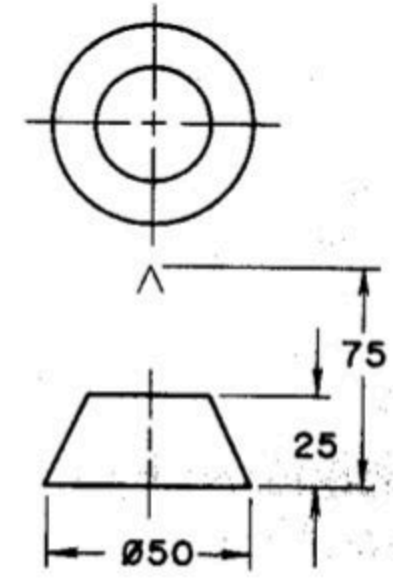
- Cone



Frustum

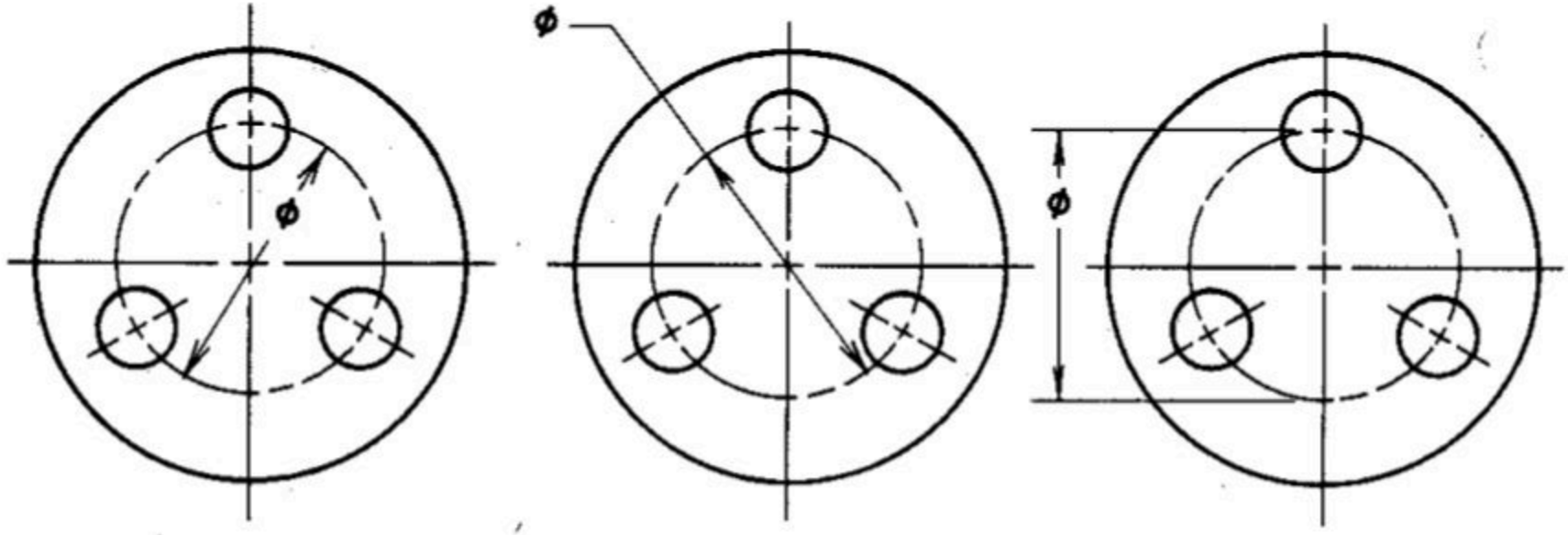






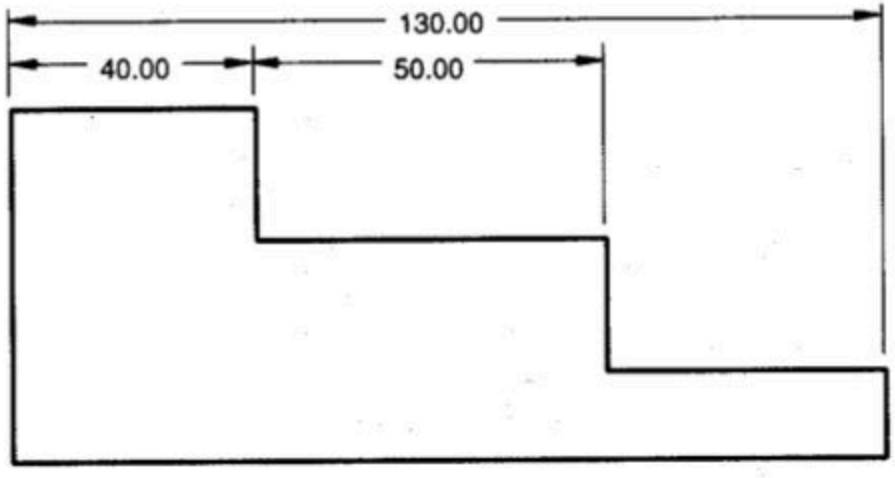
Dimensioning Basic Shapes

- Circle Pattern Center Lines

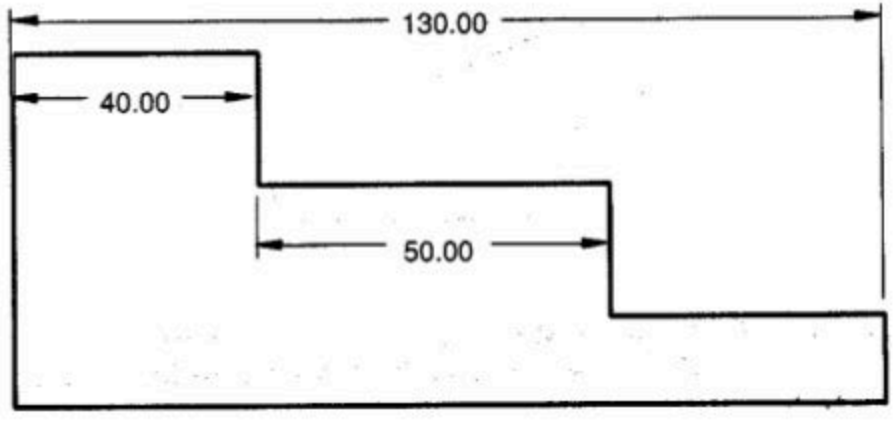


