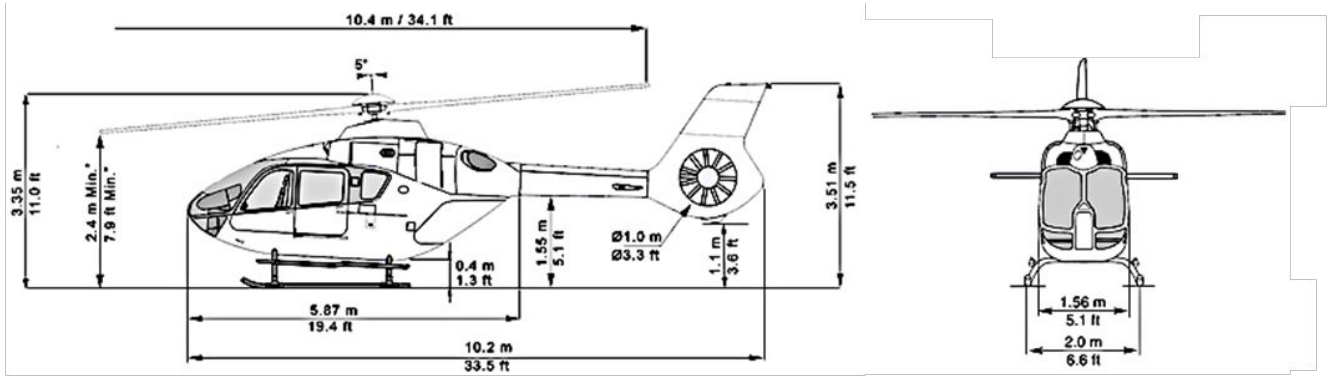
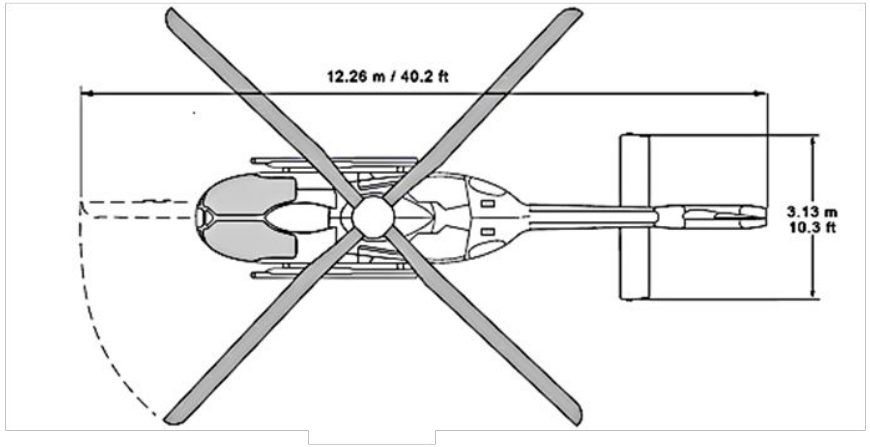
ES 101: Engineering Graphics





Drawing is vision on paper

-Andrew Loomis

https://www.aiut-alpin-dolomites.com/english/technical_details.html

Class#2 – 4th September 2024

Sameer Patel
Assistant Professor
Civil Engineering & Chemical Engineering
IIT Gandhinagar

Drawing scale

- Representative Fraction (RF) or Scaling Factor (SF):

$$RF = \frac{\text{Dimension on Drawing}}{\text{Actual Dimension}}$$

- Drawing scale is defined in the form

Scale = Drawing : Actual

- However, it is customary to represent it in the form

Scale = 1:(1/RF)

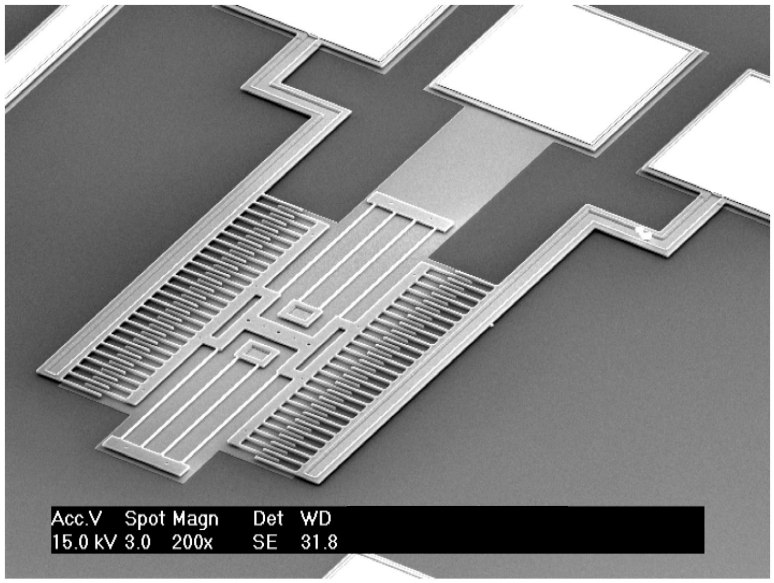
- The actual object is five times larger than the size shown on drawing (RF < 1, reduced scale)

Scale = 1:5

- The actual object is five times smaller than the size shown on drawing (RF > 1, enlarged scale)

Scale = 1:0.2

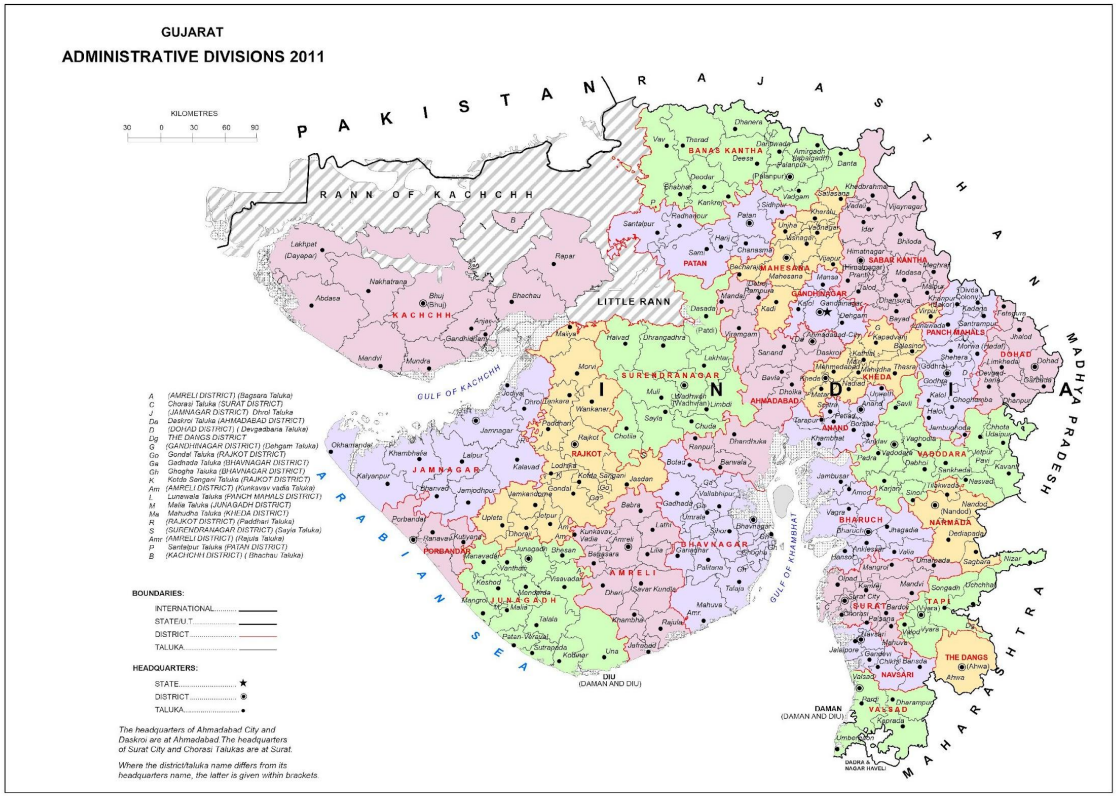
- Note that only length dimensions get scaled and not the angular dimensions



$\text{Scale} = 1:10^{-3}$

High vibration sensors: Modelling, design and integration, Conference Paper, May 2009
DOI: 10.1109/ESIME.2009.4938479, Source: IEEE Xplore

https://www.bragitoff.com/wp-content/uploads/2016/04/gujarat.jpg

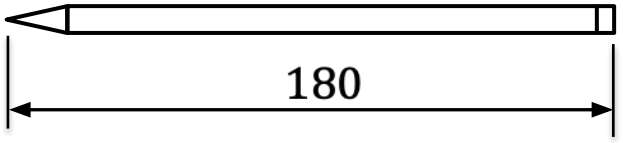


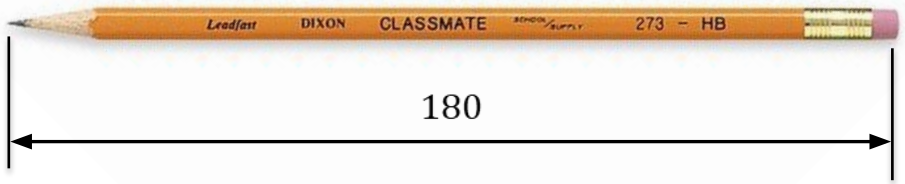
$\text{Scale} = 1:10^{6}$

Drawing scale

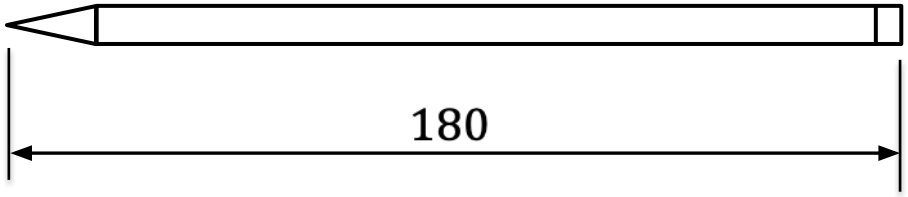
- On the drawing, always show the actual dimension and provide the scaling factor (RF)
- If RF < 1, the actual object is larger than the one shown in the drawing
- If RF > 1, the actual object is smaller than the one shown in the drawing

