Drafting

Manual Drafting

Manual Drafting

- Before you began, devote sometime to organize your working area
- Arrange properly your furniture and tools to make your self comfortable
- Select a drawing sheet (type and size)
- Select a suitable pencil and sharpen it properly

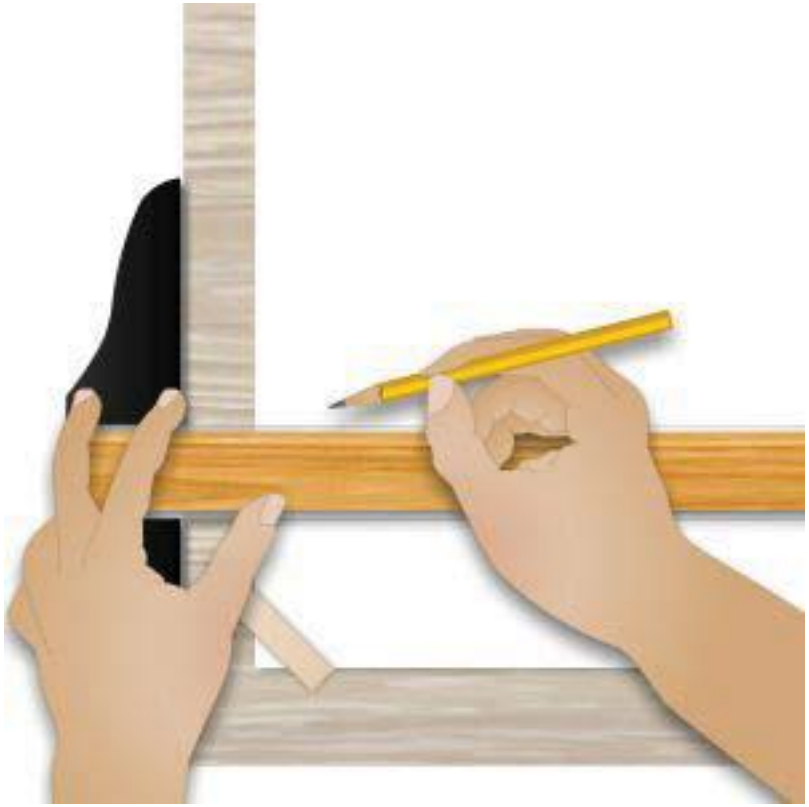
Drafting Techniques

Fixing paper on the board

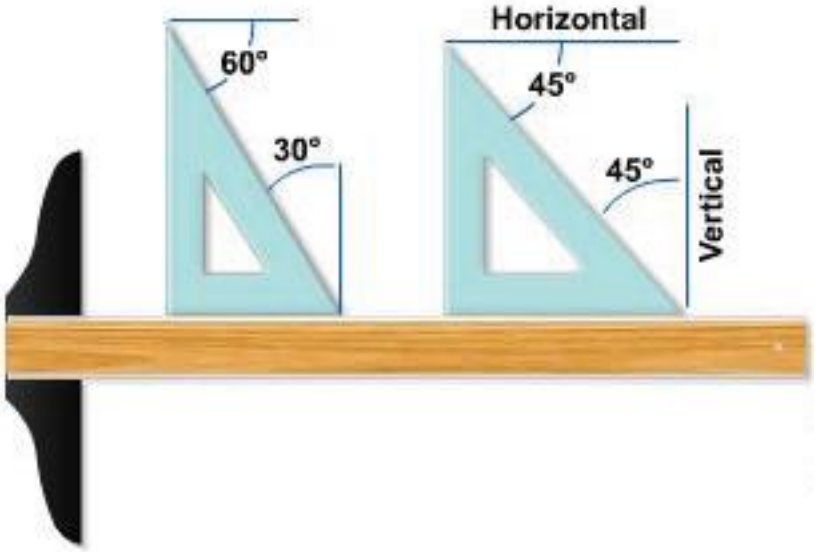
- If using a T-square, attach the paper on the left side of your board
- If using a drafting machine/drafter, then fix the sheet in the middle of the board
- Keep some distance from the bottom of the board to accommodate the head of the T-square while you are drawing at lower side of sheet
- After aligning the sheet, smooth out the wrinkles and use drafting tape to hold the sheet. Use of transparent and masking tape will result in tearing of paper
- Avoid using thumb pins as they offer obstruction in the movement of T-square and damage the board over the period of time.