Grouping Dimensions

- Dimensions should always be placed outside the part



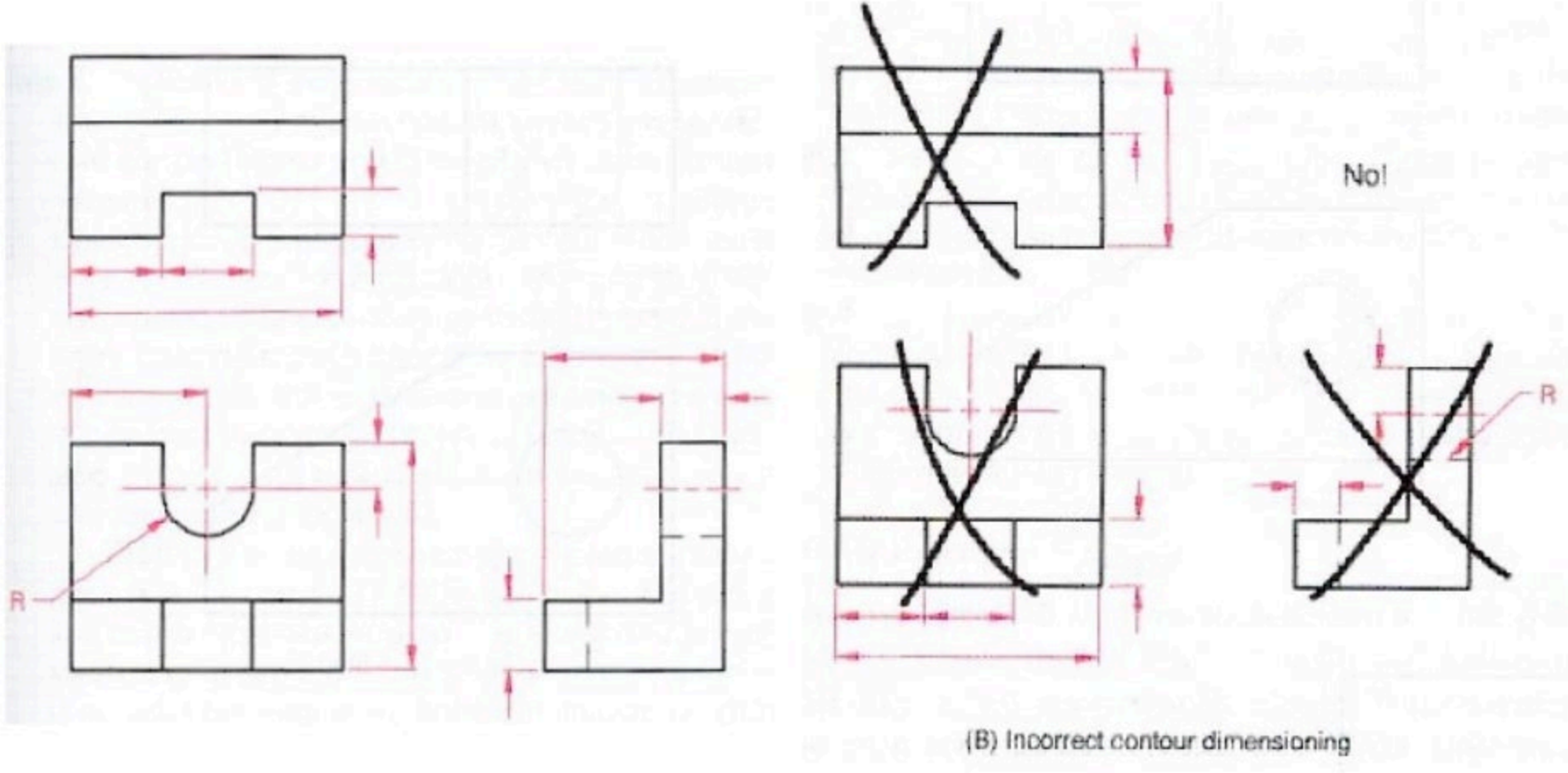
Yes



No

Dimension guidelines

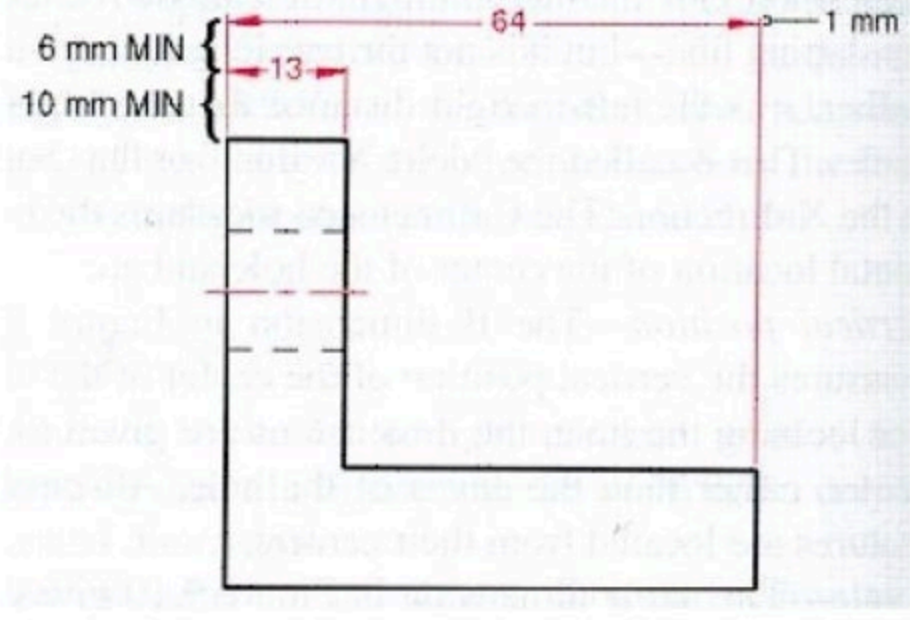
Dimensions should be placed in the view that most clearly describes