Scale = 1: 2 ⇒ RF = 0.5

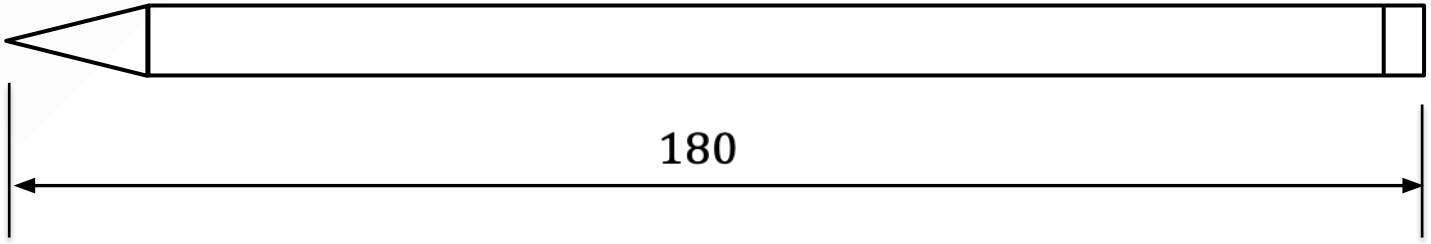




Scale = 1: 1 ⇒ RF = 1

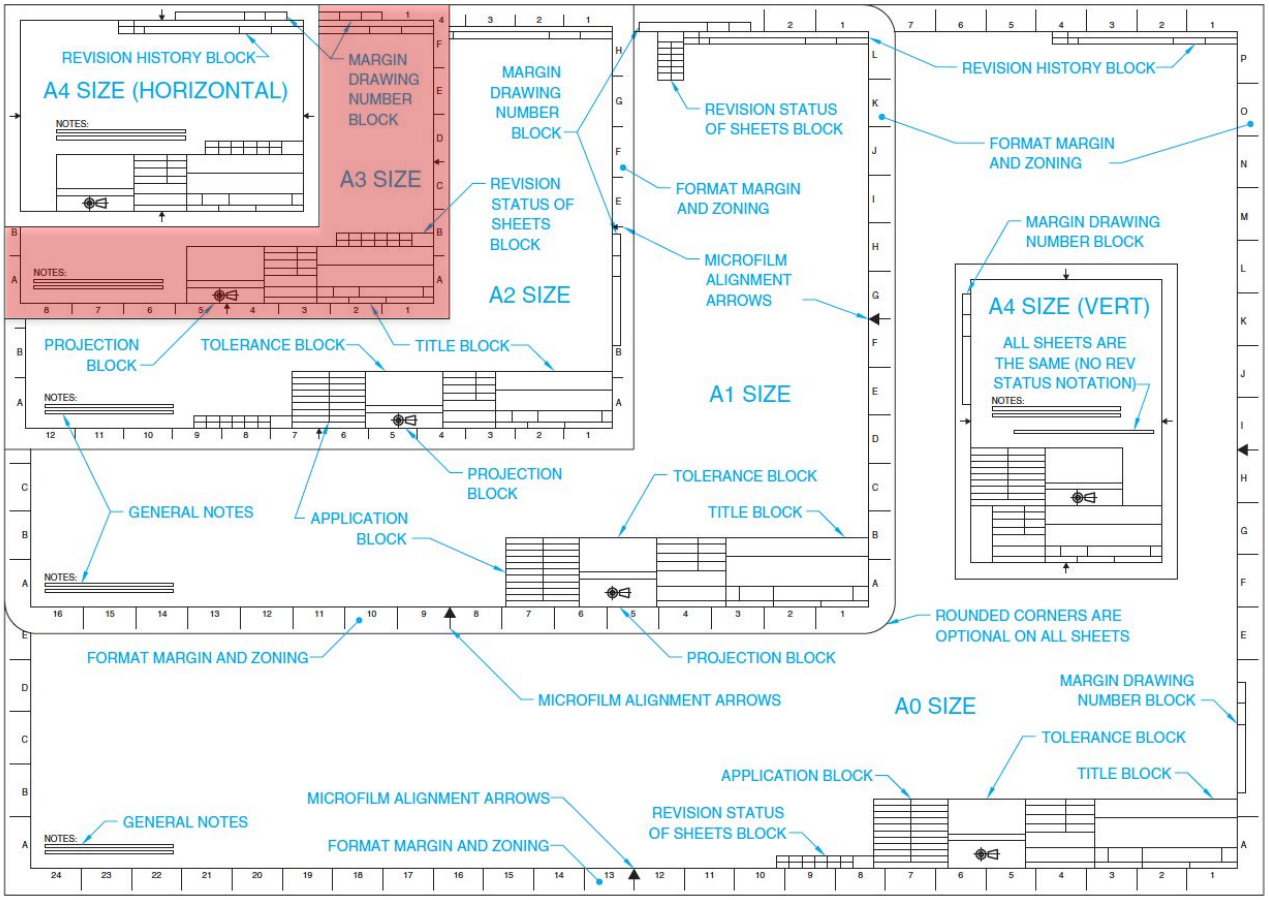


Scale = 1: 0.5 ⇒ RF = 2



https://www.indiamart.com/proddetail/classmate-273-hb-black-lead-wooden-pencil-21396431462.html

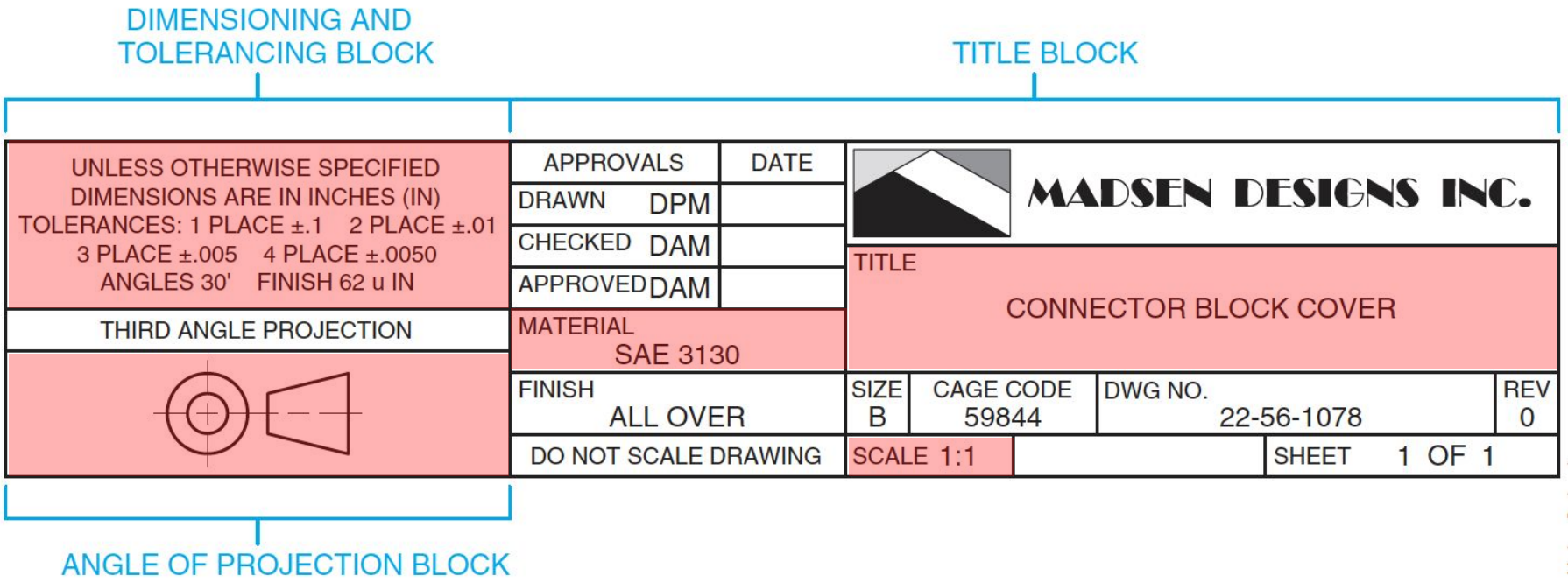
Engineering Drawing



Size Designation	Size in Millimeters	
	Vertical	Horizontal
A0	841	1189
A1	594	841
A2	420	594
A3	297	420
A4	210	297

ASME Y14.1M, Metric Drawing Sheet Size and Format

Title block



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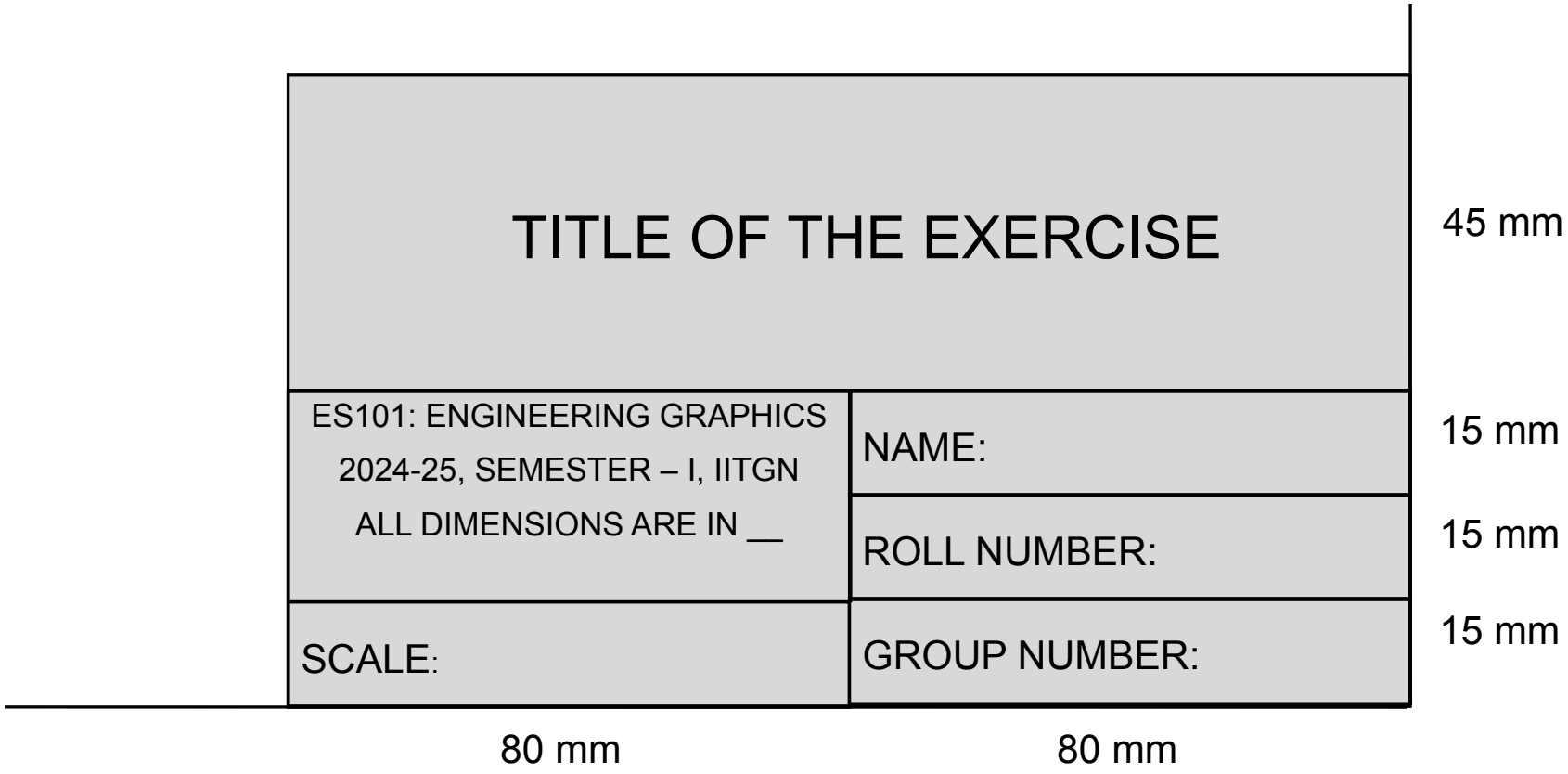
TITLE BLOCK


TITLE OF THE EXERCISE
45 mm
ES101: ENGINEERING GRAPHICS
2024-25, SEMESTER – I, IITGN
ALL DIMENSIONS ARE IN __
NAME:
15 mm
ROLL NUMBER:
15 mm
SCALE:
GROUP NUMBER:
15 mm
80 mm
80 mm

Engineering drawing lettering

- Drawing numbers, title block, and letters denoting the cutting planes and sections are written in 10 mm size (minimum character height)
- Drawing title is written in 7 mm size (minimum character height)
- Hatching, subtitles, materials, dimensions, notes, etc., are written in 3.5 mm size (minimum character height)

Engineering drawing lettering

TIP

Creating Letters that Appear Stable

Certain letters and numerals appear top-heavy when they are drawn with equal upper and lower portions as in the example below.

To correct this, reduce the size of the upper portion to give a balanced appearance, as in the example below.

If you put the central horizontal strokes of the letters B, E, F, and H at midheight, they will appear to be below center.