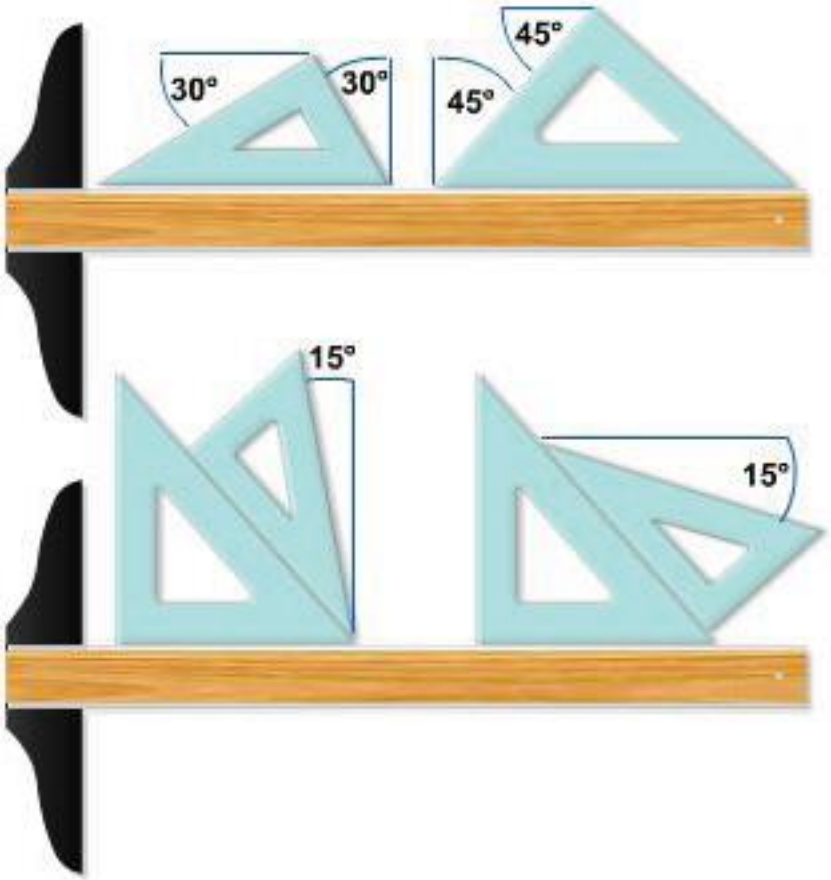
Fixing paper on the board

Drawing horizontal and vertical lines

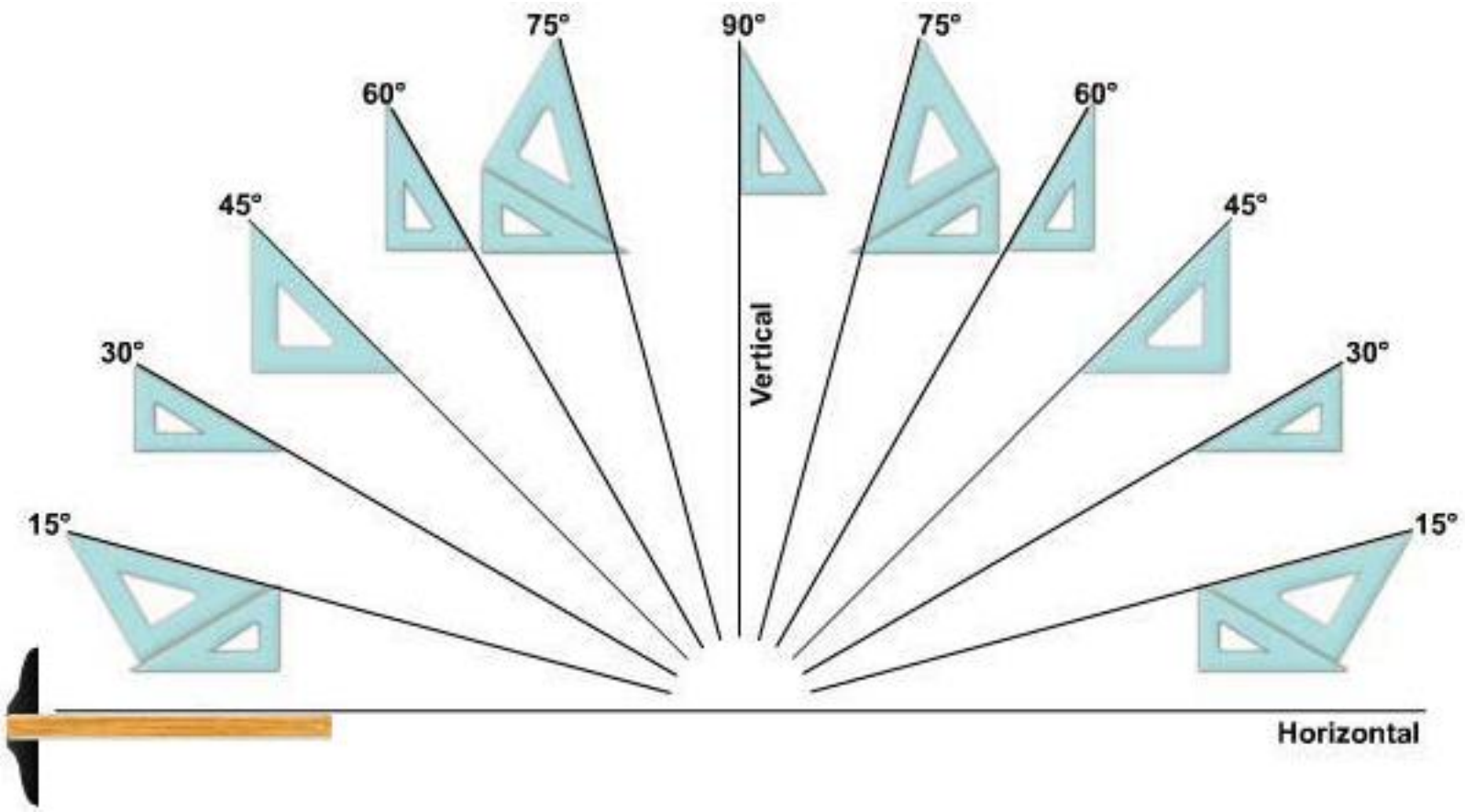


Drawing inclined lines

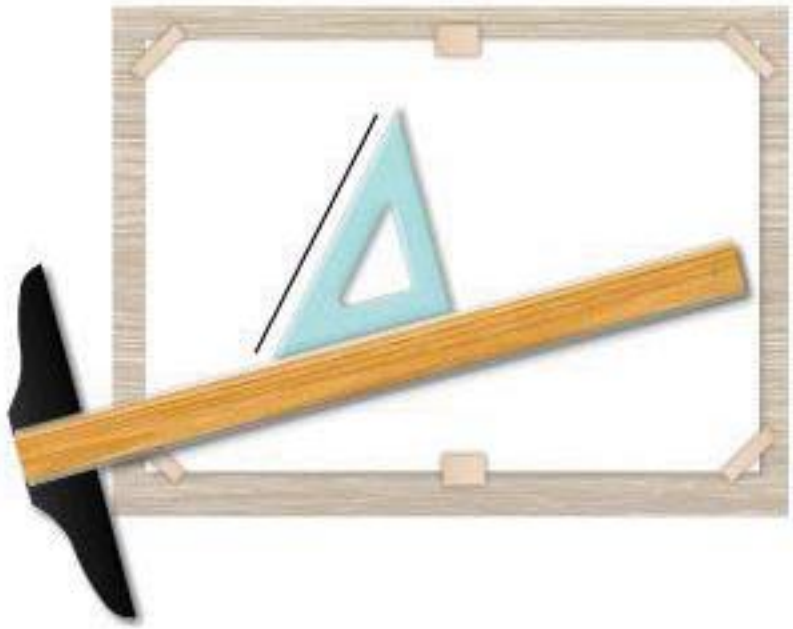


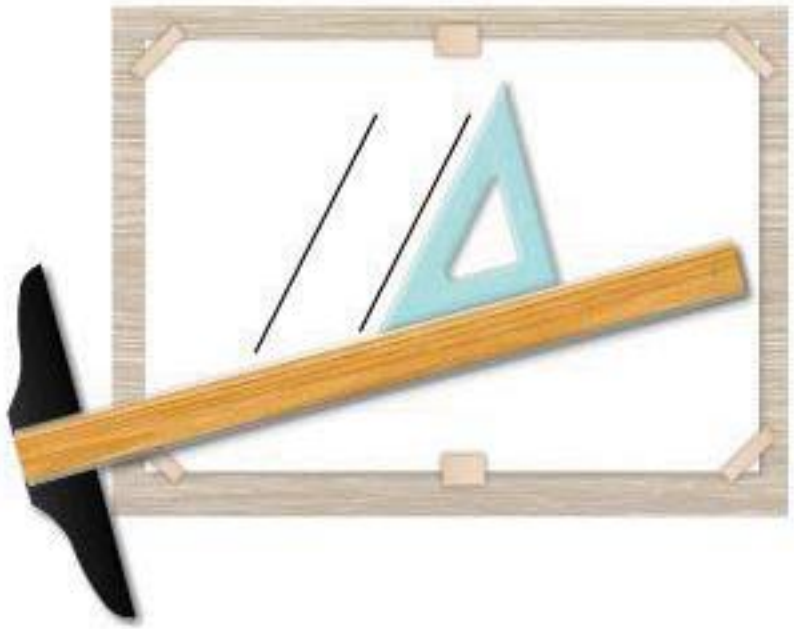


Drawing inclined lines

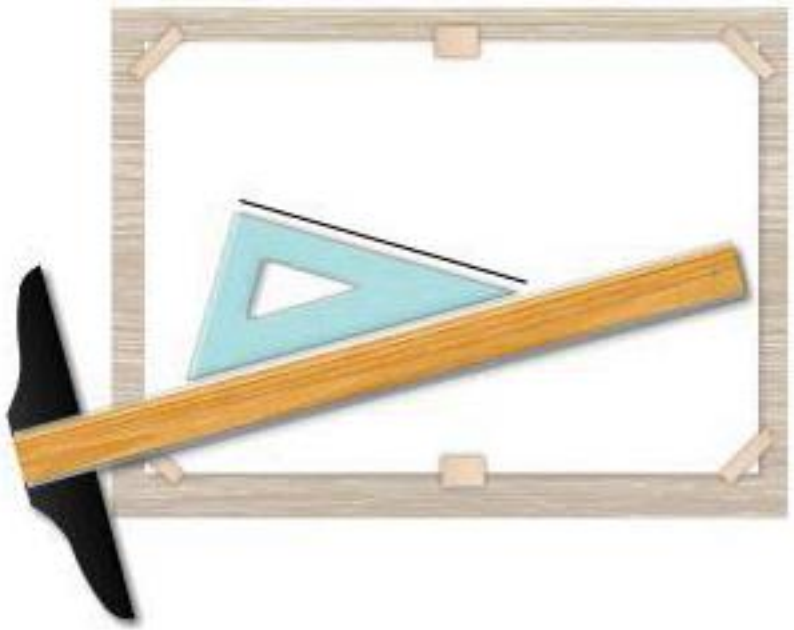


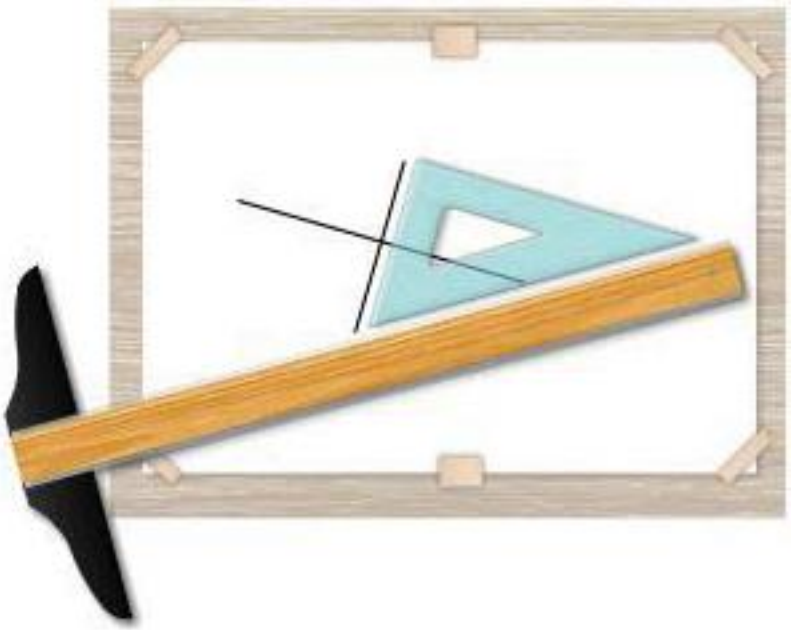
Parallel and Perpendicular lines



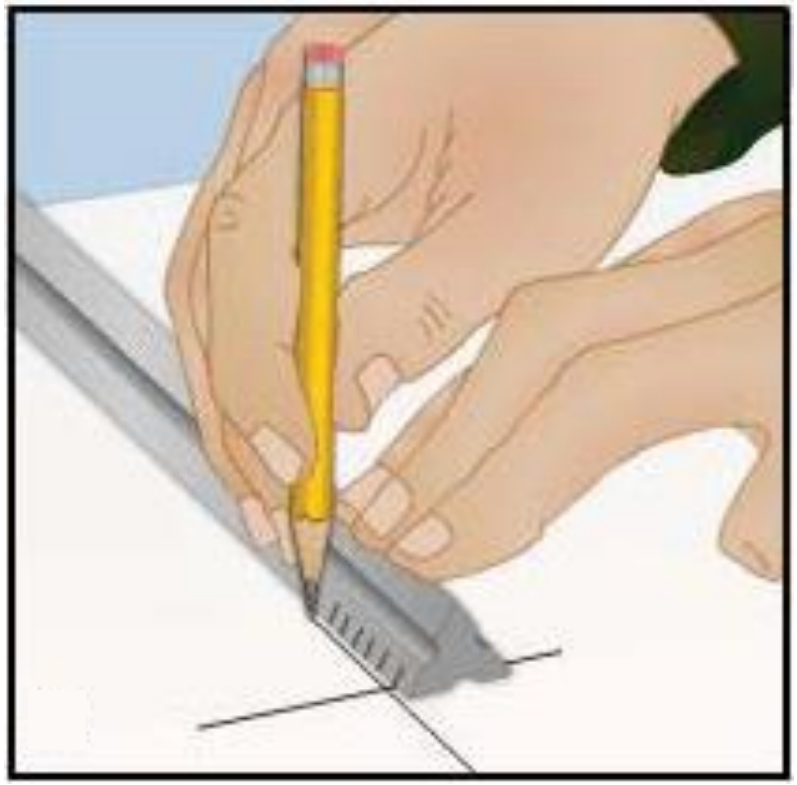


Parallel and Perpendicular lines

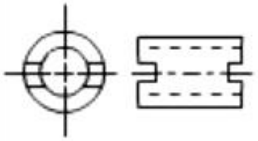
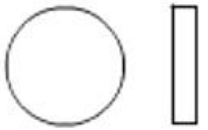
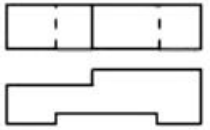
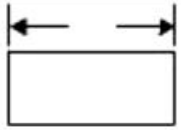
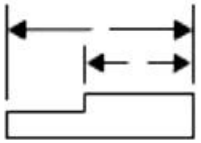
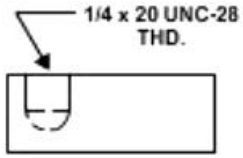




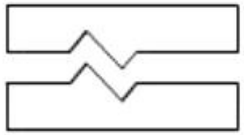
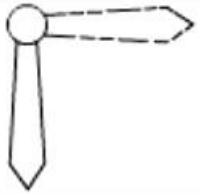
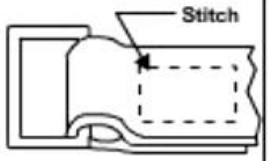
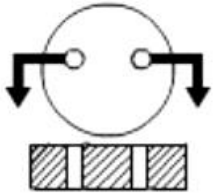
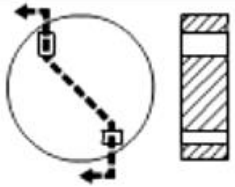
Drawing circles of known diameter



Line Conventions

LINE STANDARDS			
Name	Convention	Description and Application	Example
Center Lines		Thin lines made up of long and short dashes alternately spaced and consistent in length. Used to indicate symmetry about an axis and location of centers.	
Visible Lines		Heavy unbroken lines Used to indicate visible edges of an object	
Hidden Lines		Medium lines with short evenly spaced dashes Used to indicate concealed edges	
Extension Lines		Thin unbroken lines Used to indicate extent of dimensions	
Dimension Lines		Thin lines terminated with arrow heads at each end Used to indicate distance measured	
Leader		Thin line terminated with arrowhead or dot at one end Used to indicate a part, dimension or other reference	
Break		Thin, solid ruled lines with freehand zigzags	

Line Conventions

Leader		one end Used to indicate a part, dimension or other reference	
Break (Long)		Thin, solid ruled lines with freehand zigzags Used to reduce size of drawing required to delineate object and reduce detail	
Break (Short)		Thick, solid free hand lines Used to indicate a short break	
Phantom or Datum Line		Medium series of one long dash and two short dases evenly spaced ending with long dash Used to indicate alternate position of parts, repeated detail or to indicate a datum plane	
Stitch Line		Medium line of short dases evenly spaced and labeled Used to indicate stitching or sewing	
Cutting or Viewing Plane Viewing Plane Optional		Thick solid lines with arrowhead to indicate direction in which section or plane is viewed or taken	
Cutting Plane for Complex or Offset Views		Thick short dashes Used to show offset with arrowheads to show direction viewed	

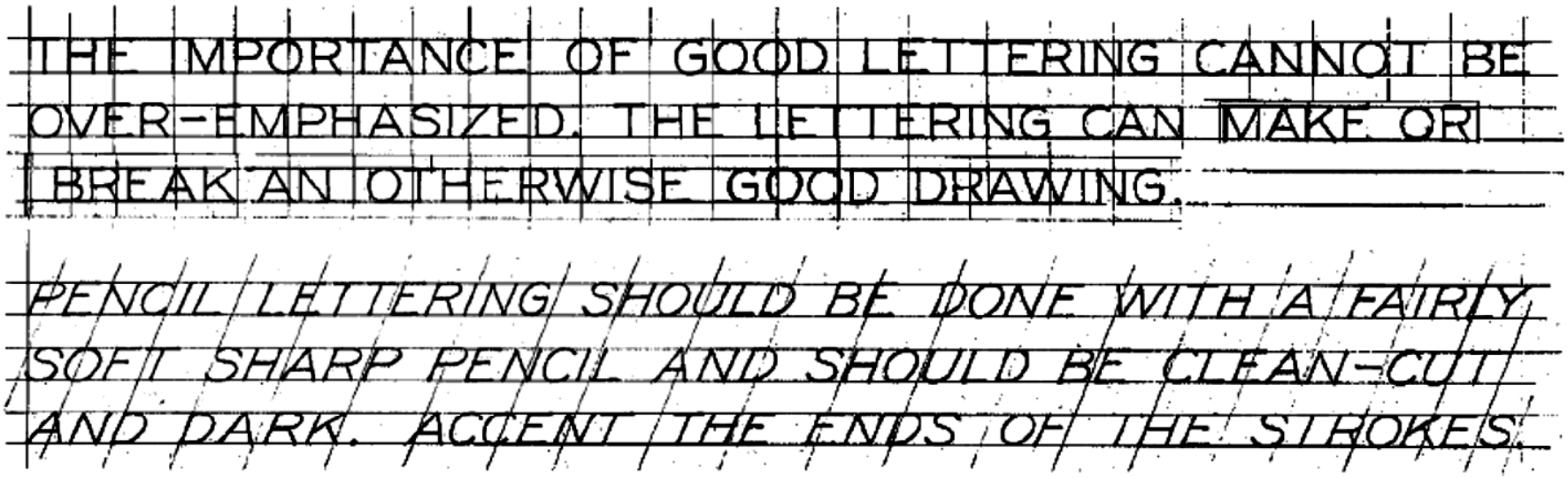

Spacing between
words and lines

Lettering

- The process of forming letters, numerals and other characters in a drawing
- Lettering enables the complete description of an object
- Dimensions, titles, labels, and materials needed, must be lettered
- Lettering must be clear and uniform in style
- Normally, Gothic sans-serif style is used for lettering