the feature being dimensioned (contour (shape) dimensioning)



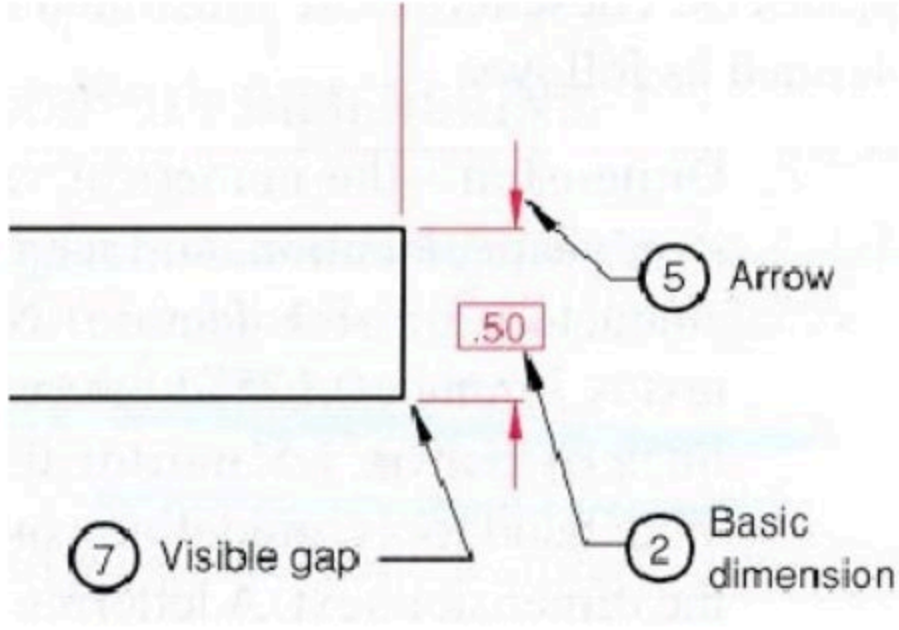
(B) Incorrect contour dimensioning

Dimension guidelines

Maintain a minimum spacing between the object and the dimension between multiple dimensions.