To overcome this optical illusion, draw the strokes for B, E, F, and H slightly above the center as you letter, keeping letters uniform, as in the second example below.

The same practice applies to numerals. In the illustrations below, the example at left looks top-heavy. Note how the example at right looks more balanced.

A good example of uniform lettering

RELATIVELY

These examples show what not to do

Nonuniform style

Relatively

Nonuniform letter height

RELATIVELY
RELATIVELY

Nonuniform angle

RELATIVELY
RELATIVELY

Nonuniform stroke thickness

RELATIVELY
RELATIVELY

Nonuniform letter spacing

RELATIVELY

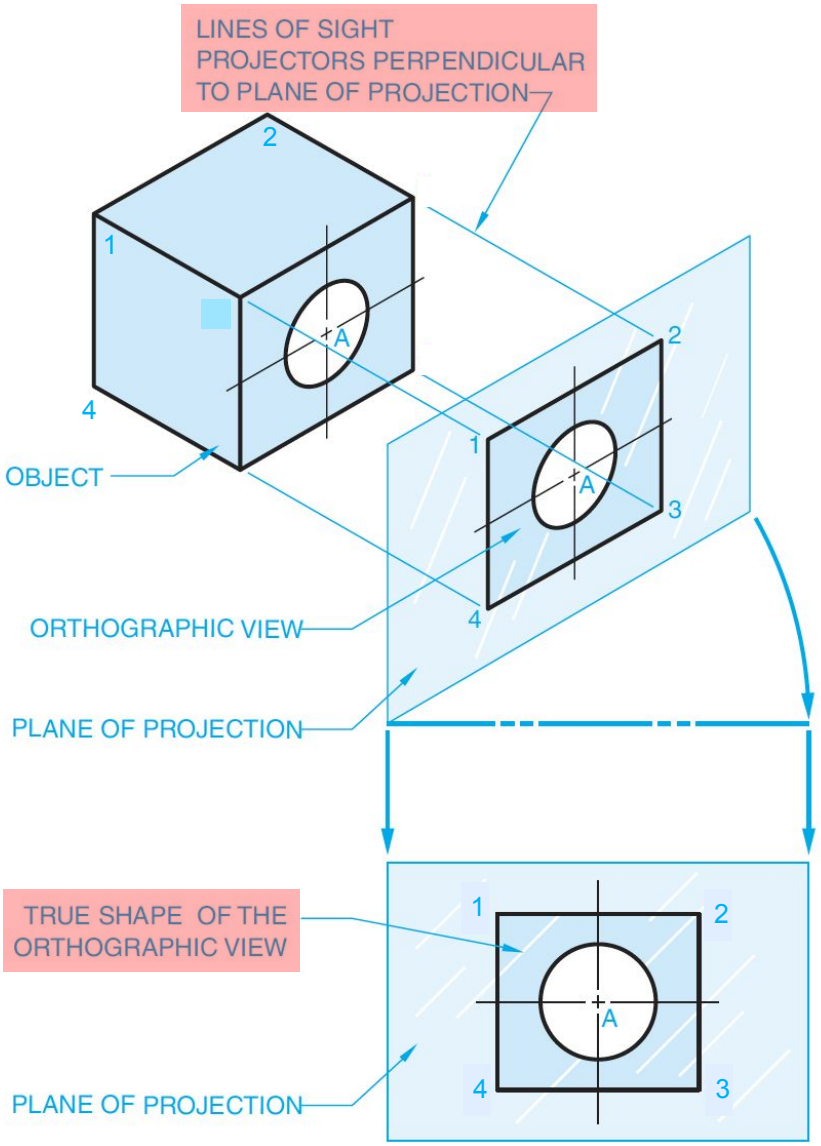
Nonuniform word spacing

NOW IS THE TIME FOR EVERY GOOD PERSON TO COME TO THE AID OF HIS OR HER COUNTRY

F. E. Giesecke et al., *Technical Drawing with Engineering Graphics*, Prentice Hall, 15th Ed., New York

Drawing views (Orthographic projections)

- Orthographic projection is used to change 3-D physical objects into 2-D drawings that effectively describe the design and features of an object
- Orthographic projection is projection of the features of an object onto an imaginary plane called a plane of projection
- The projection of the features of the object is made by lines of sight that are perpendicular to the plane of projection
- The view that shows the actual shape of the object is called the true geometry view. The plane of projection is parallel to the surface of the object
- When the plane of projection is not parallel to the surface of the object, the resulting orthographic view is foreshortened, or shorter than true length



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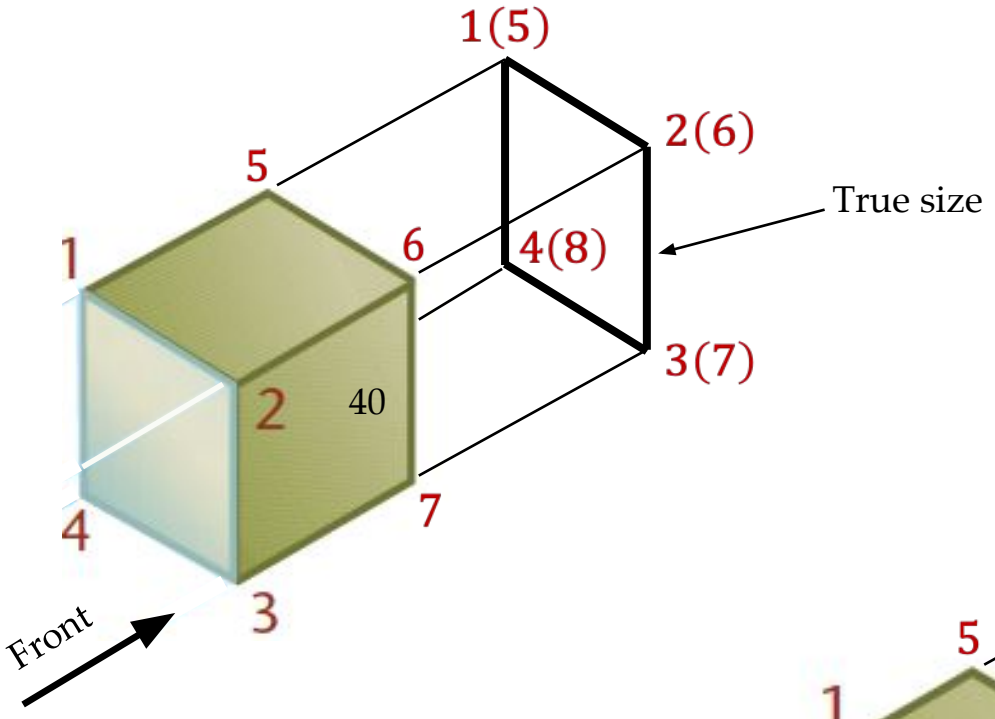
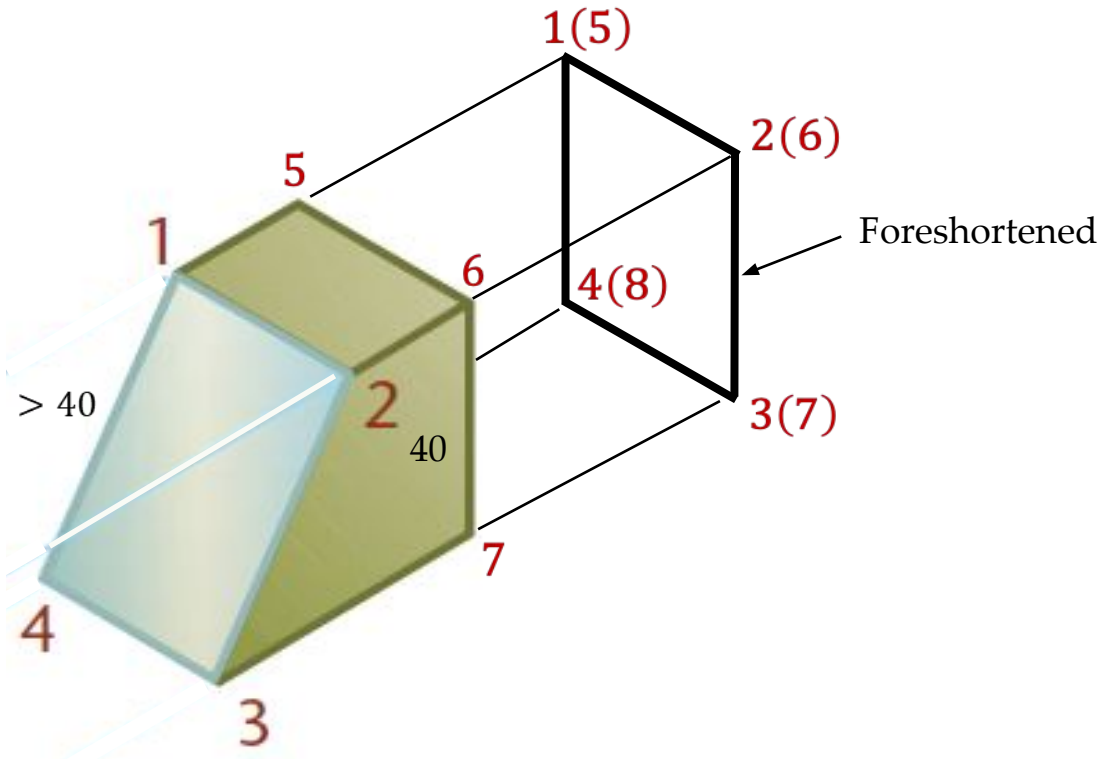
- When the plane of projection is not parallel to the surface of the object, the resulting orthographic view is foreshortened, or shorter than true length