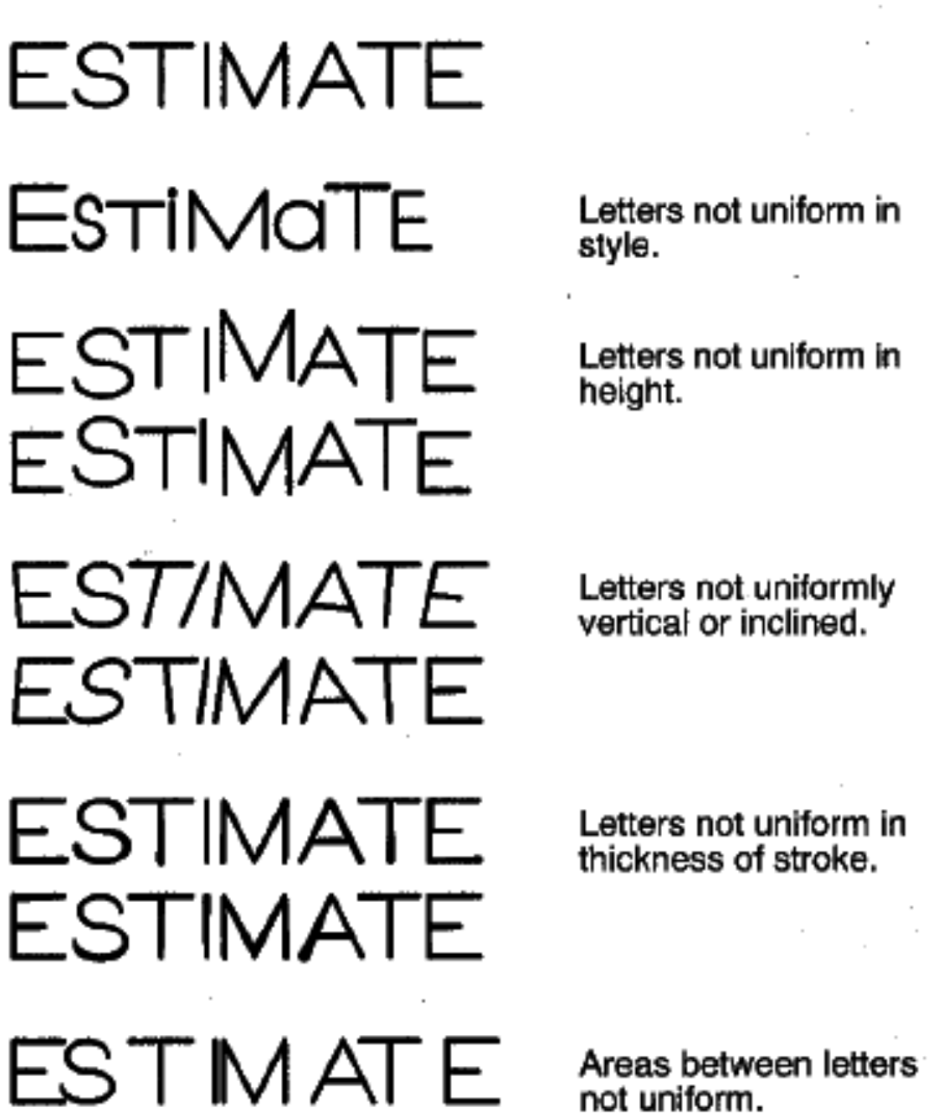
- Normal practice is to use capital letters only

Single Stroke Gothic Lettering



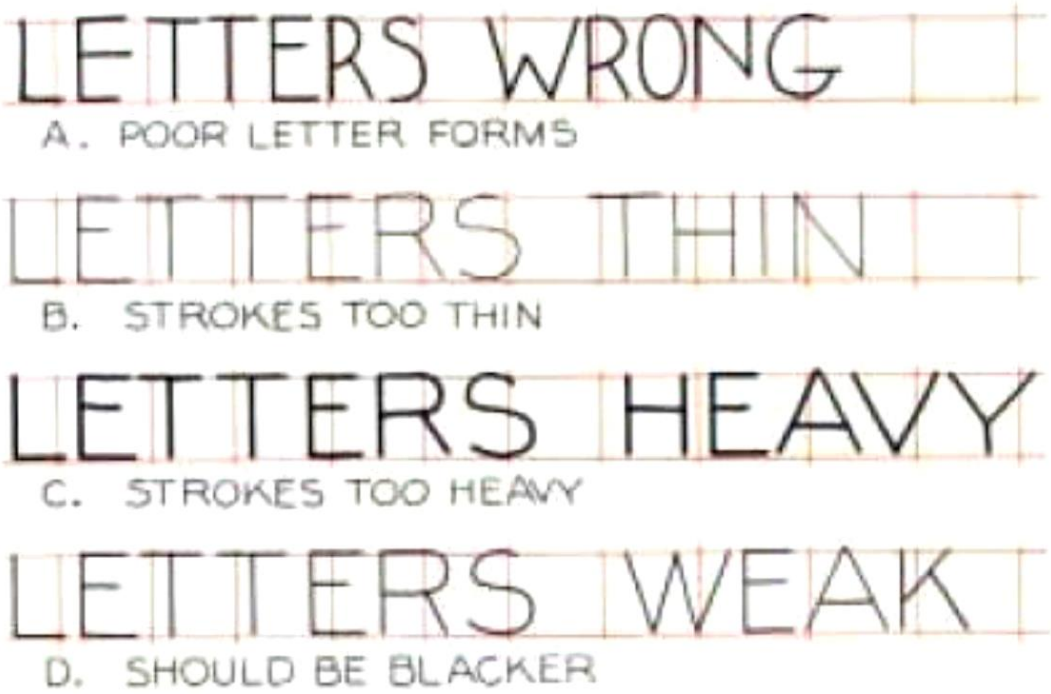
EXAMPLES OF GOOD COMPOSITION
USING ENGINEERING LETTERING

Single Stroke Gothic Lettering



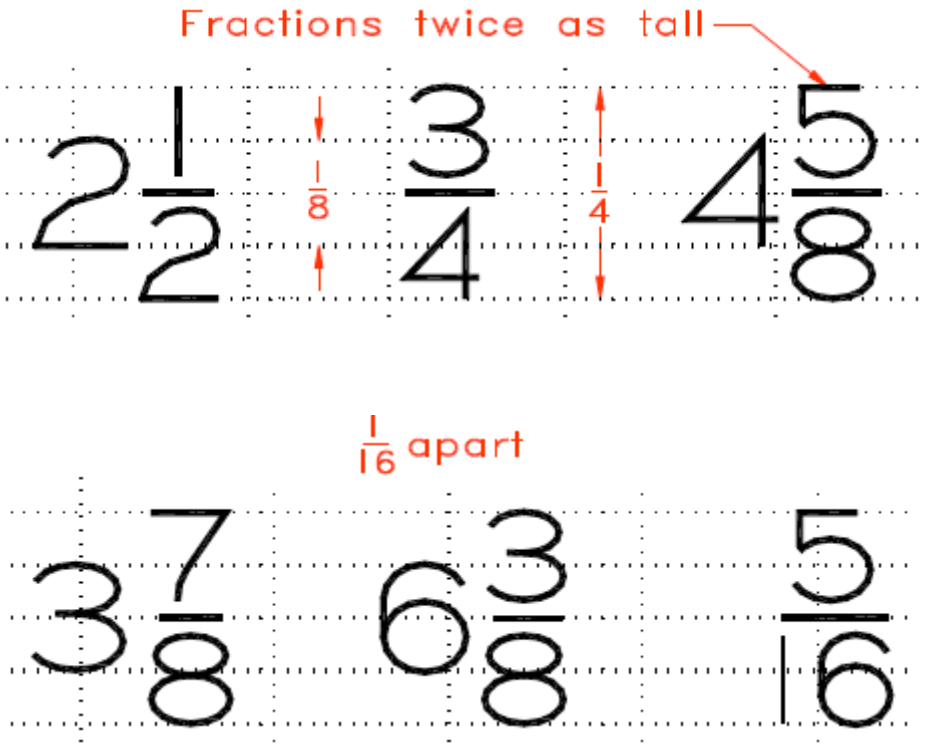
EXAMPLES OF LETTERING ERRORS

Single Stroke Gothic Lettering



EXAMPLES OF LETTERING ERRORS

Lettering With Fractions



Methods of Lettering

- Freehand lettering
- Mechanical lettering
- CAD software

Free Hand Lettering

- Freehand letters should be graceful and stable
- Emphasis should be on overall beauty of word rather than individual letters
- Lettering dimensions:
  - The height (h) of the outline contour of the upper case letter is the size of letter
  - Central line is an imaginary line in the middle of each line
  - For minimum thickness of line element, standard d/h ratio are 1/14 and 1/10. where d is the width of the line element
  - Nominal size of lettering are one of the sequence 2.5 mm, 3.5 mm, 5 mm, 7 mm, 10 mm, 14 mm, 20 mm.