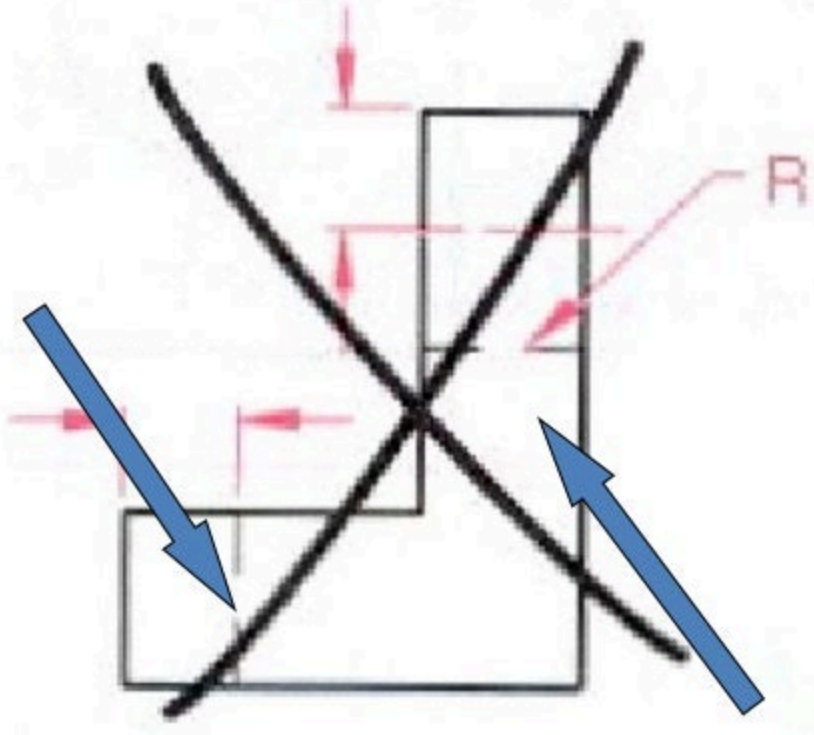


A visible gap shall be placed between the ends of extension lines and the feature to which they refer.