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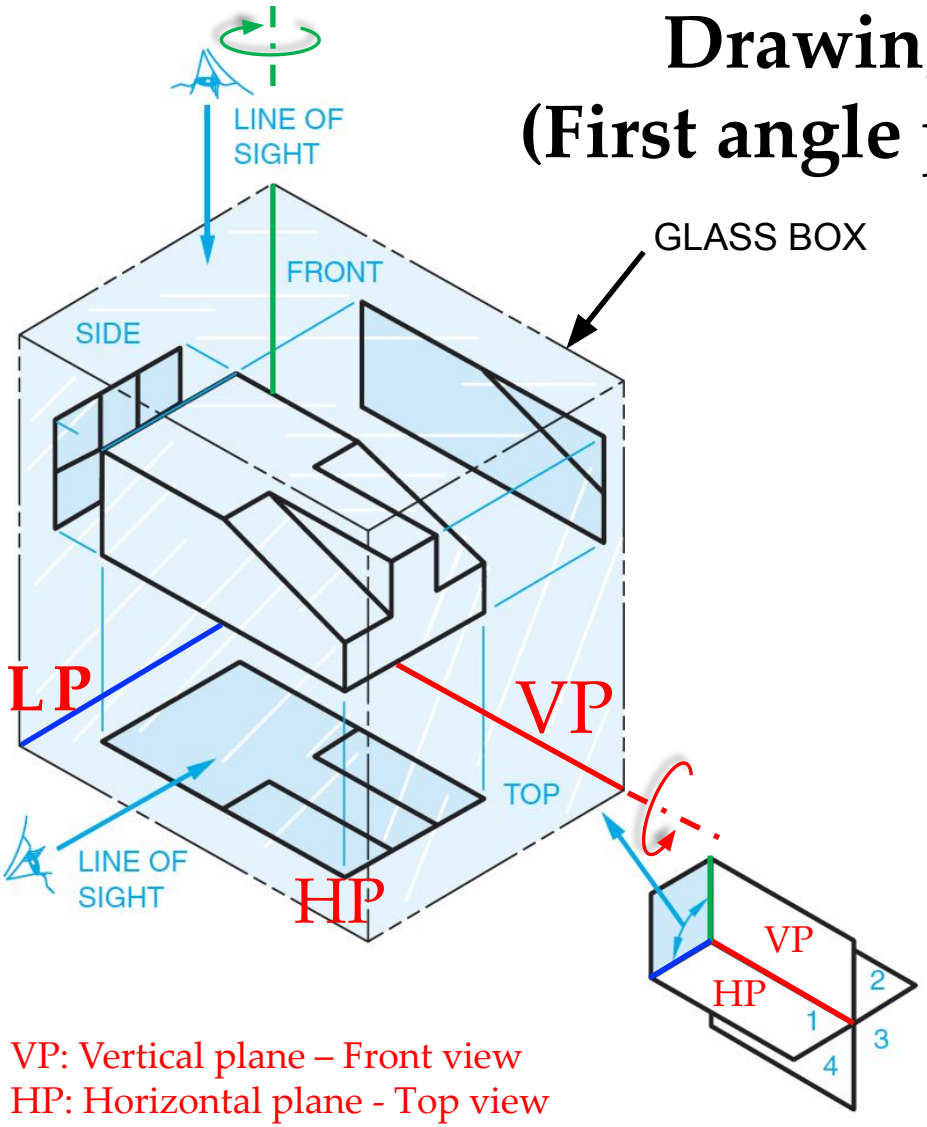
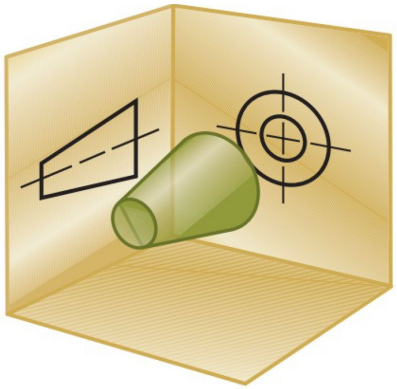
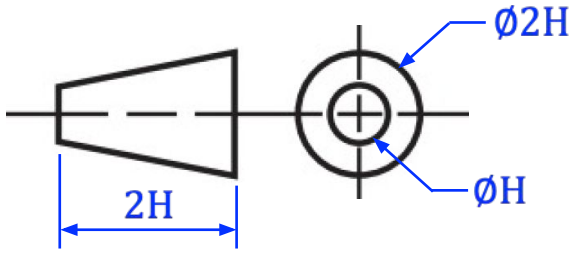
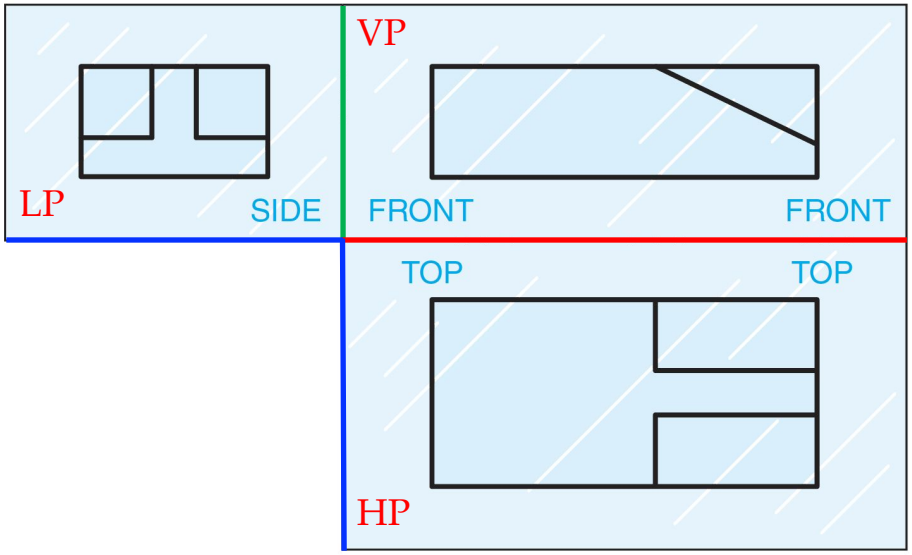
Drawing views
(First angle projections)









VP: Vertical plane – Front view
HP: Horizontal plane - Top view
LP: Left profile plane – Right side view

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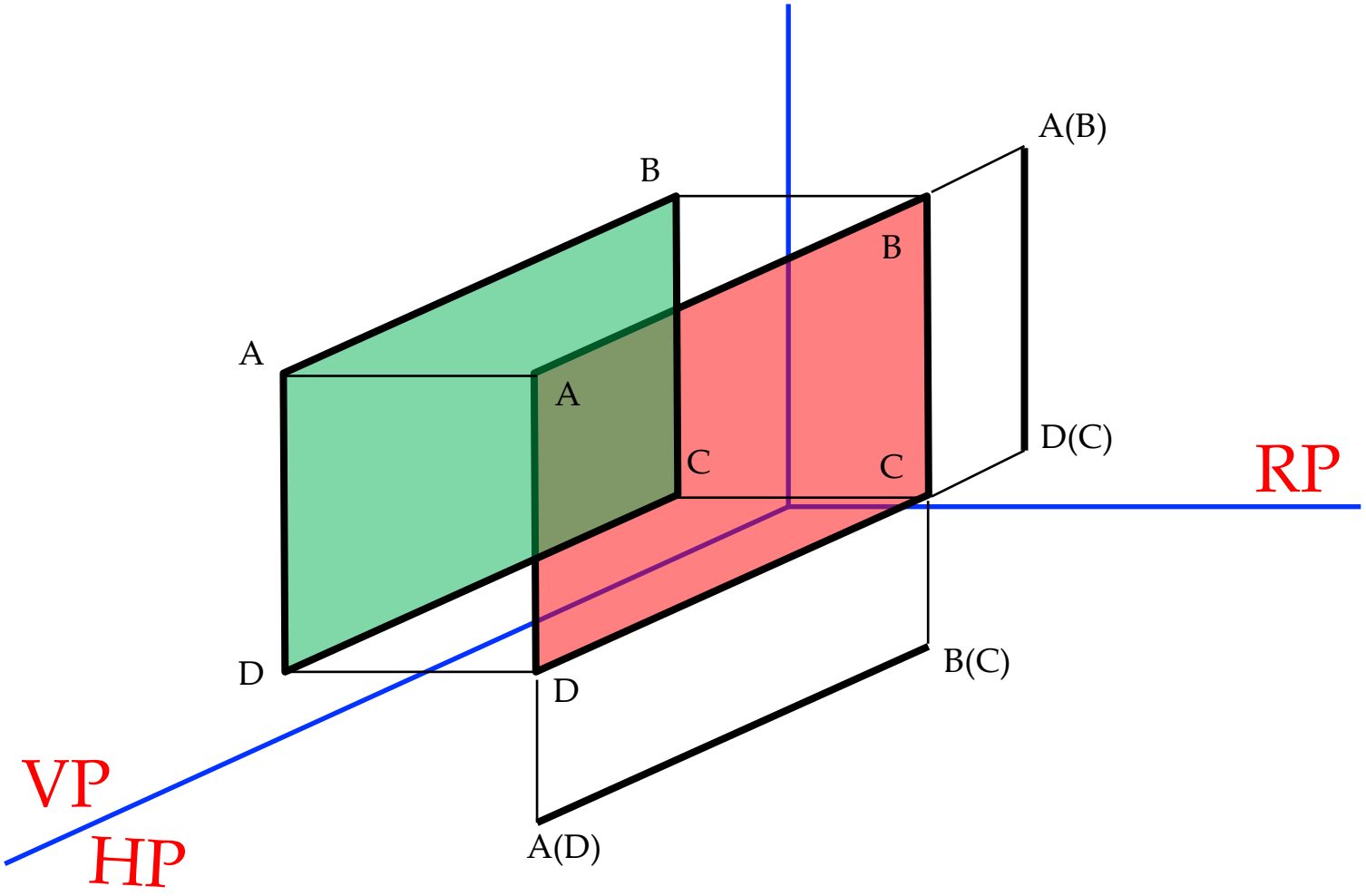
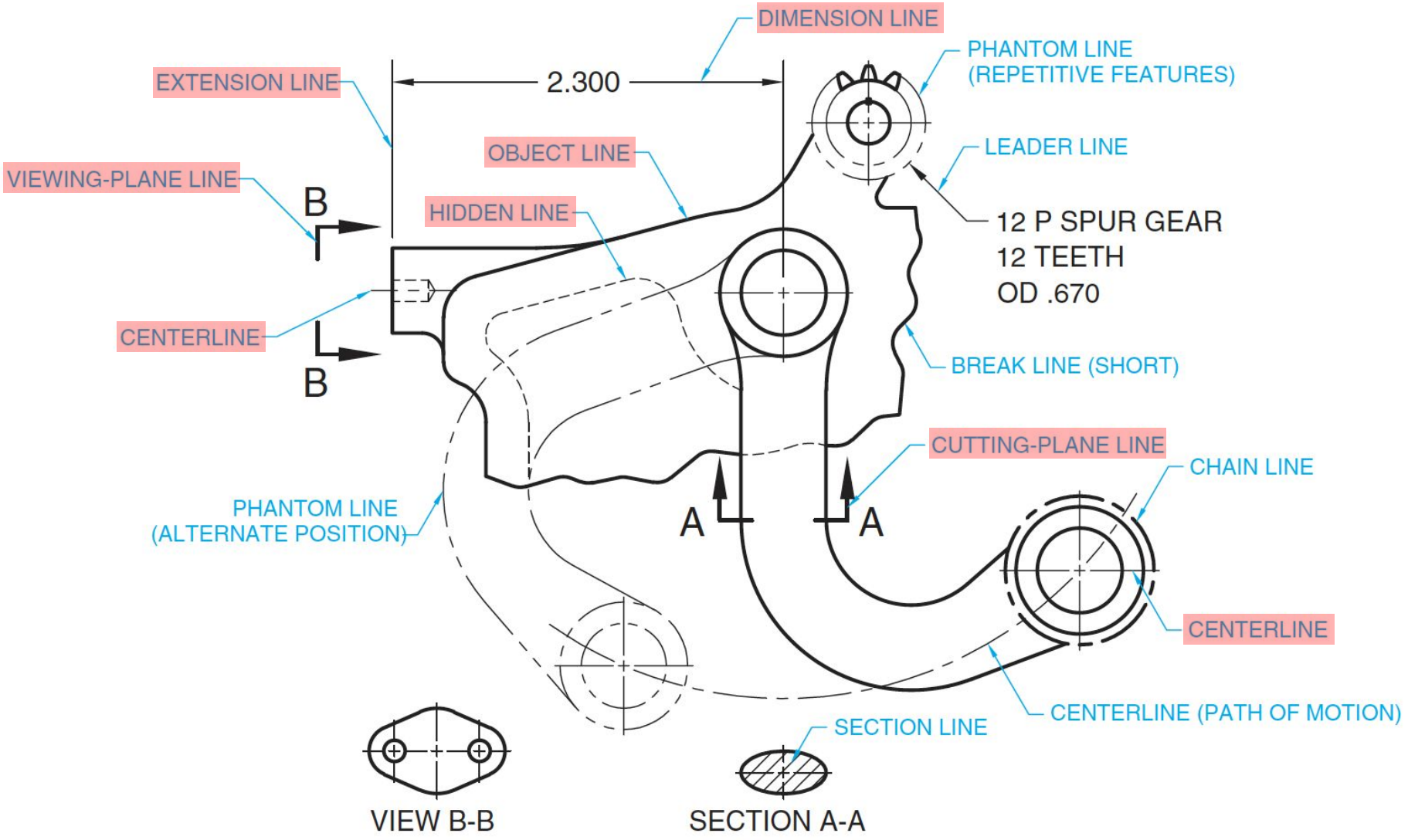