Free Hand Lettering

- Lettering angle may be vertical/straight or inclined
- The ratio of height to width varies, but mostly it is 6:5

Lettering - A

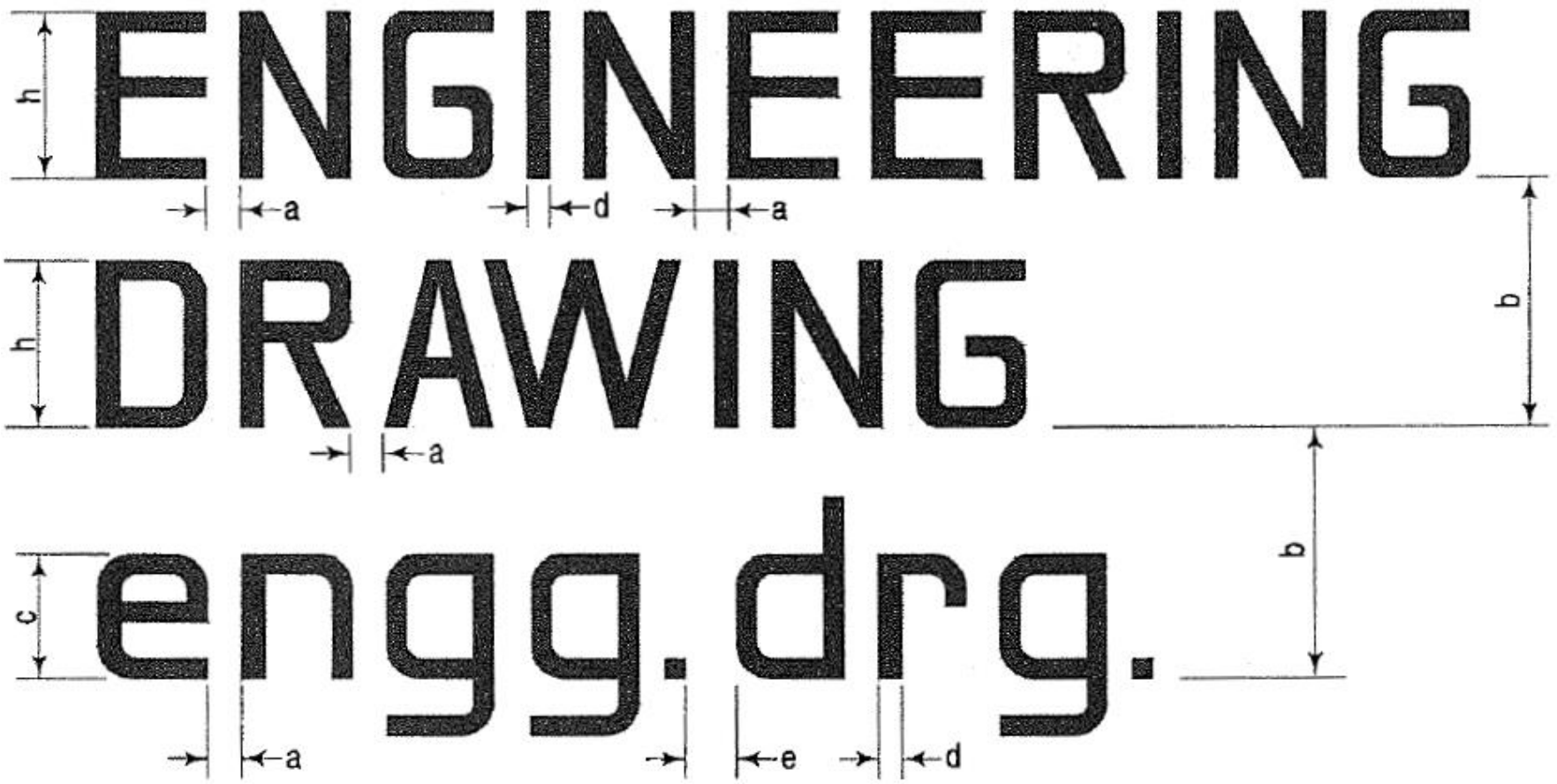
Characteristic	Parameter	Ratio	Dimensions(mm)						
Lettering Height (Height of capitals)	*h*	(14/14)*h*	2.5	3.5	5	7	10	14	20
Height of lower case letters (without stem or tail)	*c*	(10/14)*h*	-	2.5	3.5	5	7	10	14
Spacing between characters	*a*	(2/14)*h*	0.35	0.5	0.7	1	1.4	2	2.8
Minimum spacing of base characters	*b*	(20/14)*h*	3.5	5	7	10	14	20	28
Minimum spacing between words	*e*	(6/14)*h*	1.05	1.5	2.1	3	4.2	6	8.4
Thickness of lines	*d*	(1/14)*h*	0.18	0.25	0.35	0.5	0.7	1	1.4

Lettering - B

Mostly used

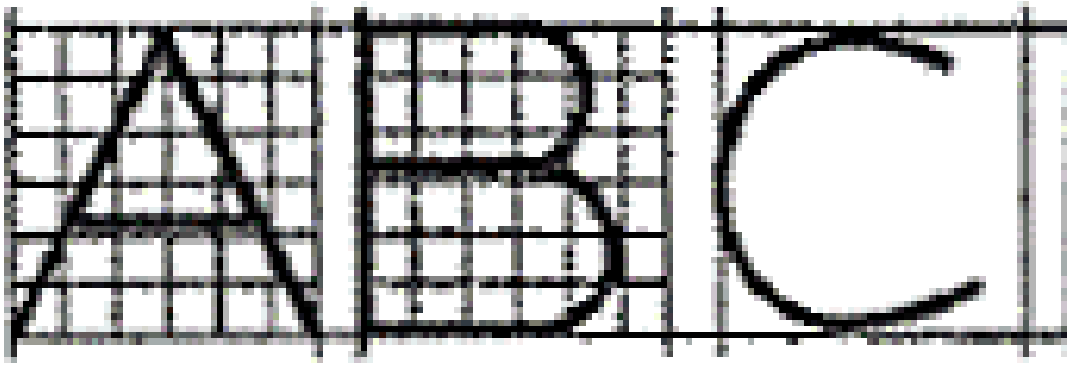
Characteristic	Parameter	Ratio	Dimensions(mm)						
Lettering Height (Height of capitals)	*h*	(10/10)*h*	2.5	3.5	5	7	10	14	20
Height of lower case letters (without stem or tail)	*c*	(7/10)*h*	-	2.5	3.5	5	7	10	14
Spacing between characters	*a*	(2/10)*h*	0.5	0.7	1	1.4	2	2.8	4
Minimum spacing of base characters	*b*	(14/10)*h*	3.5	5	7	10	14	20	28
Minimum spacing between words	*e*	(6/10)*h*	1.5	2.1	3	4.2	6	8.4	12
Thickness of lines	*d*	(1/10)*h*	0.25	0.35	0.5	0.7	1	1.4	2

Parameters of Lettering



Lettering Structure

Lettering Structure



$6x6$ Vs $6:5$ (height to width ratio)

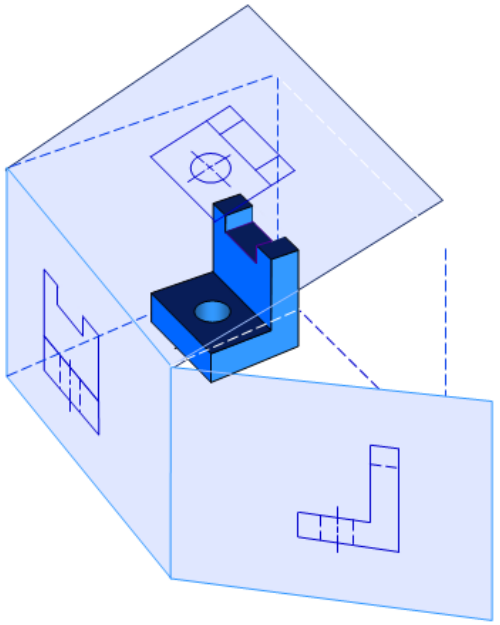
Dimensioning

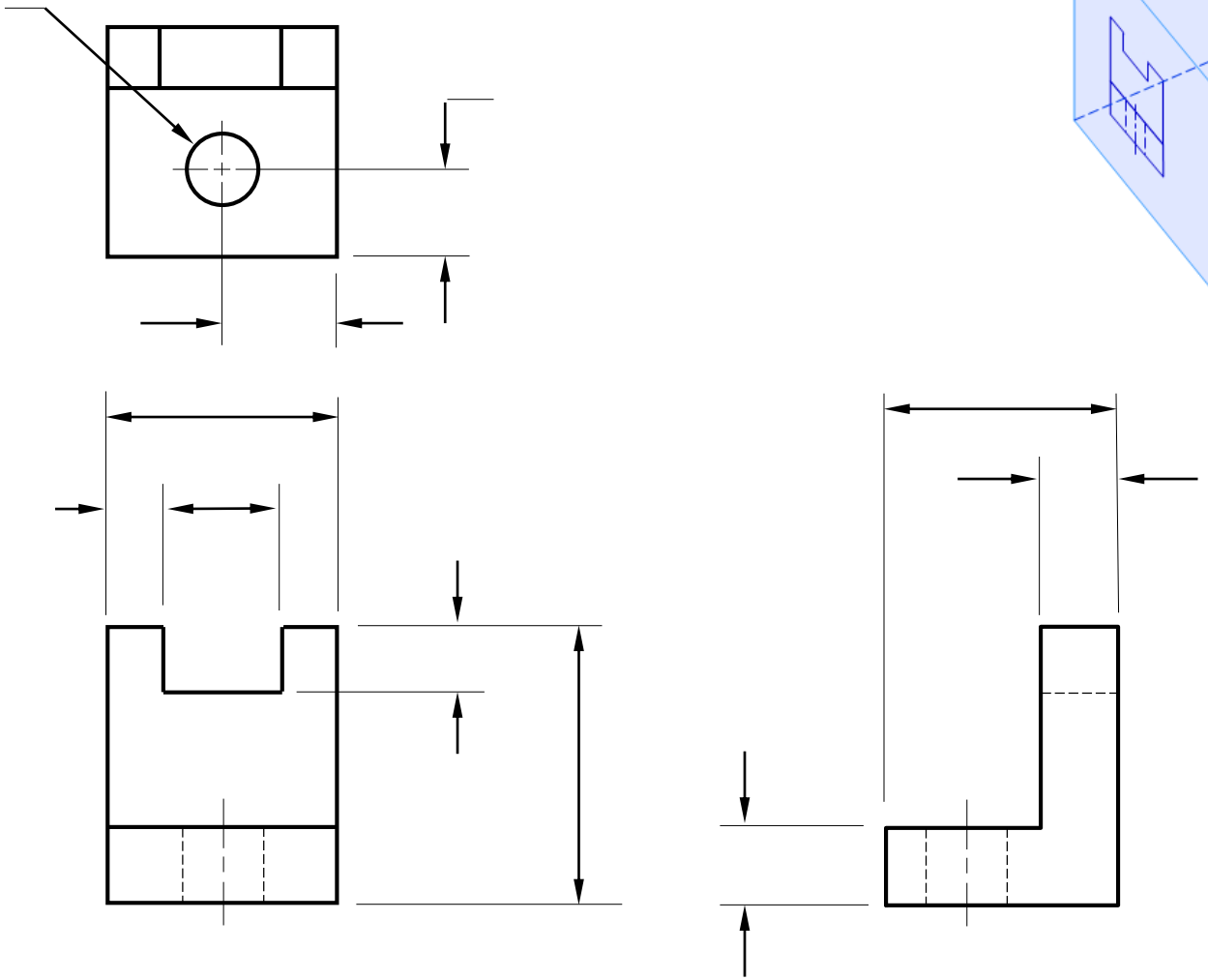
- Marking a diagram with measurements

Dimensioning Scheme

- Deciding what, where, and how to add dimensions

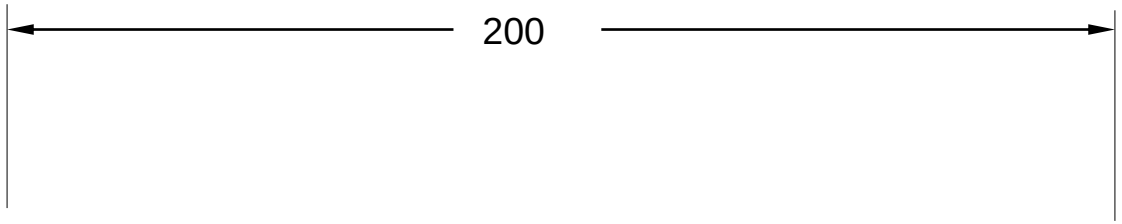
to the drawing

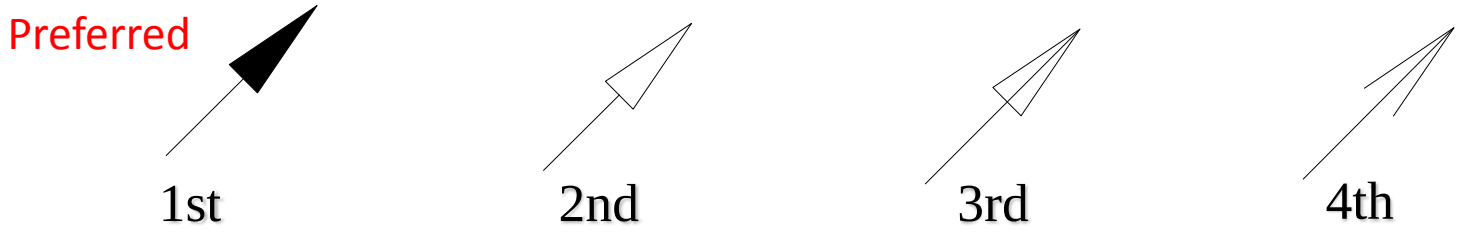




Arrowheads

Arrowheads are used as terminators on dimension lines. The points of the arrowheads on leader lines and dimension lines must make contact with the feature object line or extension lines which represent the feature being dimensioned. The standard size ratio for all arrowheads on mechanical drawings is 3:1 (length to width).