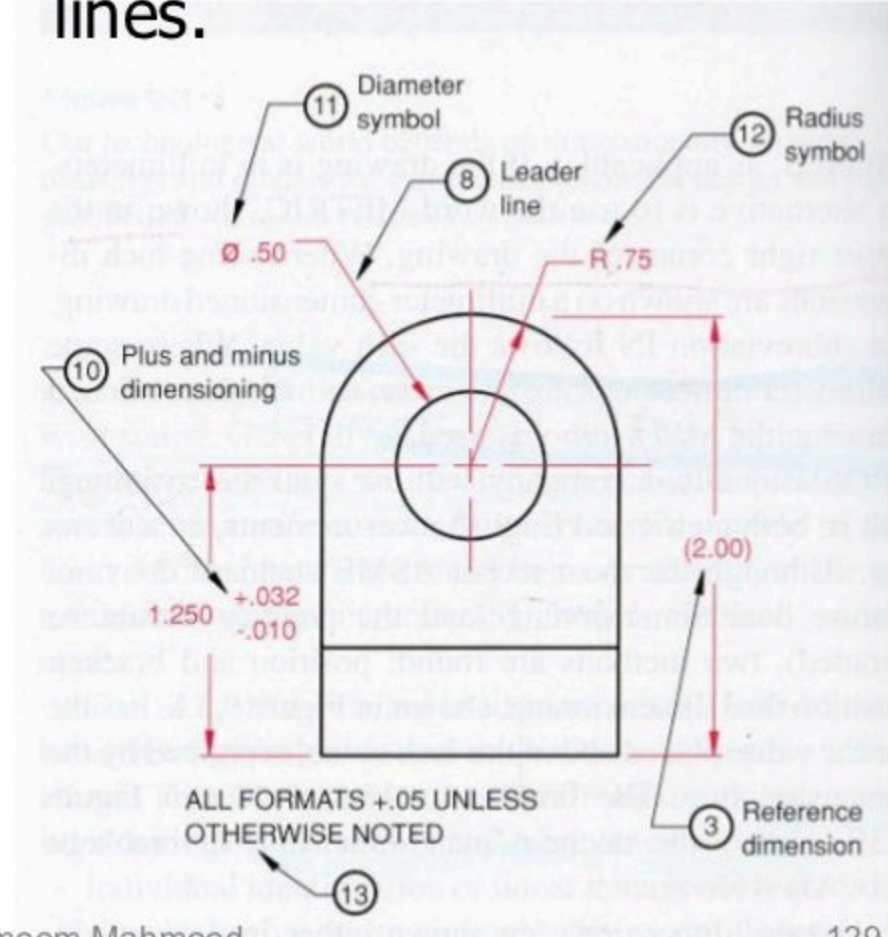


Dimension guidelines

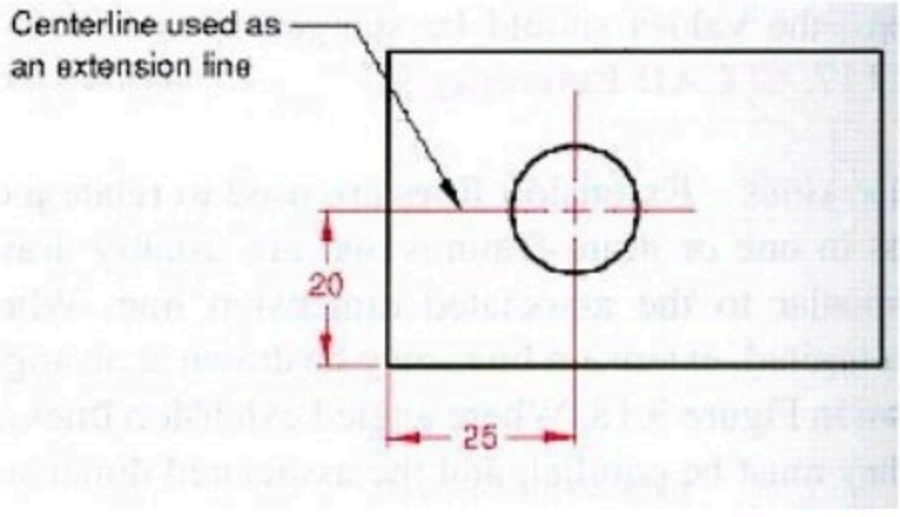
Avoid dimensioning hidden lines.

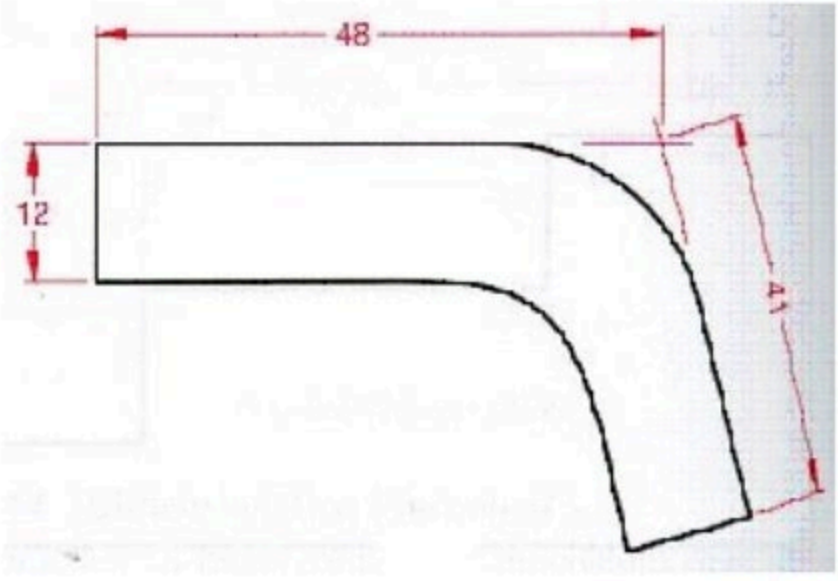


Leader lines for diameters and radii should be radial lines.