A(B)
B
B
A
A
D(C)
C
C
RP
D
D
B(C)
VP
HP
A(D)

Line types



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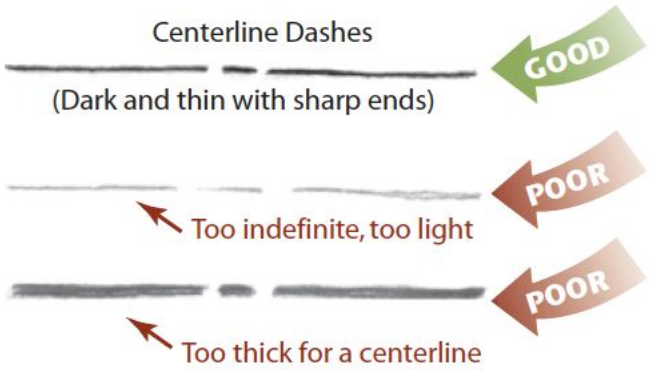
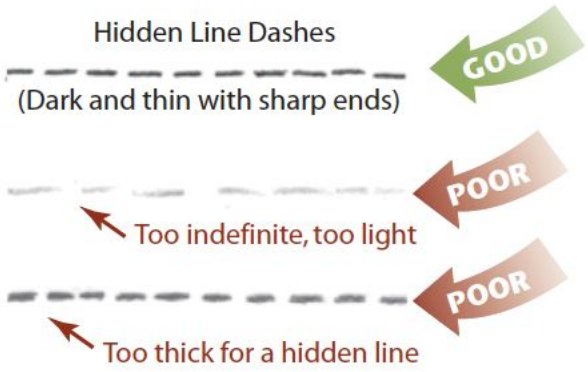
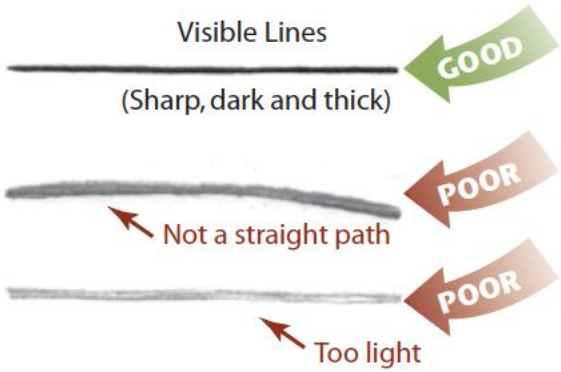
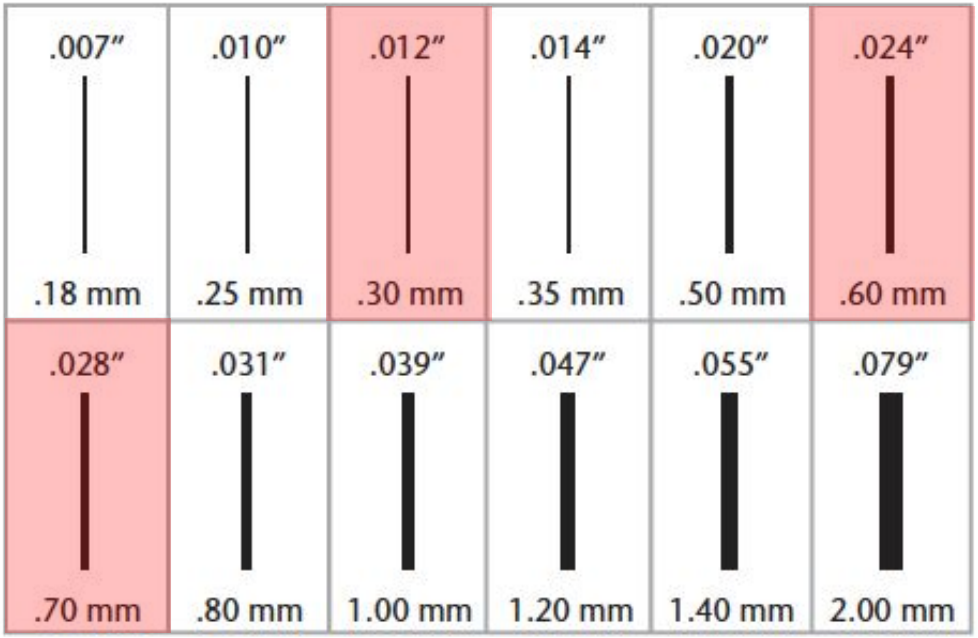
Line types









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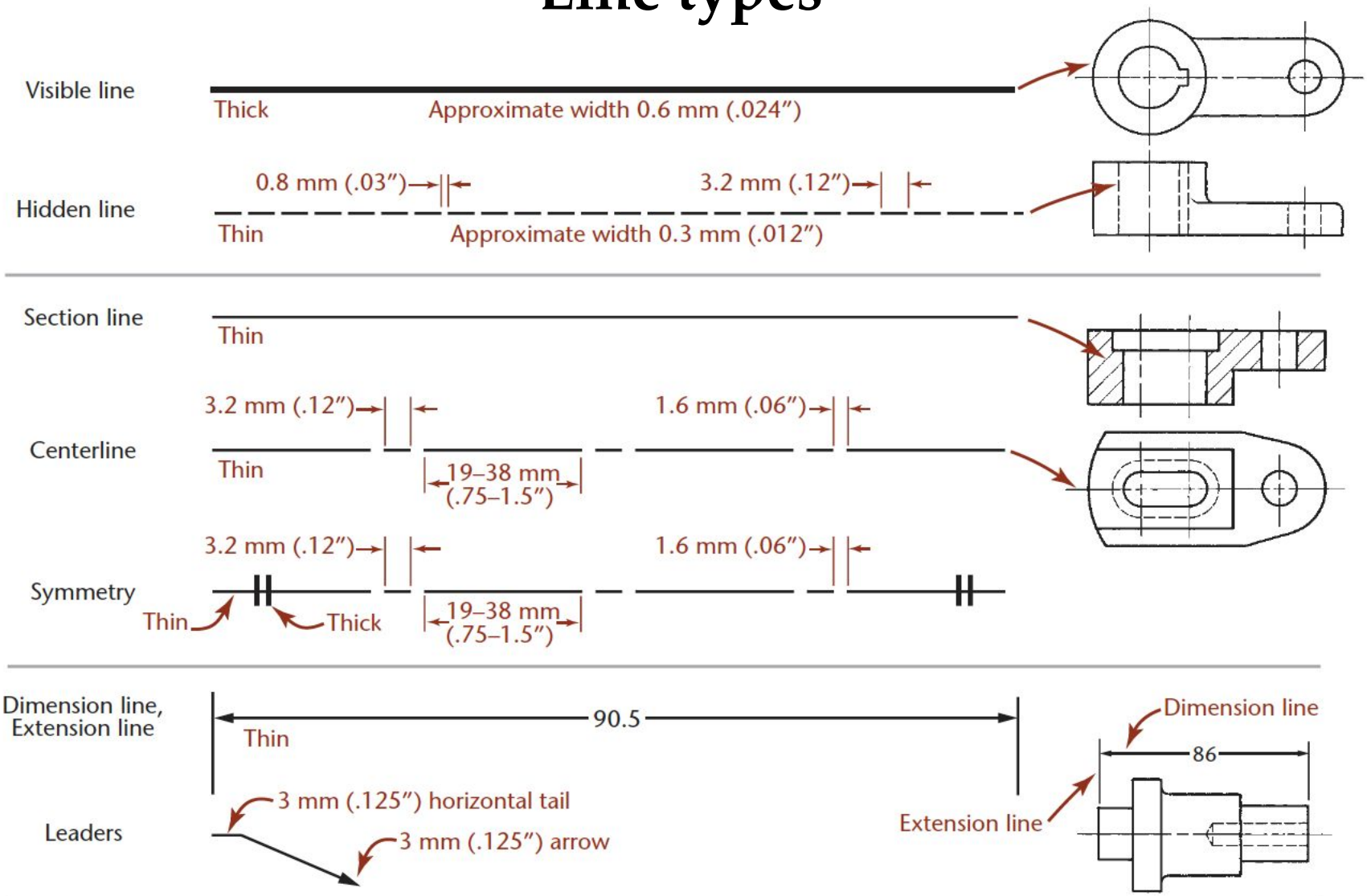
Line types



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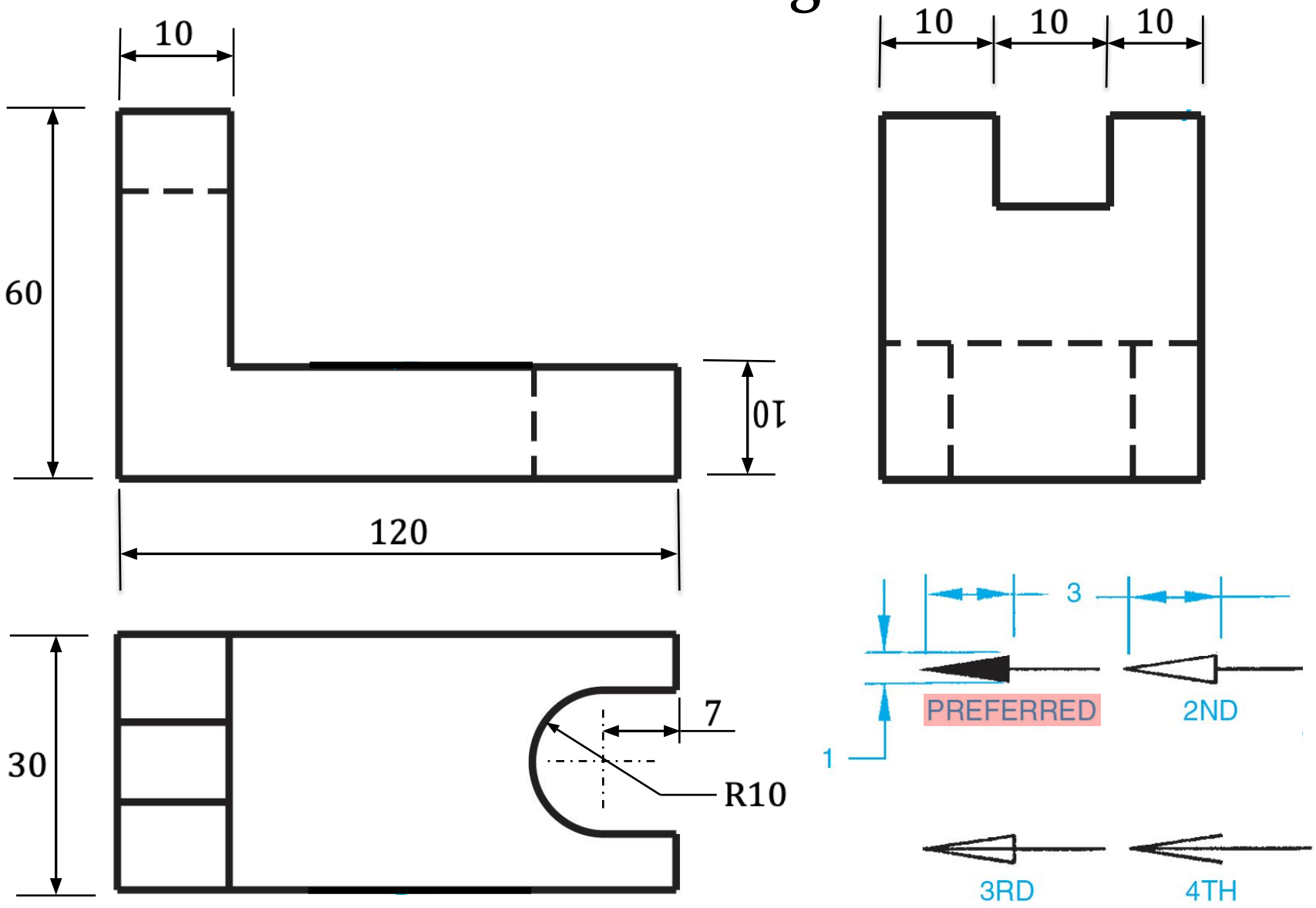
Dimensioning