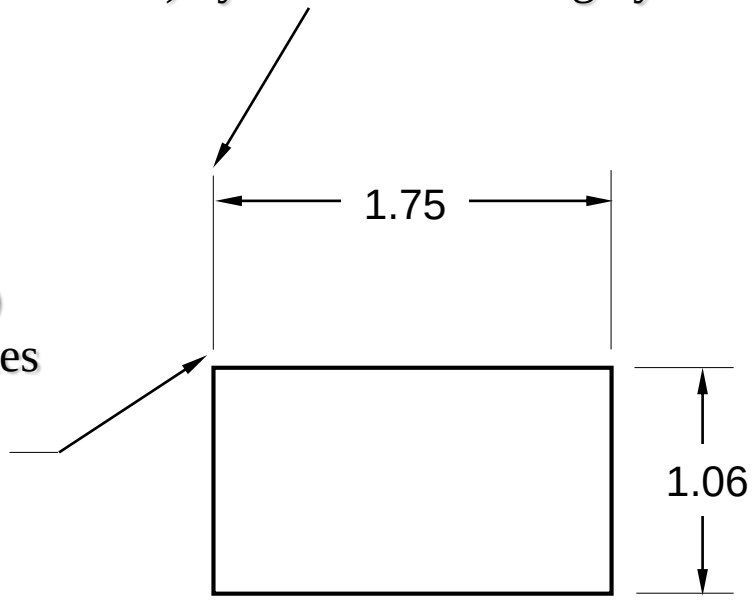




Dimension lines and Extension Lines

Extension lines overlap dimension lines (beyond the point of the arrowheads) by a distance of roughly 2-3mm

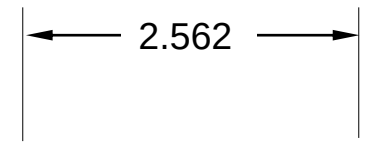
There should be a visible gap (~1.5 mm) between the object lines and the beginning of each extension line.



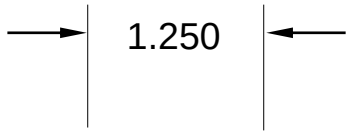
Dimensions should be placed *outside* the actual part outline. Dimensions should not be placed within the part boundaries unless greater clarity would result.

Placement of Linear Dimensions

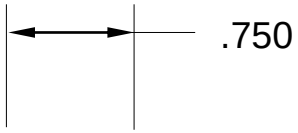
- Order of Preference



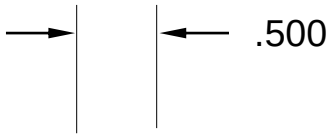
Arrows in / dimension in



Arrows out / dimension in



Arrows in / dimension out



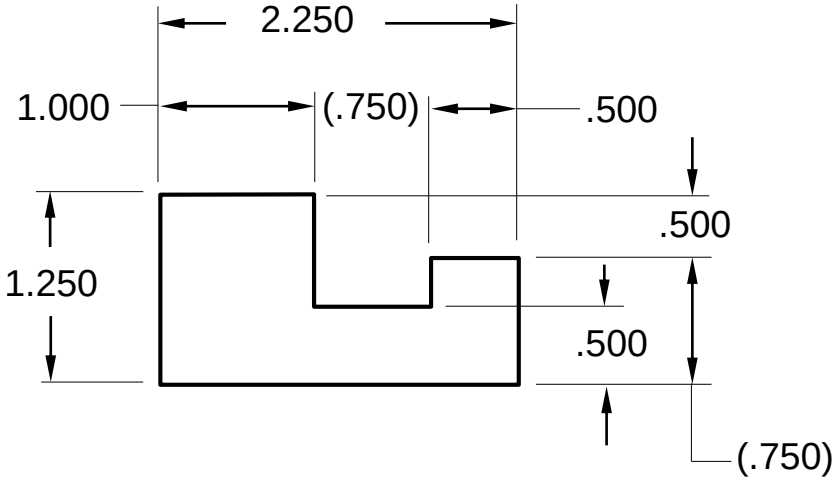
Arrows out / dimension out

When there is not enough room between the extension lines to accommodate either the dimension value or the dimension lines they can be placed outside the extension lines as shown in the fourth example (use Flip Arrows in ProE).

Reference Dimensions

Reference Dimension Symbol (X.XXX)

EXAMPLE



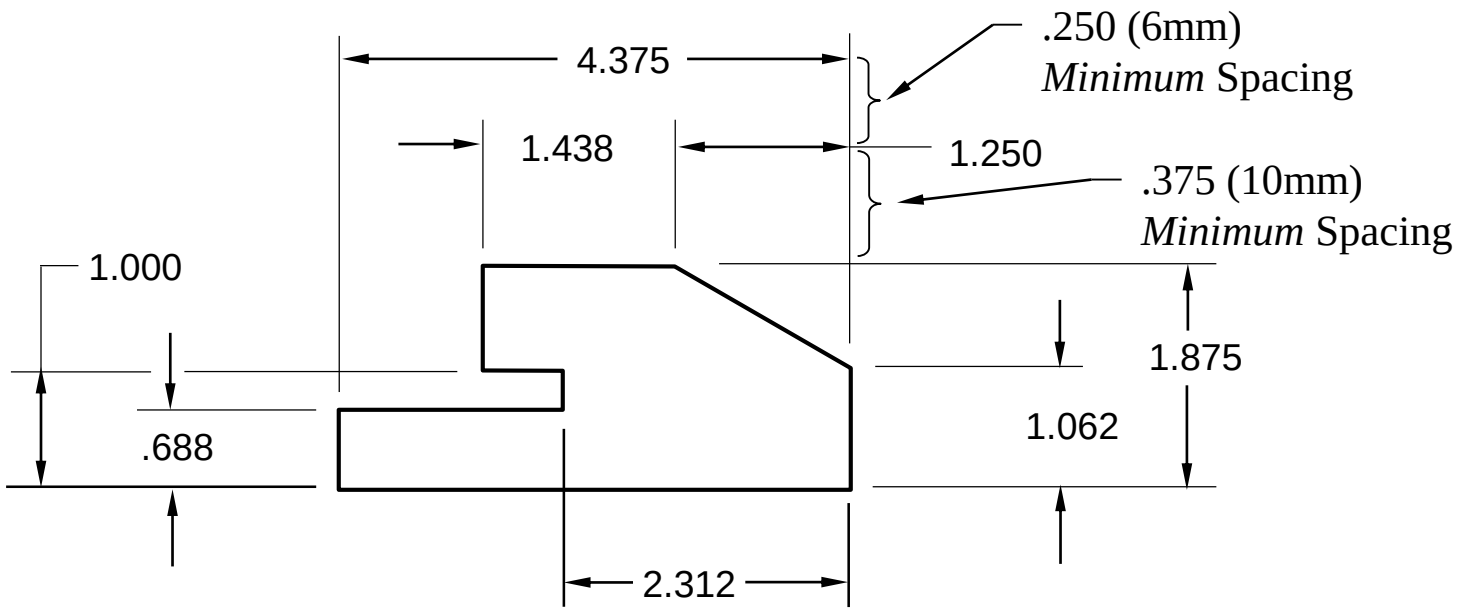
Reference dimensions are used on drawings to provide support information only.

They are values that have been derived from other dimensions and therefore should not be used for calculation, production or inspection of parts.

The use of reference dimensions on drawings should be minimized.

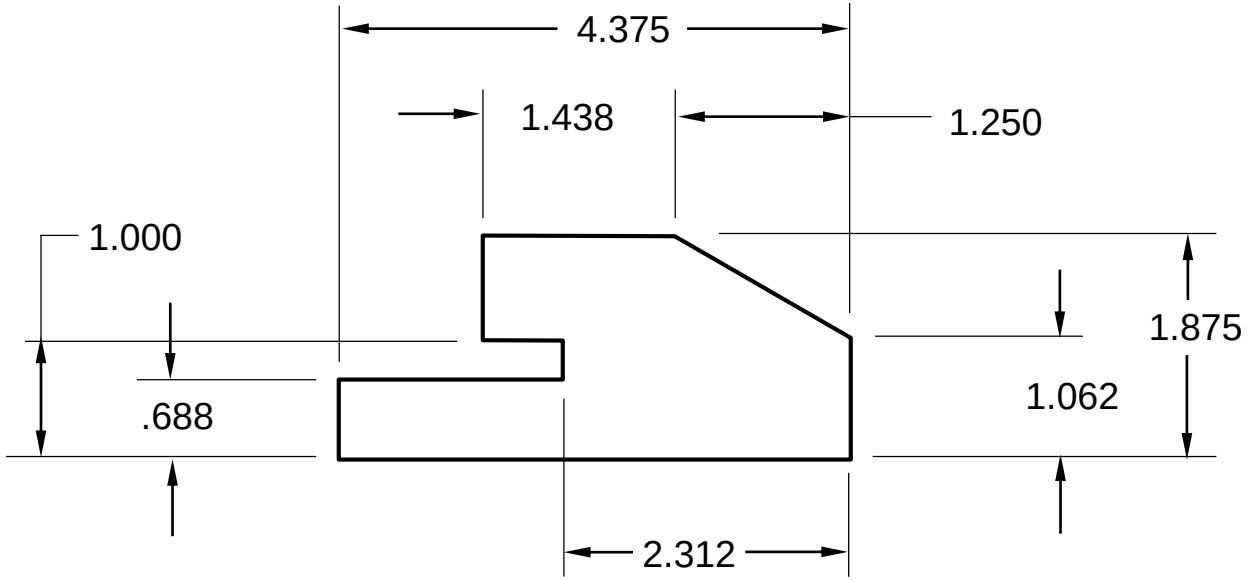
Location of Dimensions

Shorter (intermediate) dimensions are placed closest to the outline of the part, followed by dimensions of greater length. Dimensions nearest the object outline should be at least .375 inches (10 mm) away from the object, and succeeding parallel dimension lines should be at least .250 inches (6 mm) apart.