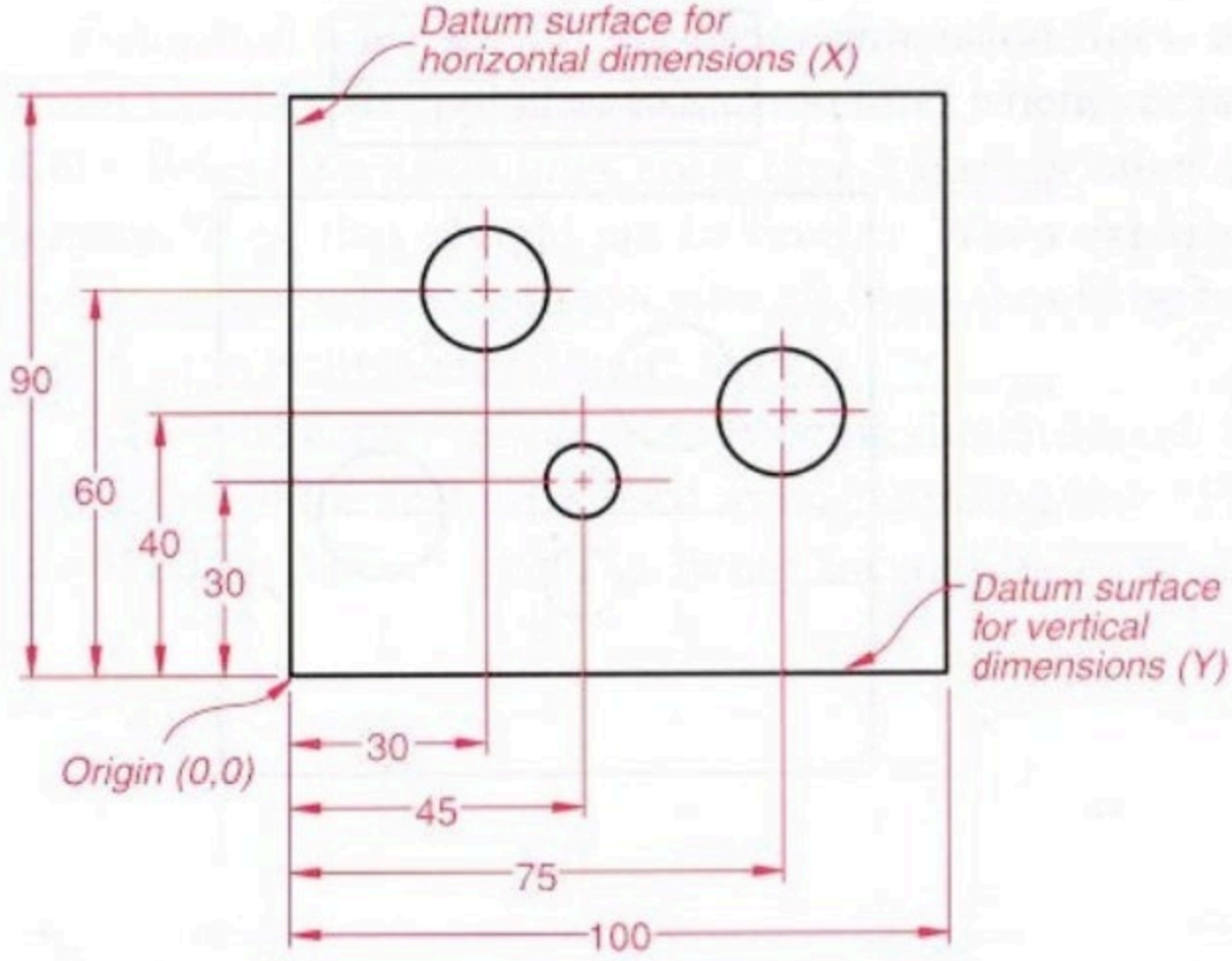


Where and how should we place dimensions when we have many dimensions?

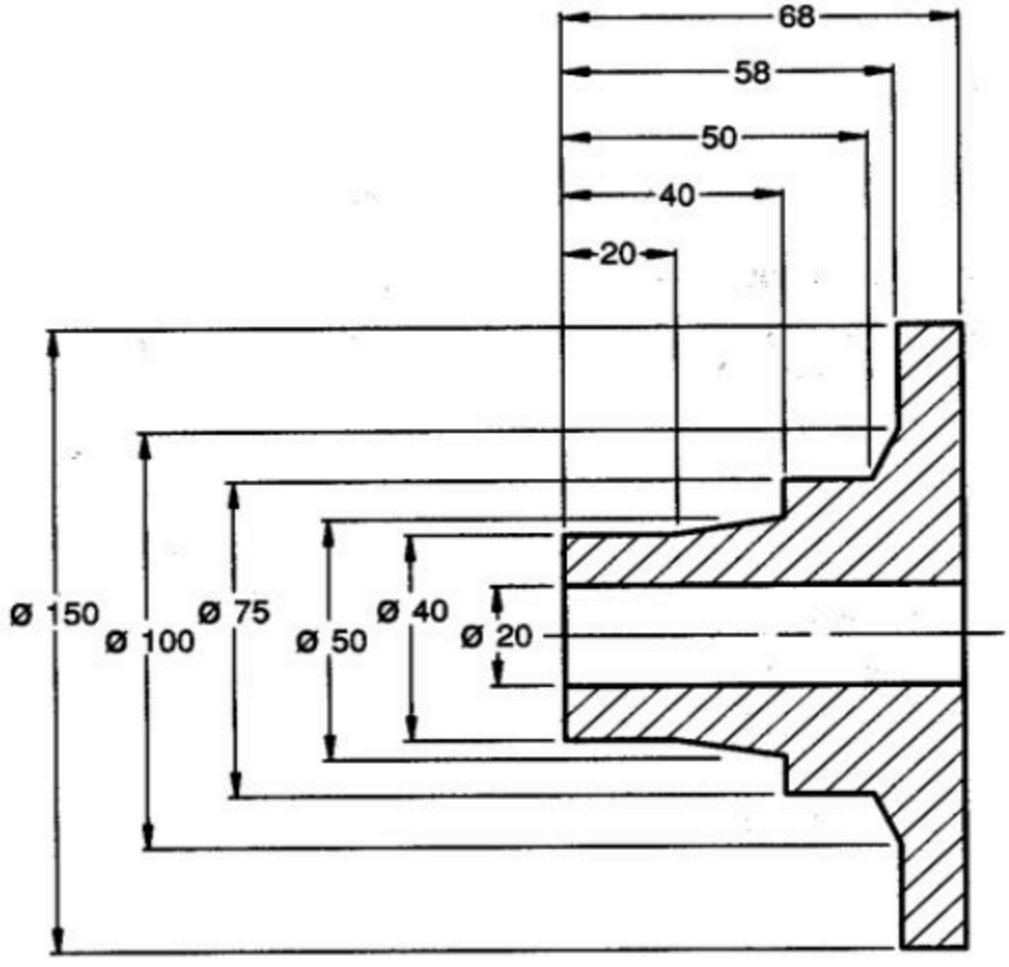




Where and how should we place dimensions when we have many dimensions? (cont.)