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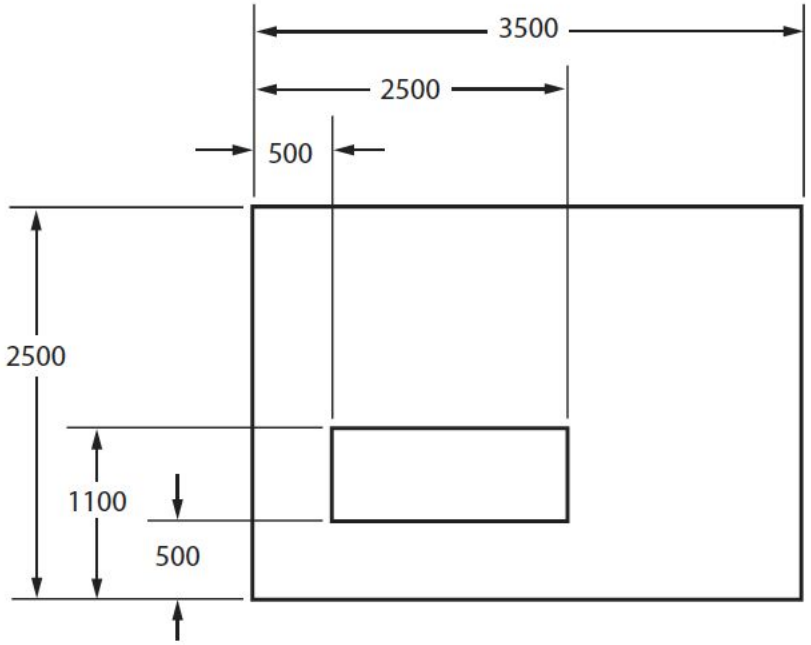
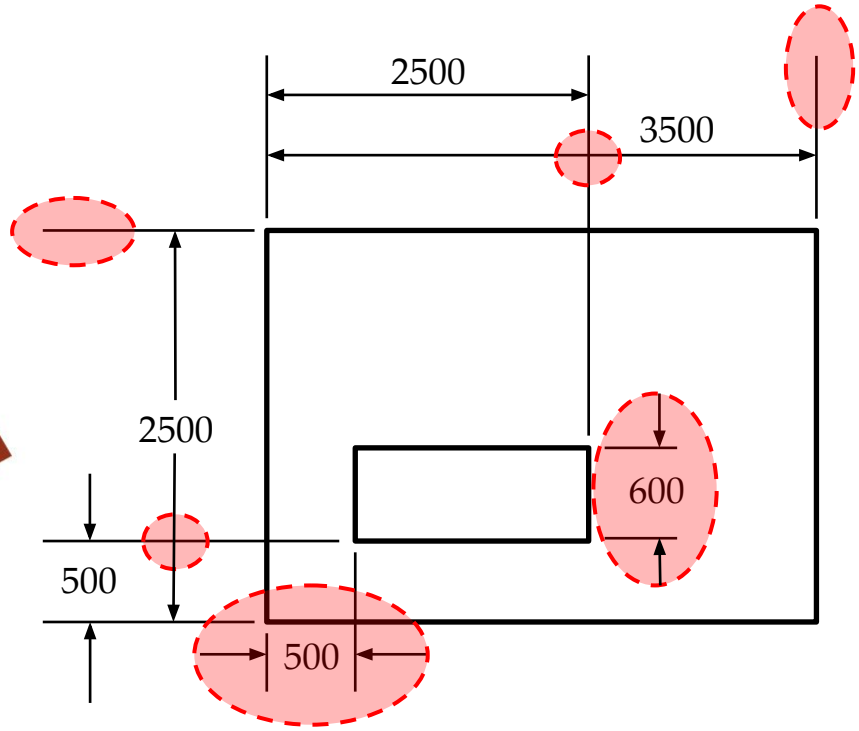
Dimensioning



GOOD

- Avoid crossing dimension line
- Provide dimensions on one side of the drawing whenever possible
- Extension line shouldn't be too long
- Do not (avoid) dimension on the drawing itself
- Do not dimension close to the drawing

POOR



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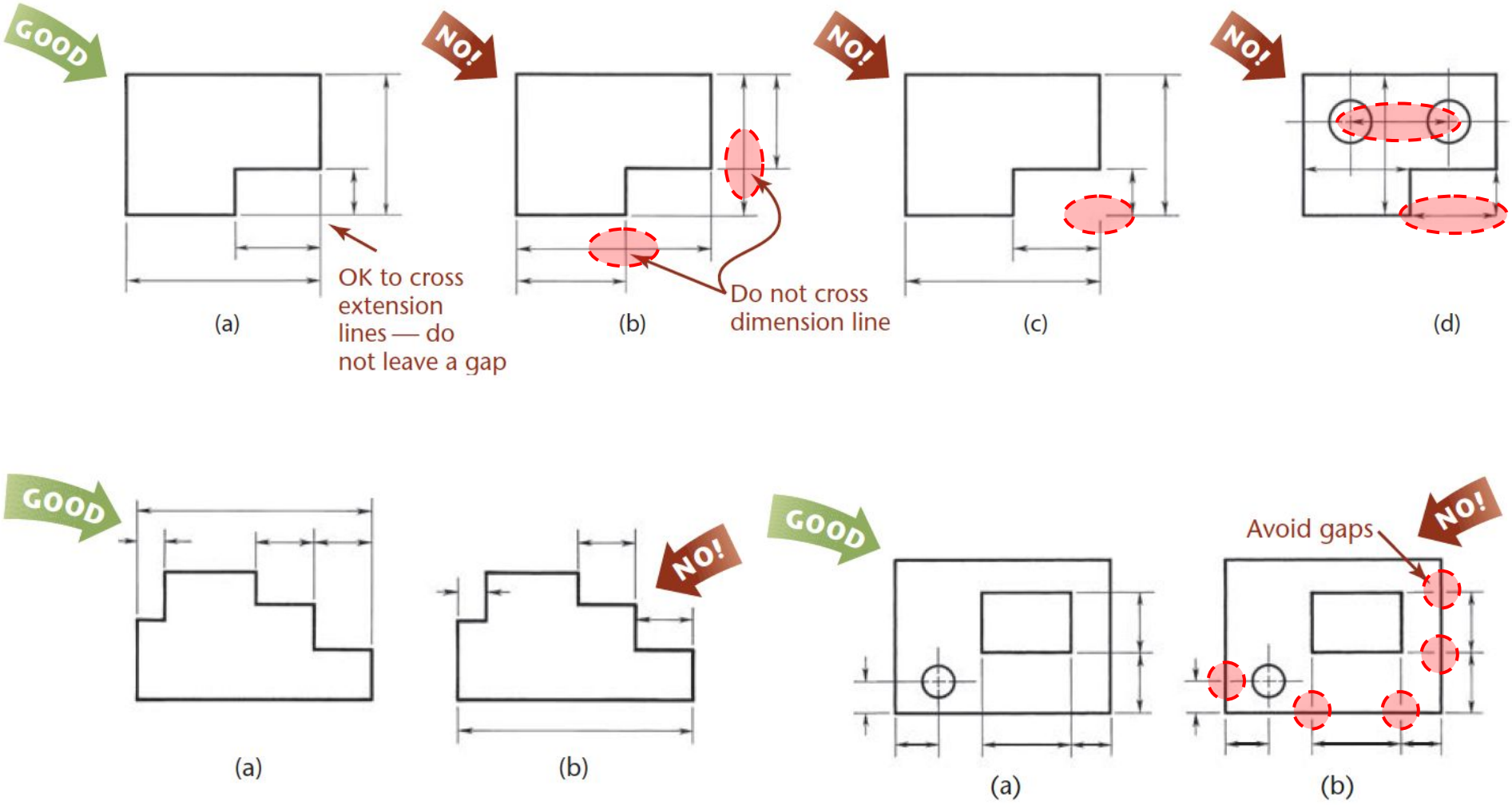
Dimensioning



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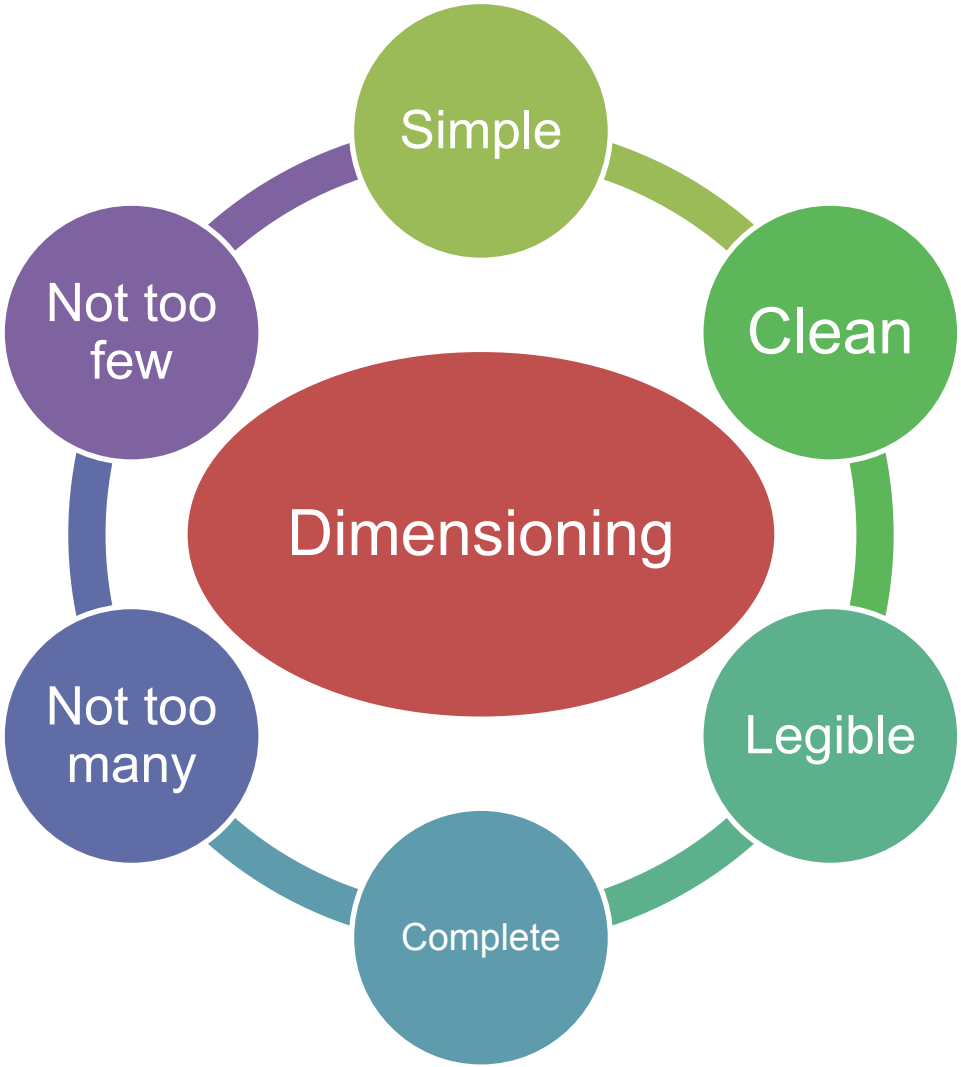
Characteristics