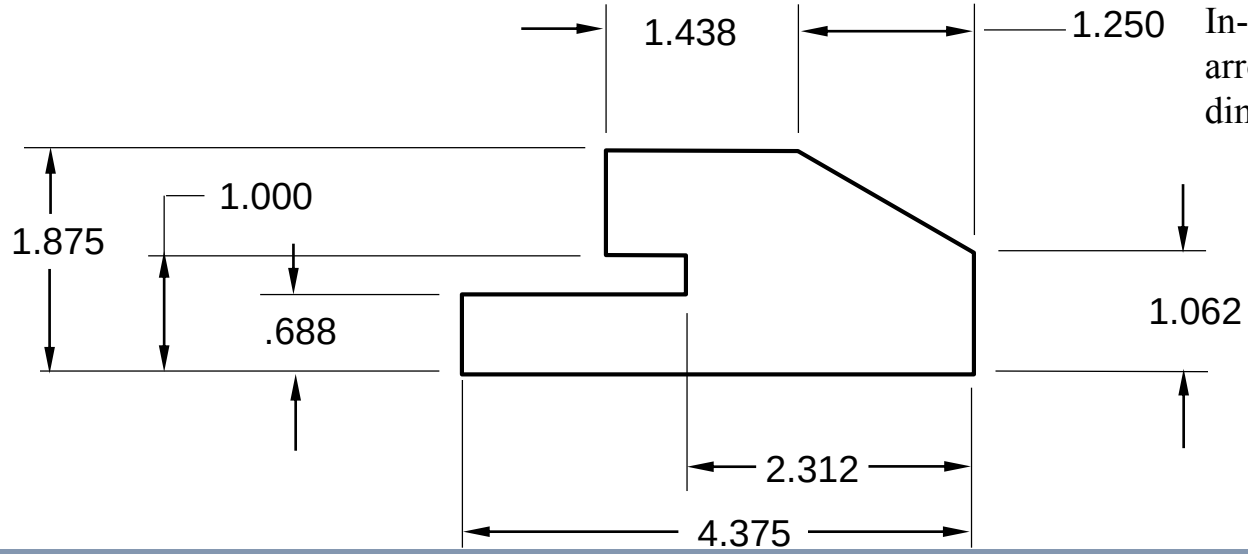


Dimensions should be placed *outside* the actual part outline

Dimensioning – Good Practice



Extension lines should not cross dimension lines if avoidable

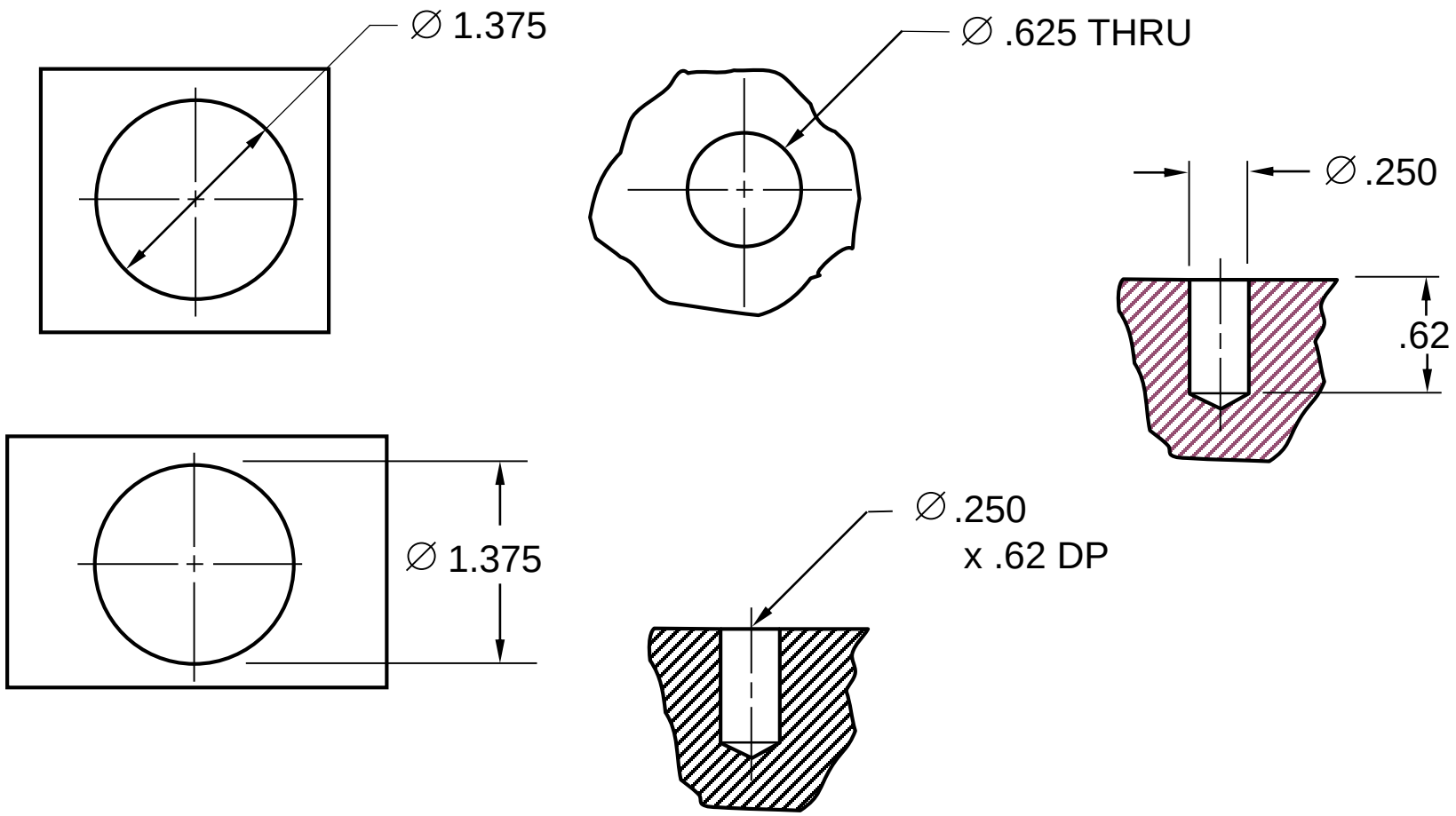


In-line dimensions can share arrowheads with contiguous dimensions

BETTER

Diameter Dimensions

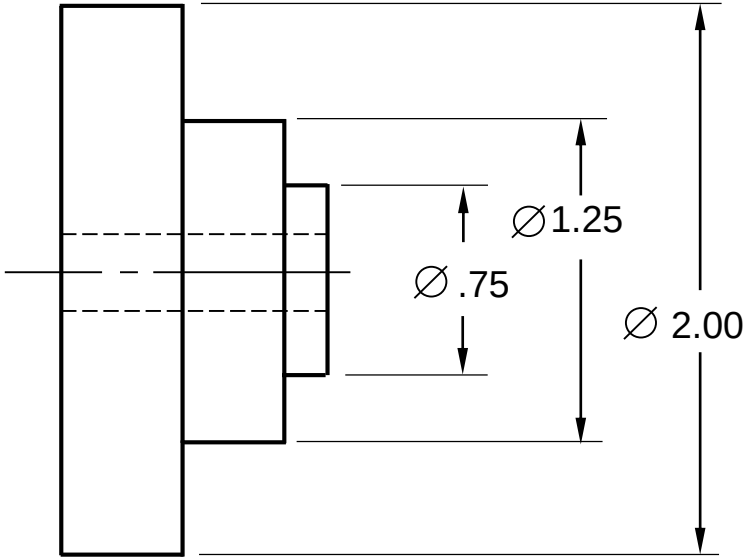
Holes and Cut outs

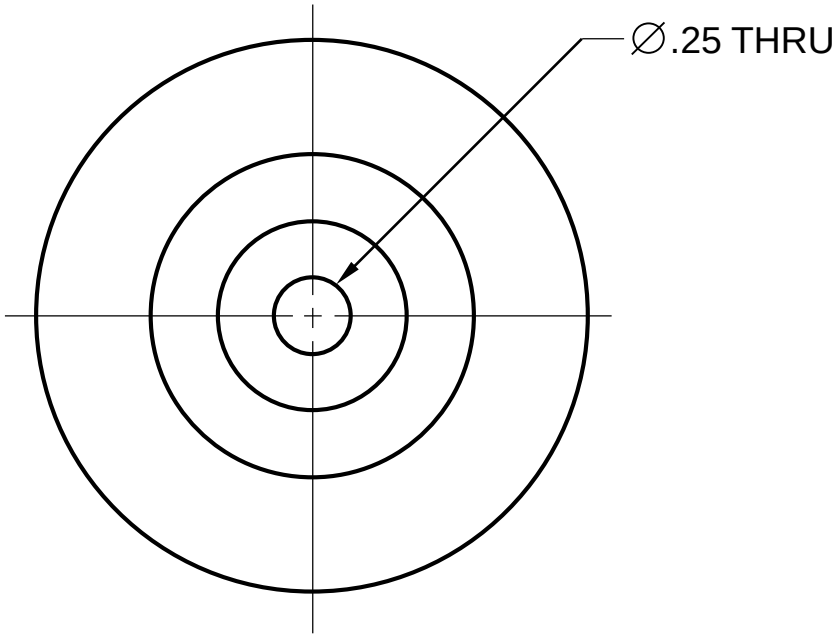


Diameter Dimensions

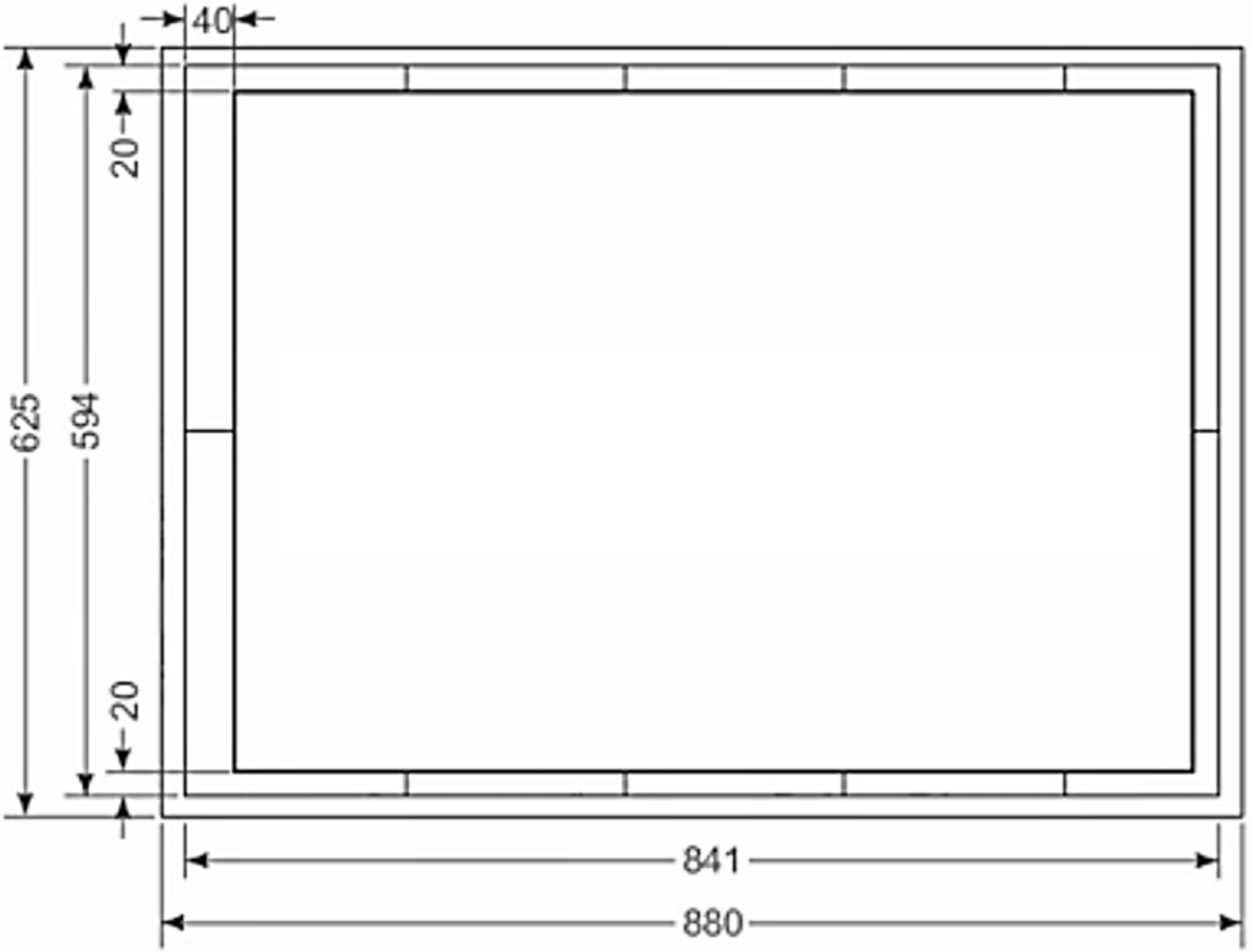
Shafts and Holes

Whenever it is practical to do so, external diameters are dimensioned in rectangular (or longitudinal) views. Cylindrical holes, slotted *holes*, and cutouts that are irregular in shape would normally be dimensioned in views where their true geometric shape is shown.