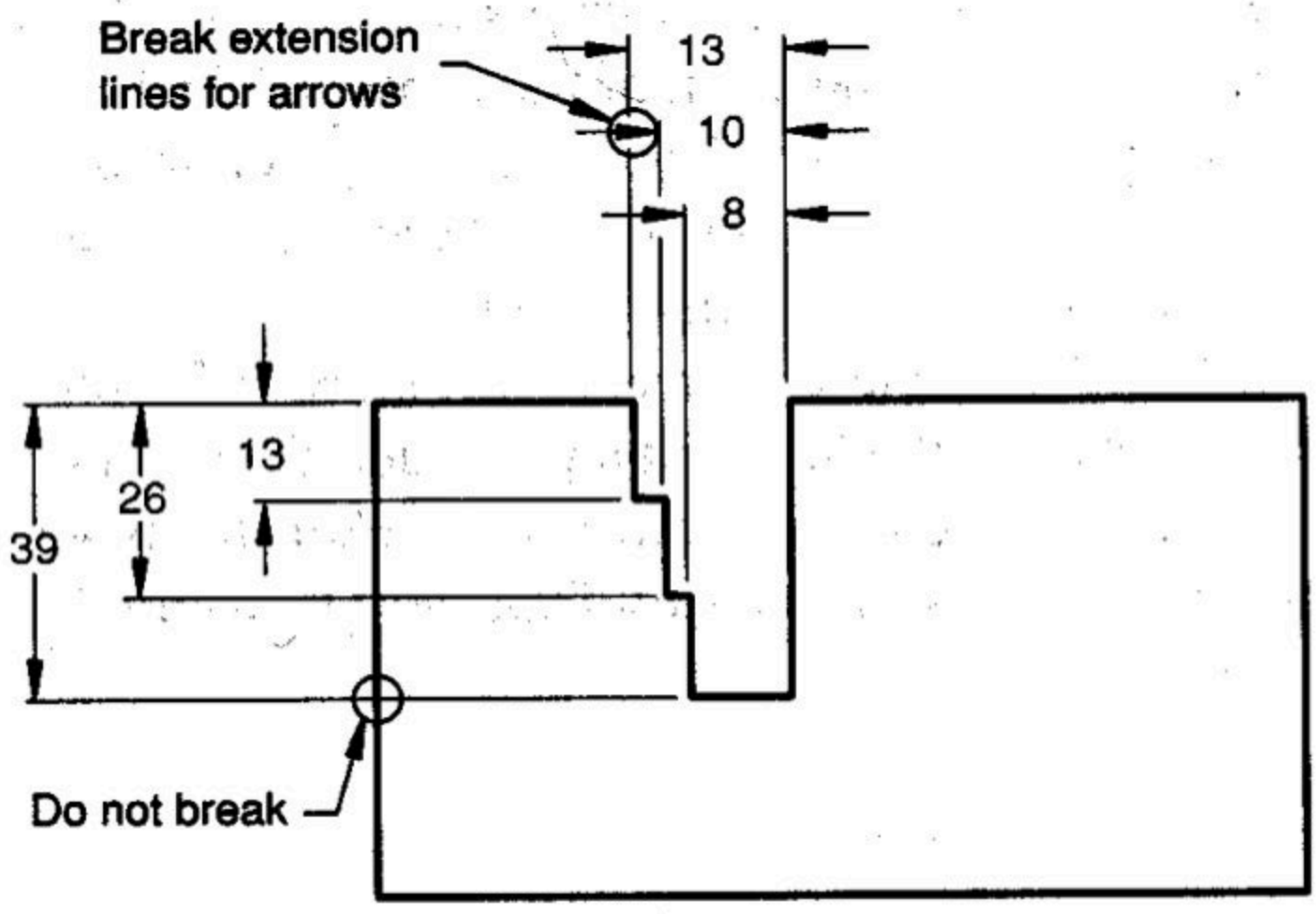


Staggering Dimensions

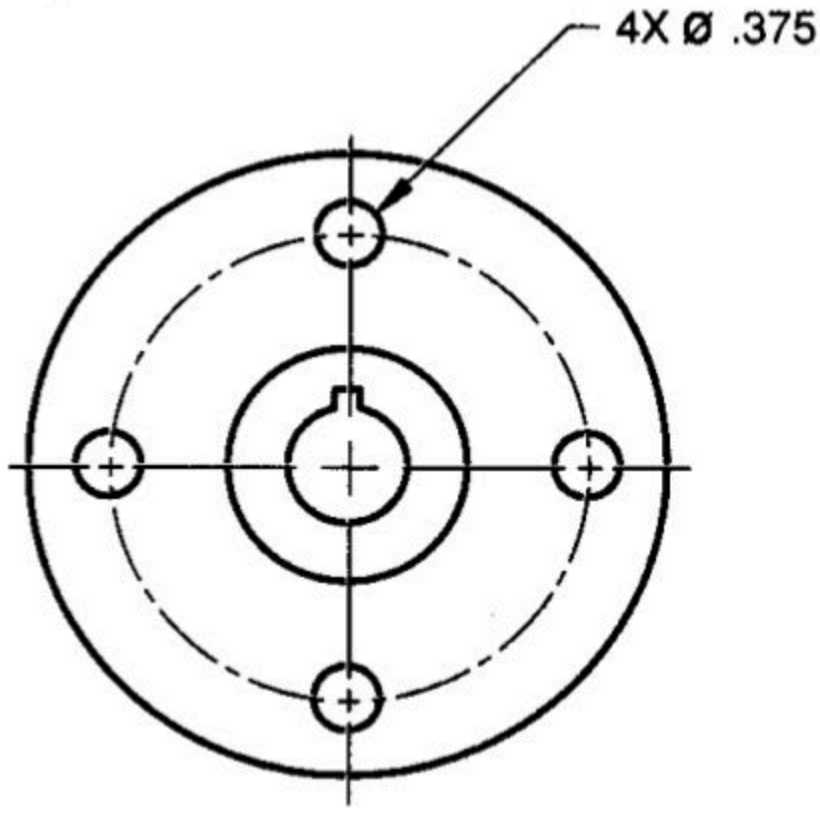


- Put the lesser dimensions closer to the part.
- Try to reference dimensions from one surface
  - This will depend on the part and how the tolerances are based.

Extension Line Practices

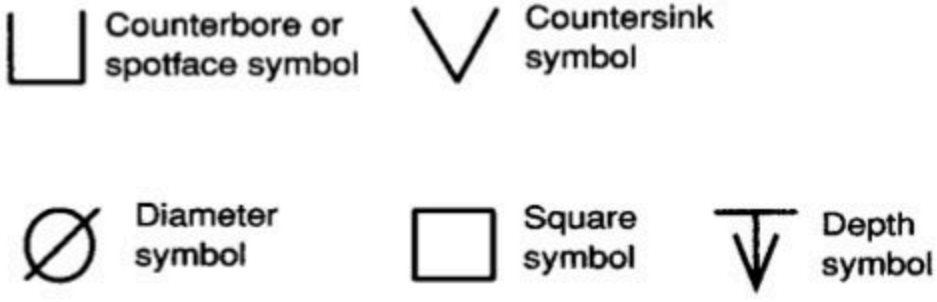