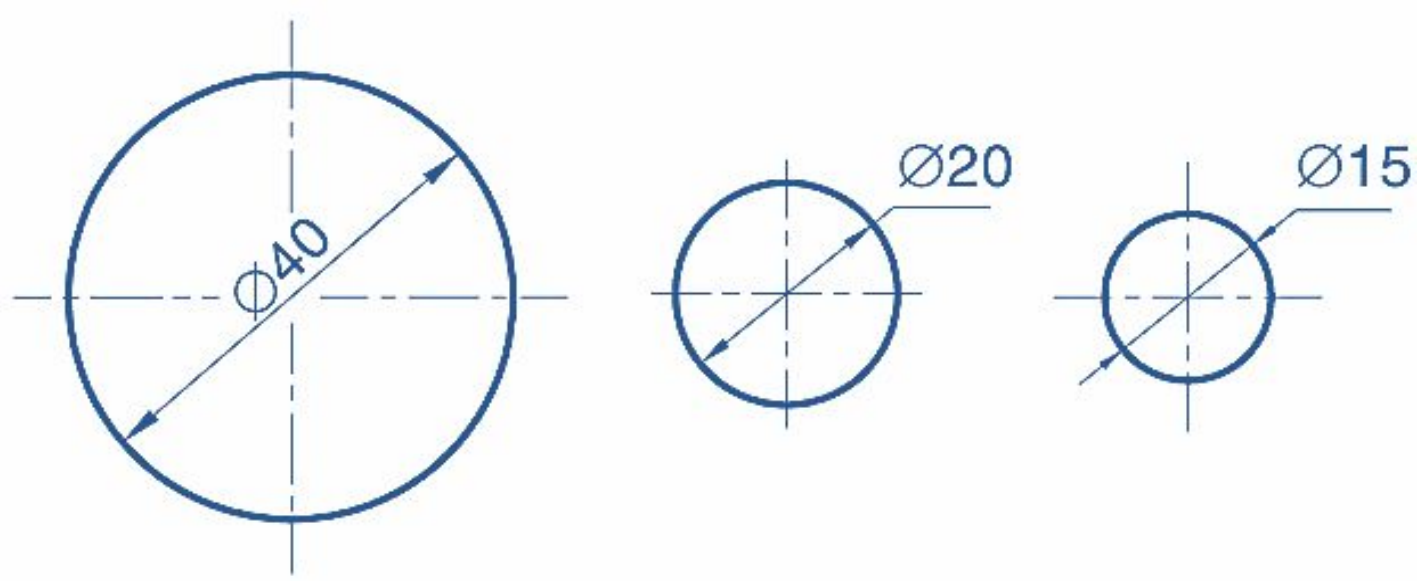


Curved features

- Diameters may be dimensioned in one of two ways.
  - Either dimension directly across the circle (not on a center line)

OR

  - Project the diameter to outside the outline.

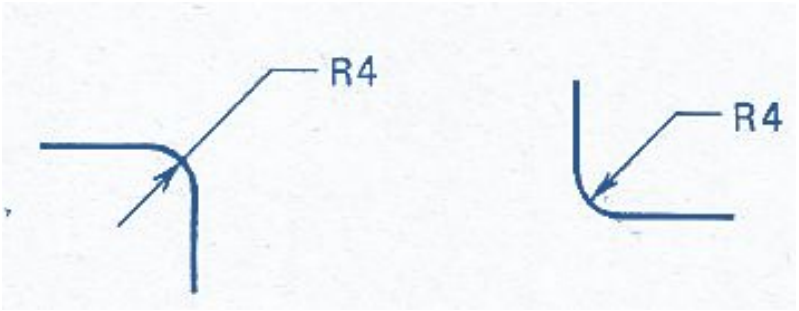


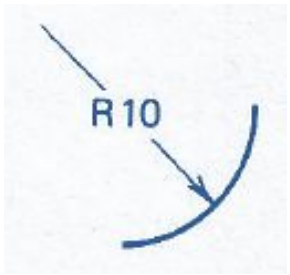
'Diameter ' is denoted by the symbol Φ

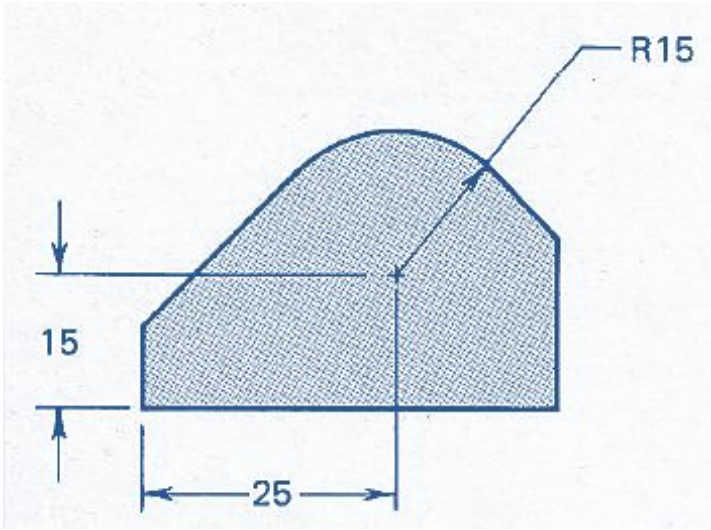
placed in front of the dimension.

Curved features

- If possible, show center of the curvature
- Show the radius with symbol **R** in front of the dimension
- On either side of the outline but should, of course, be kept outside if possible.

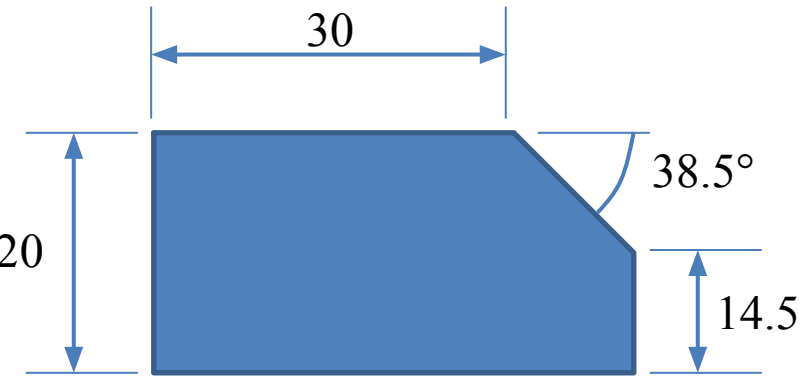


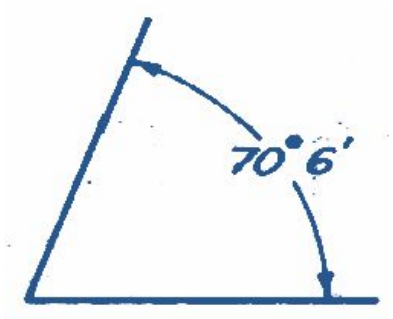


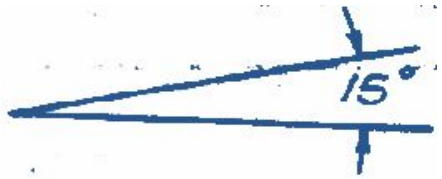


Angles

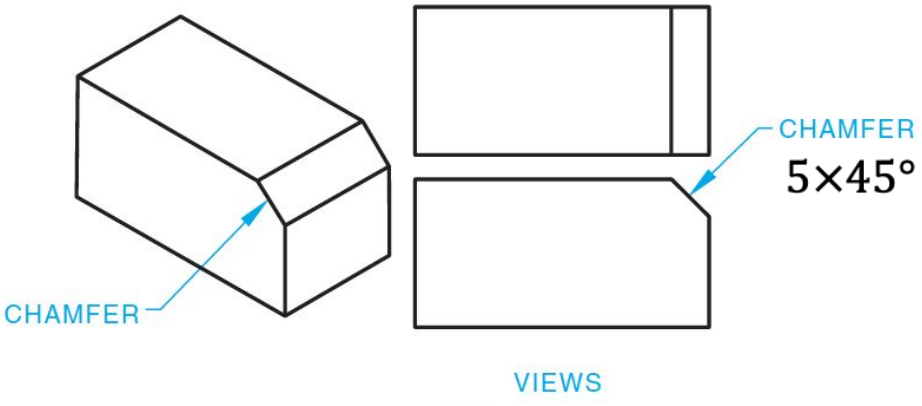
- The arrowheads may be drawn either side of the dimension lines
- The dimension may be inserted between the dimension lines or outside them.

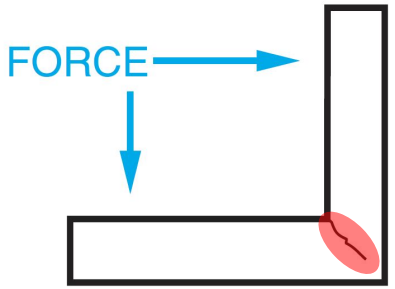




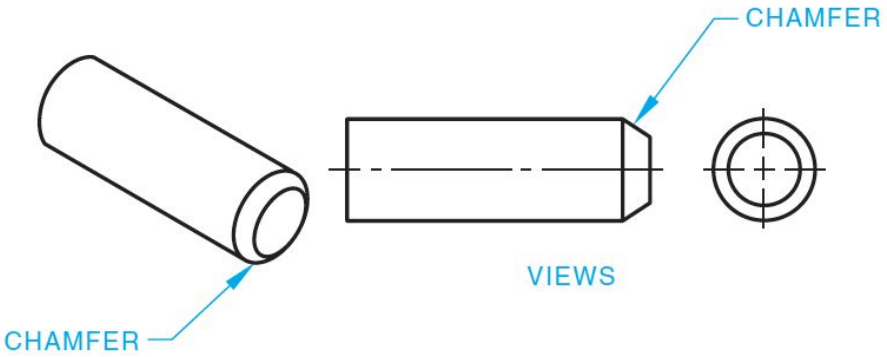


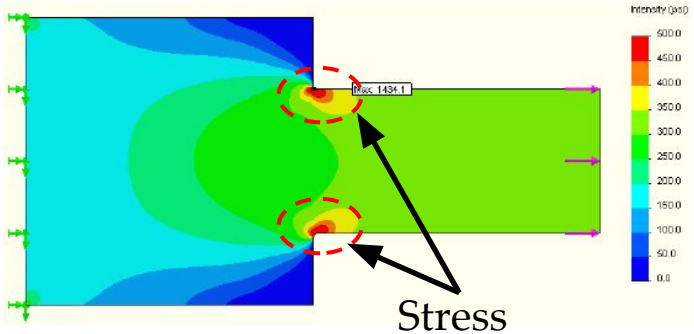
Fillets and chamfers



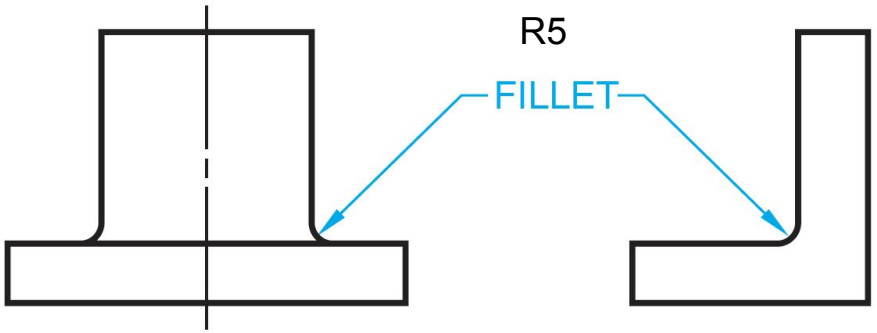


STRESS ON INSIDE CORNER MAY CAUSE FRACTURE





To avoid stress concentration and/or sharp edges, fillets and chamfers are provided