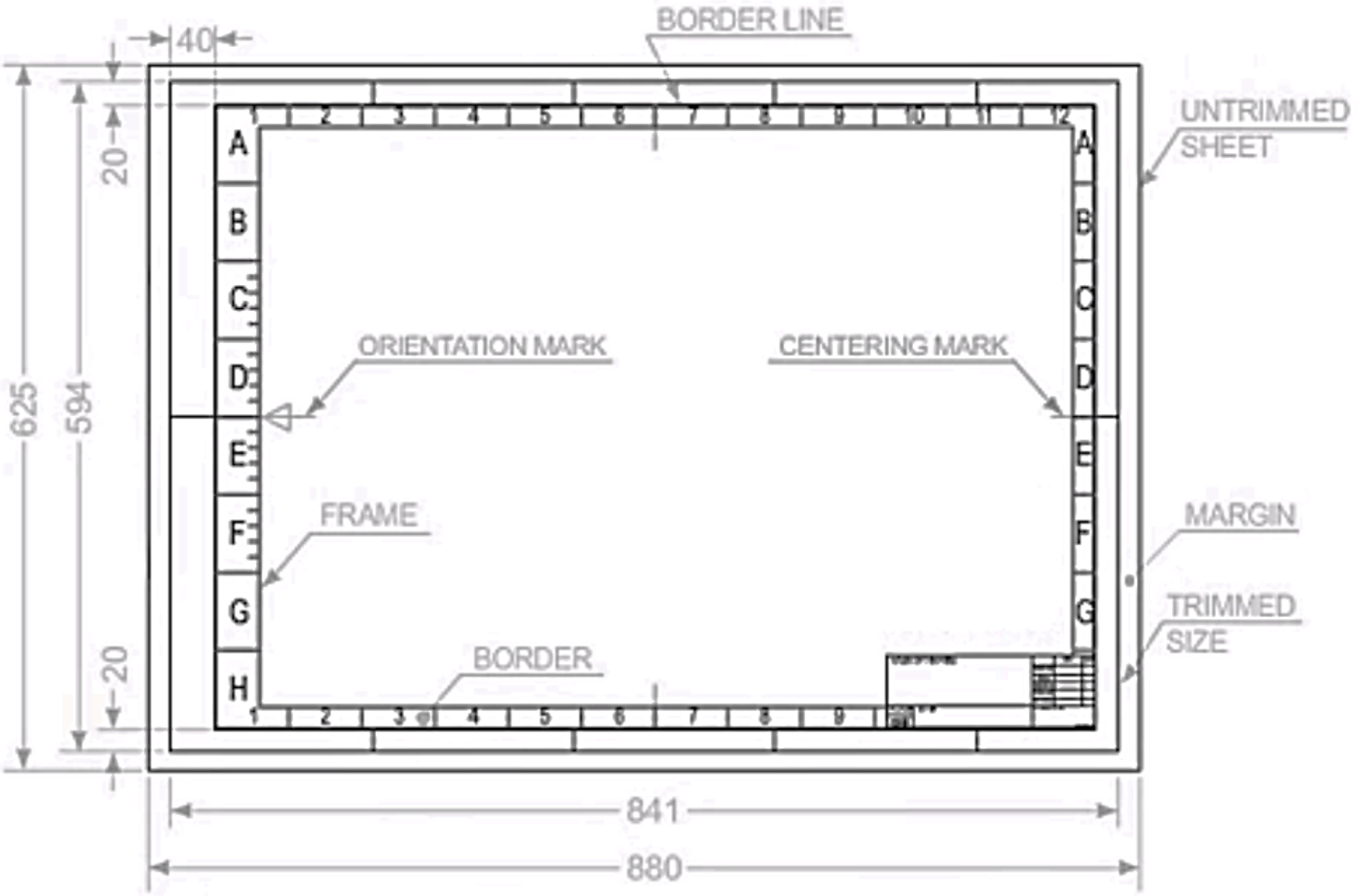




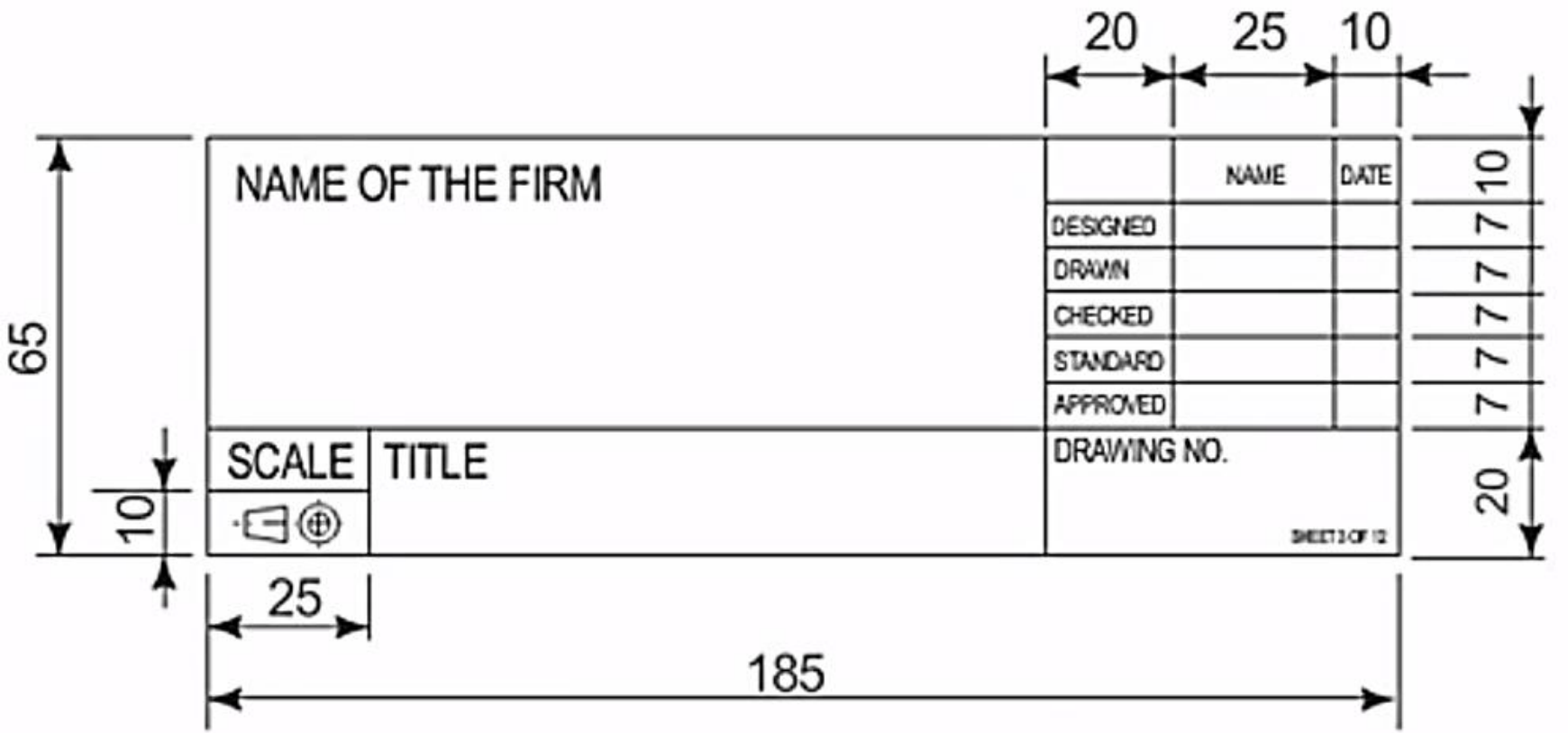
Drawing Layout (A1 sheets)



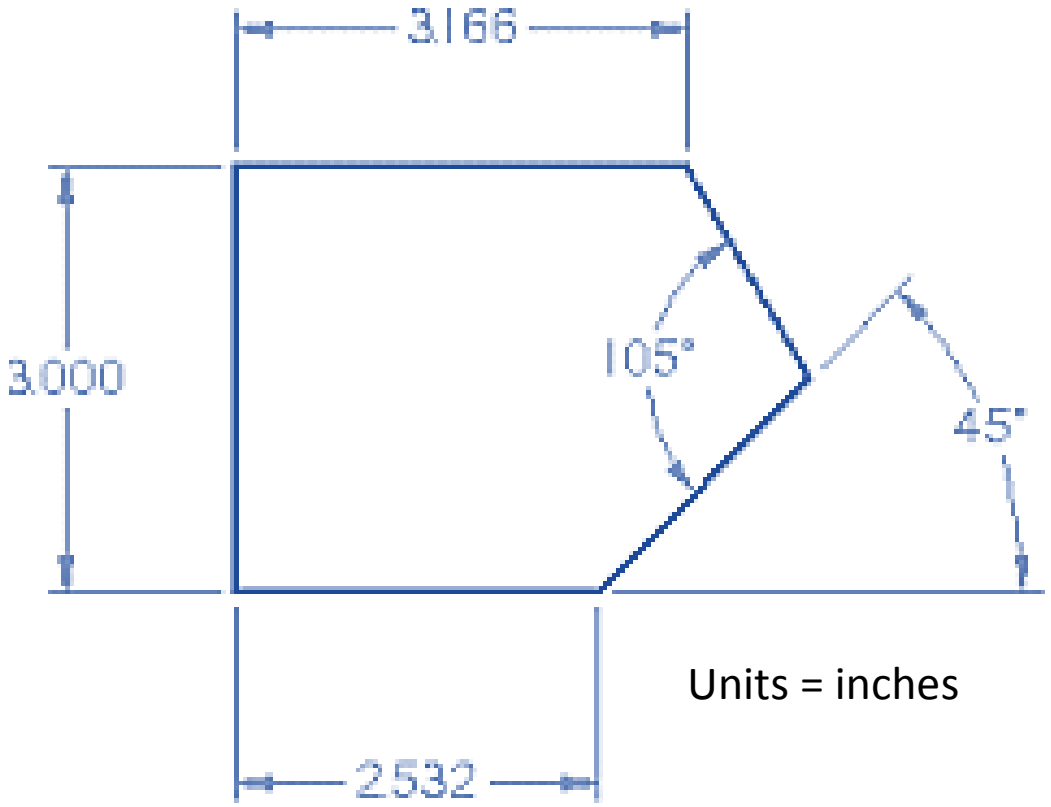
Drawing Layout (A1 sheets)



Drawing Layout (Title block for all sheets)