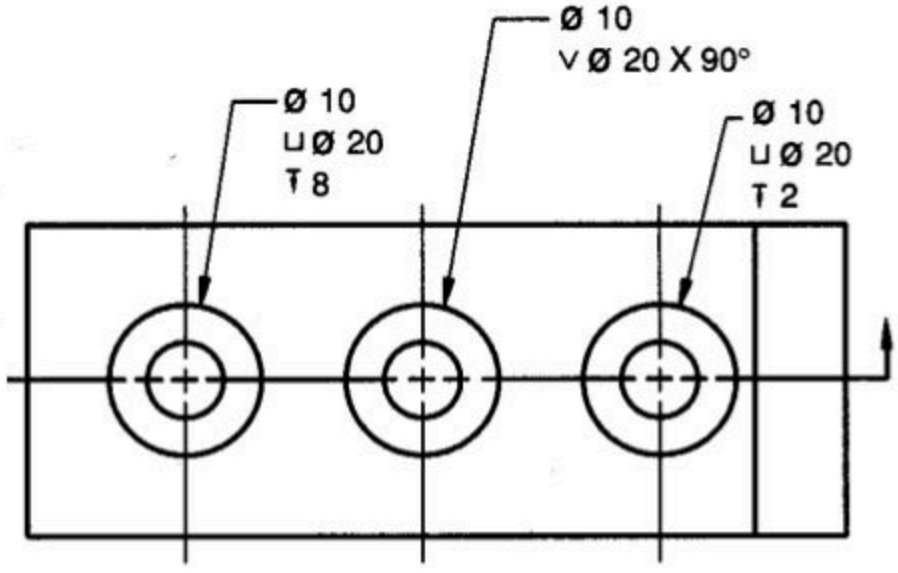
Repetitive Features

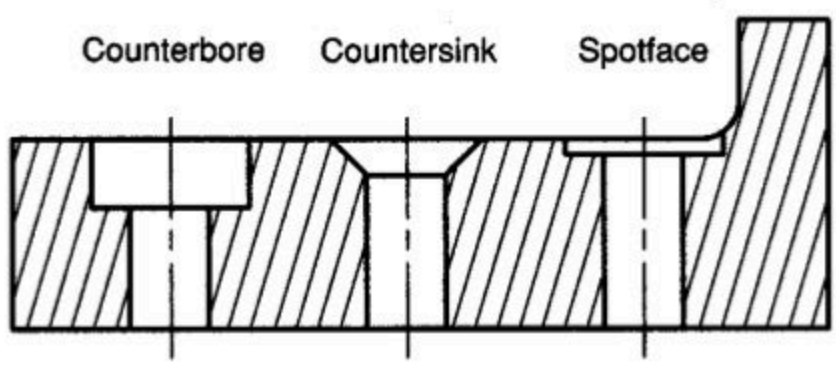


Use the Symbol ‘x’ to Dimension Repetitive Features

Symbols for Drilling Operations







References

- T. Dragomatz
- “Introduction to Engineering”, by Paul Wright
- “Design Dimensioning and Tolerance”, by J. M. McCarthy
- Dr. Ashish K Darpe