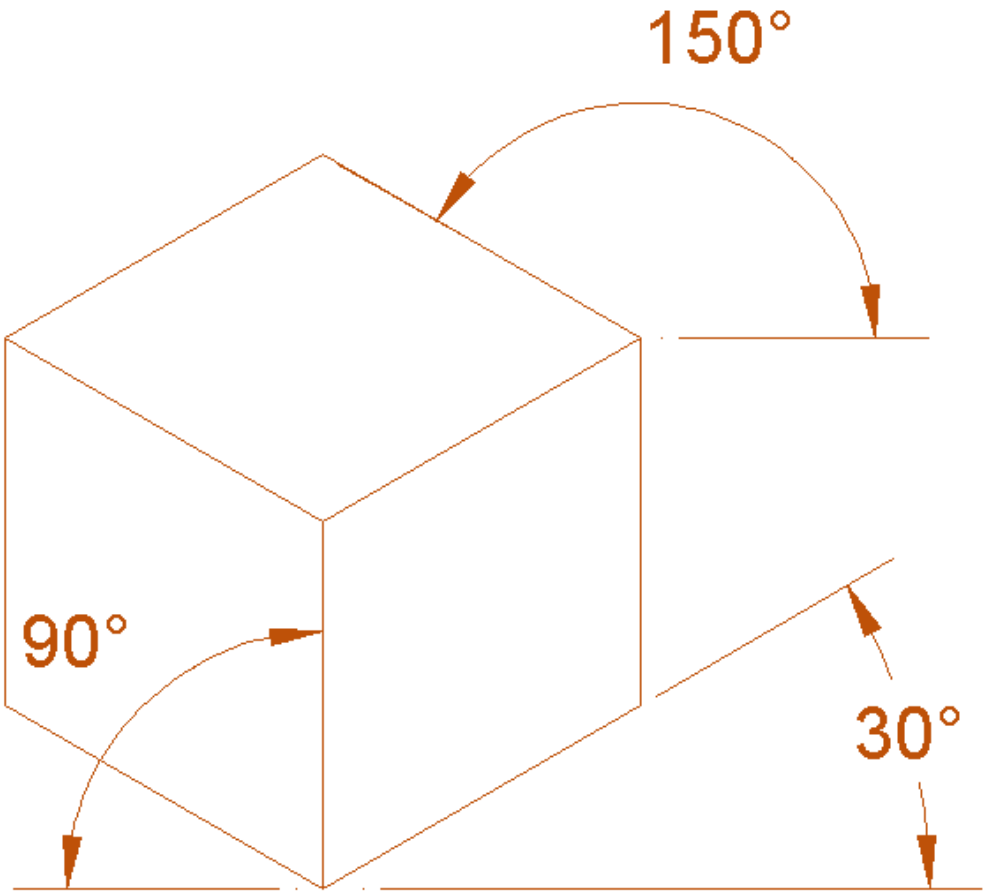
Practice Design 1



Units = inches

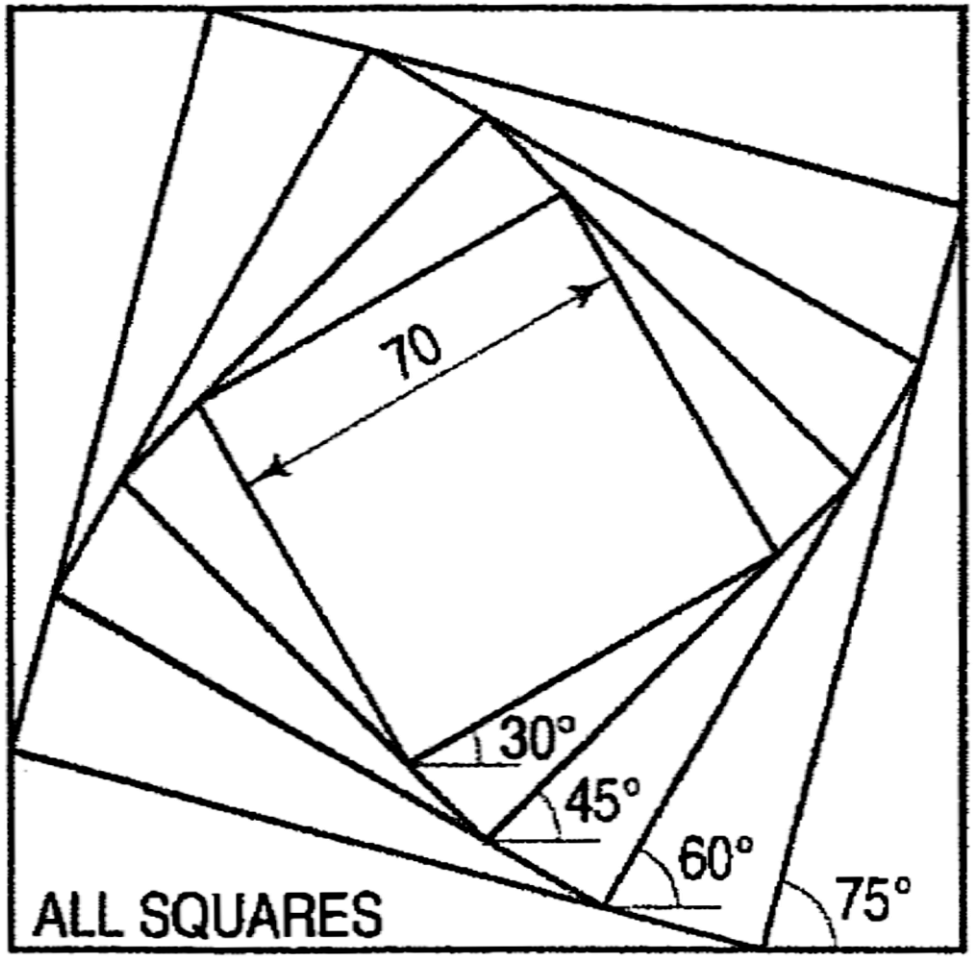
Practice Design 2

- All sides should be of equal length

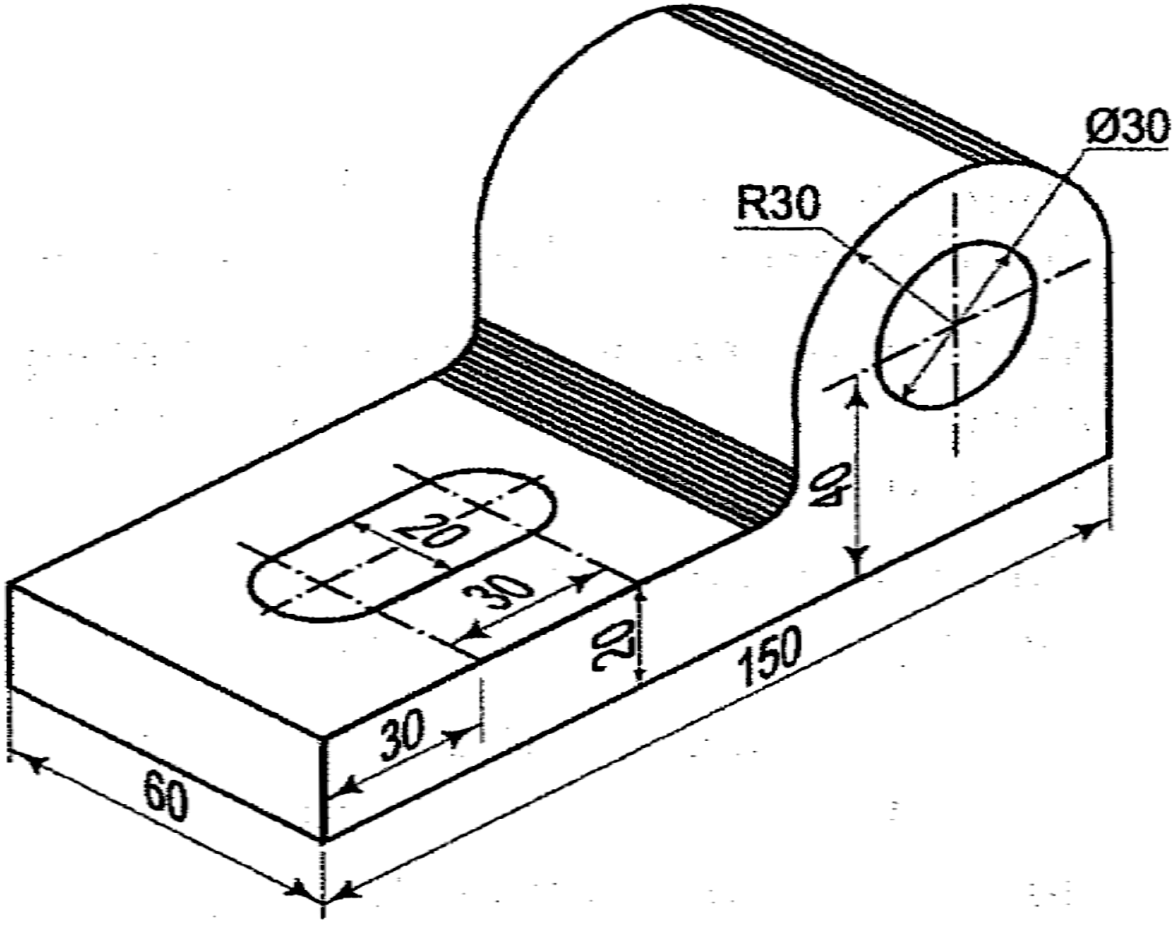


Note: This image does not show actual dimensions of a perspective view of a cube, it is only used to gain some drawing practice

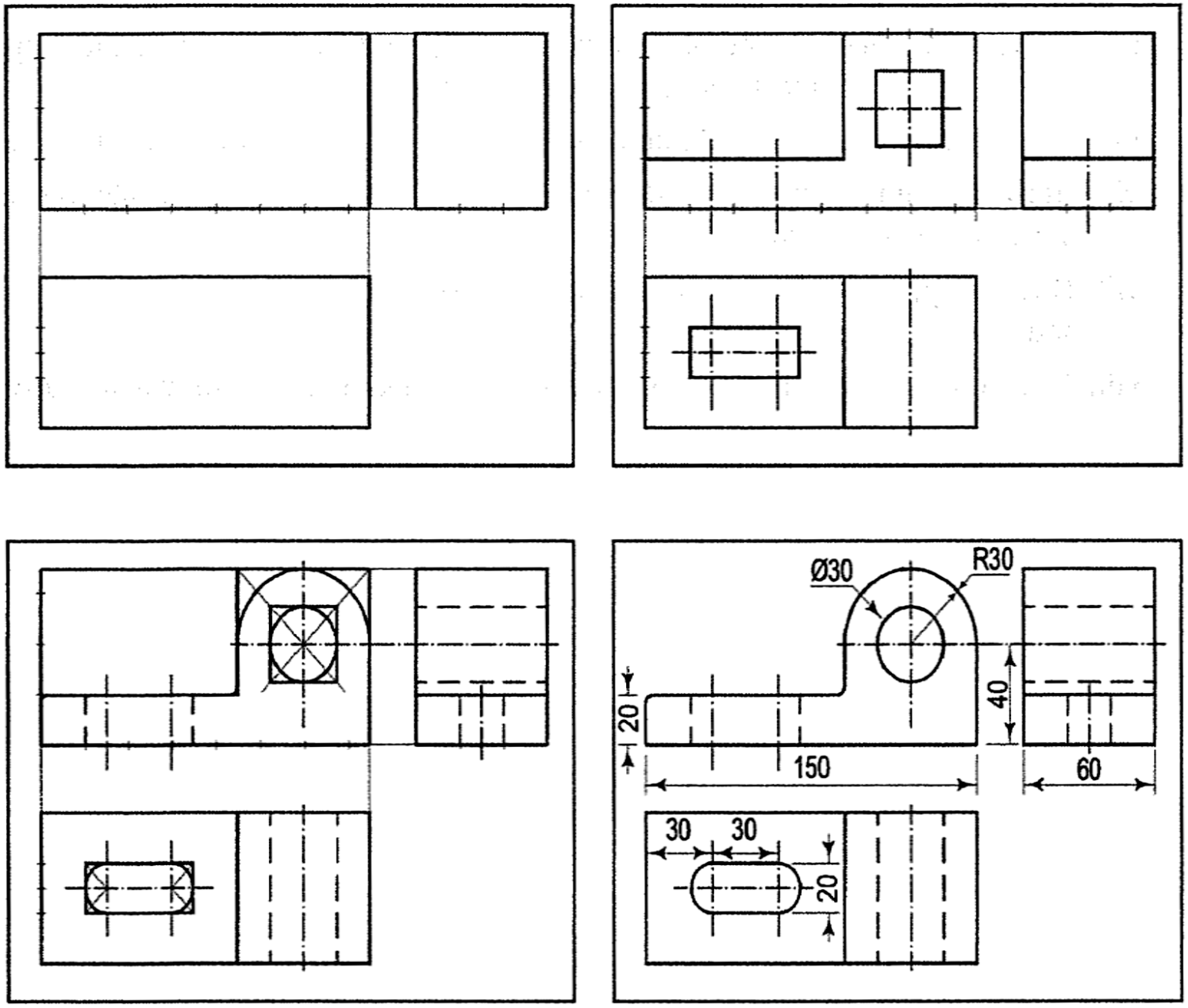
Practice Design 3



Practice Design 4



Practice Design 4



Conclusion