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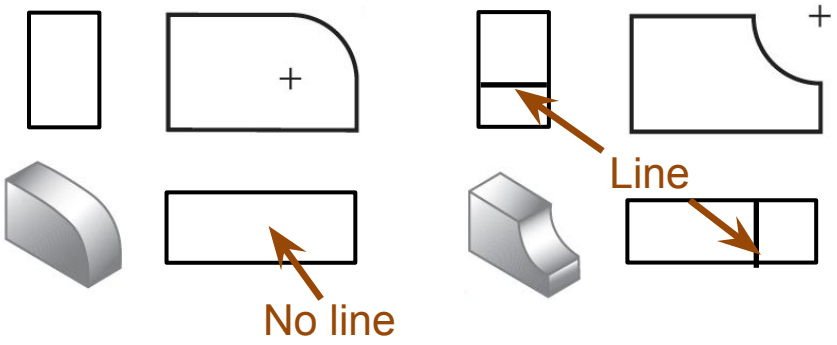
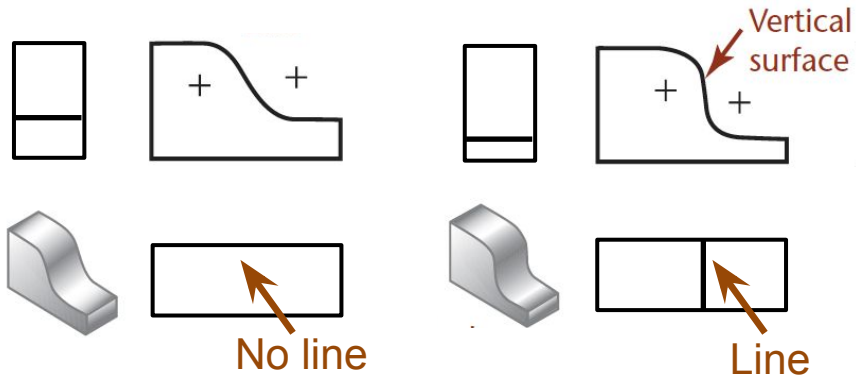
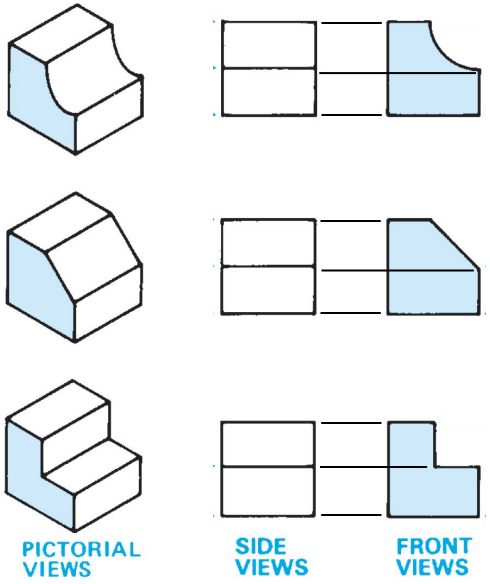
https://pveng.com/home/fea-stress-analysis/fea-methods-blog/#MeshNearDiscontinuities

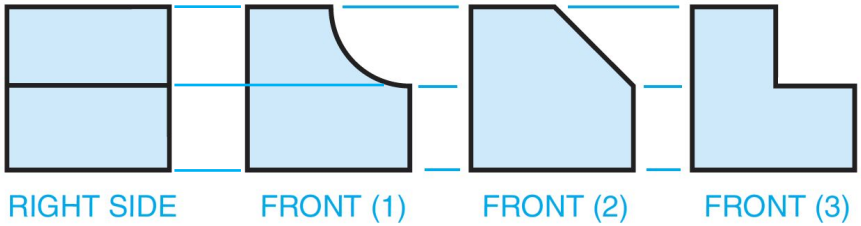
Fillets and chamfers

- When a curved surface is tangent to a plane surface, no line is drawn
- When a curved surface intersects a plane surface a definite edge is formed









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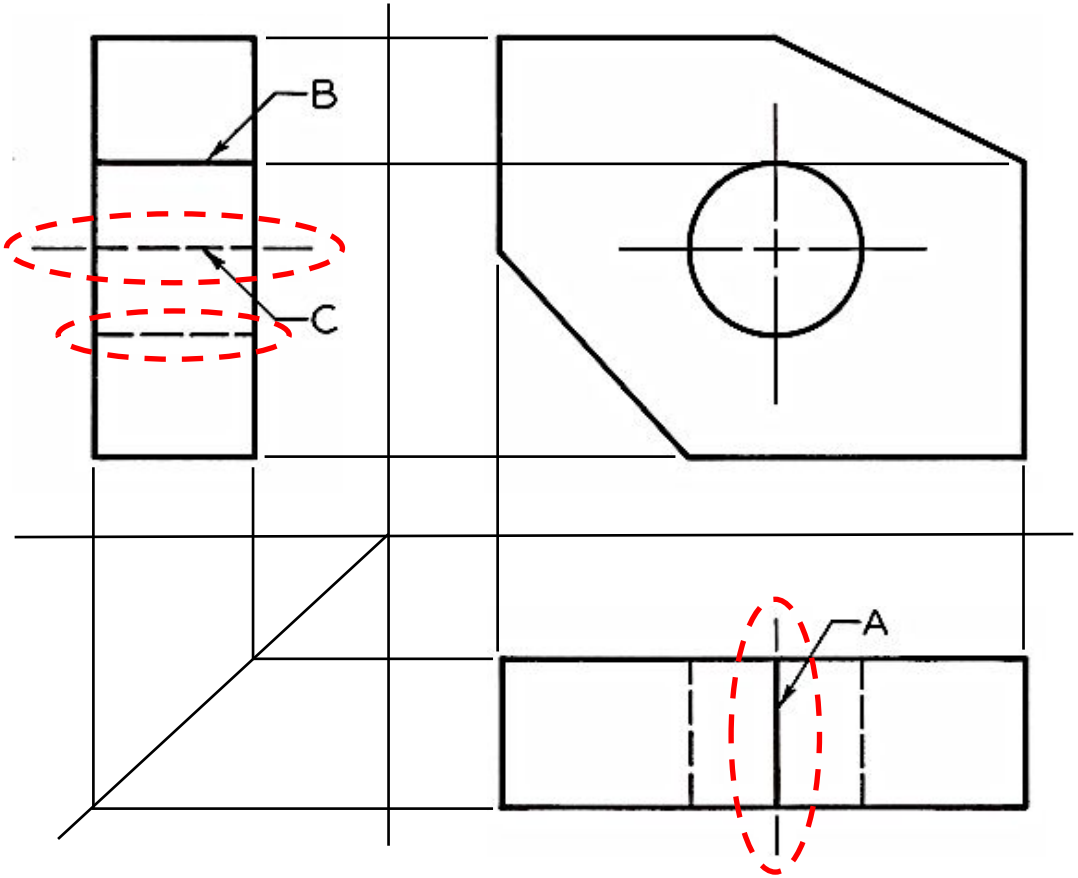
Precedence of lines

Object Line → **Hidden Line** → **Center Line**



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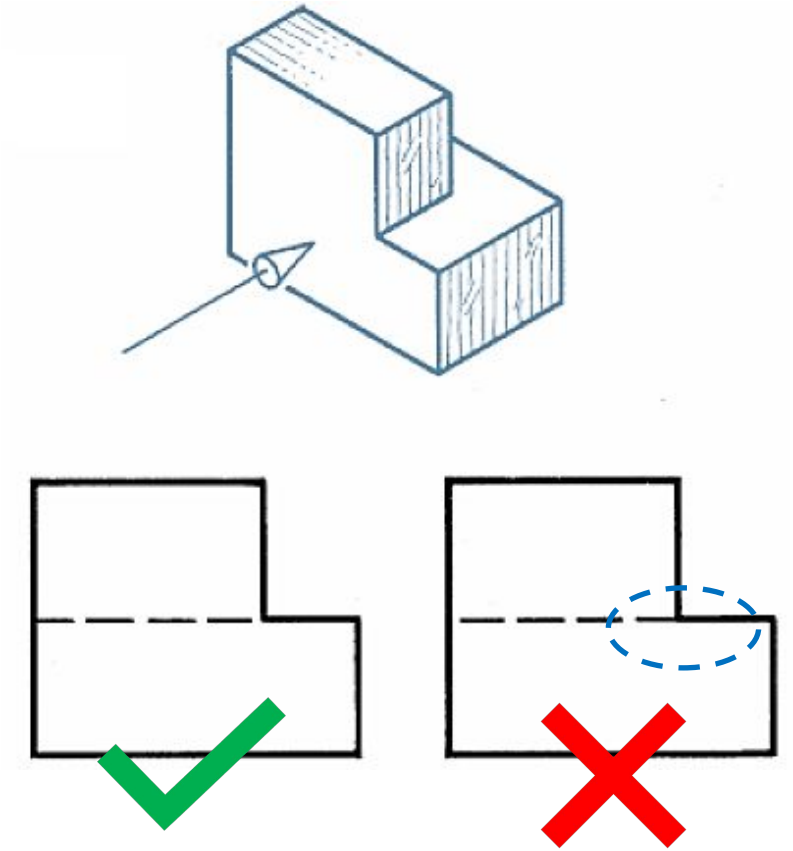
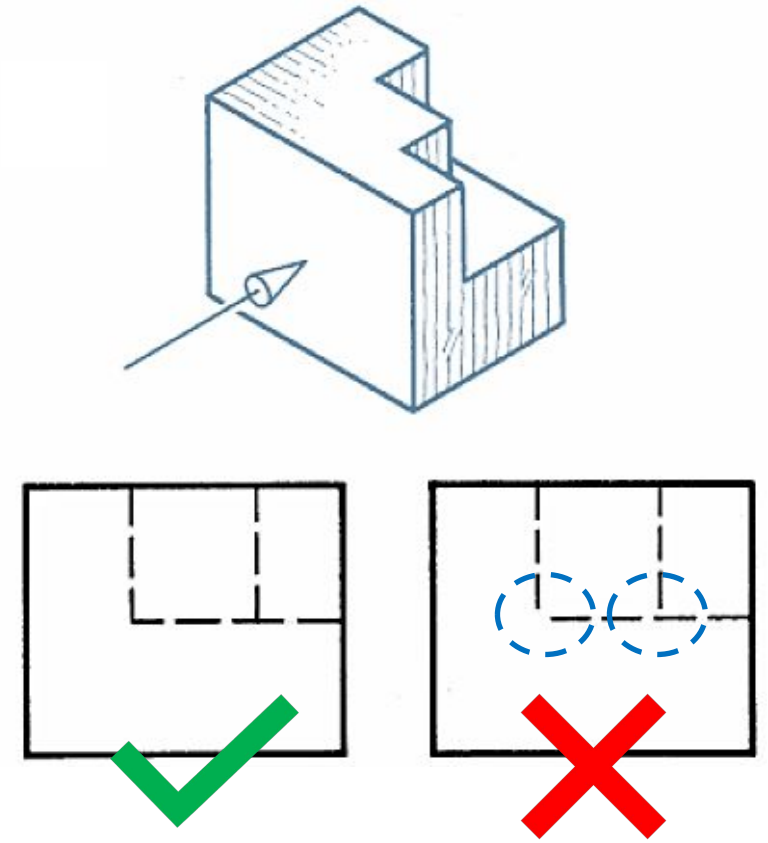
Hidden lines



Hidden line should join object line, except when it appears like an extension of the object line



Hidden lines should join other hidden lines

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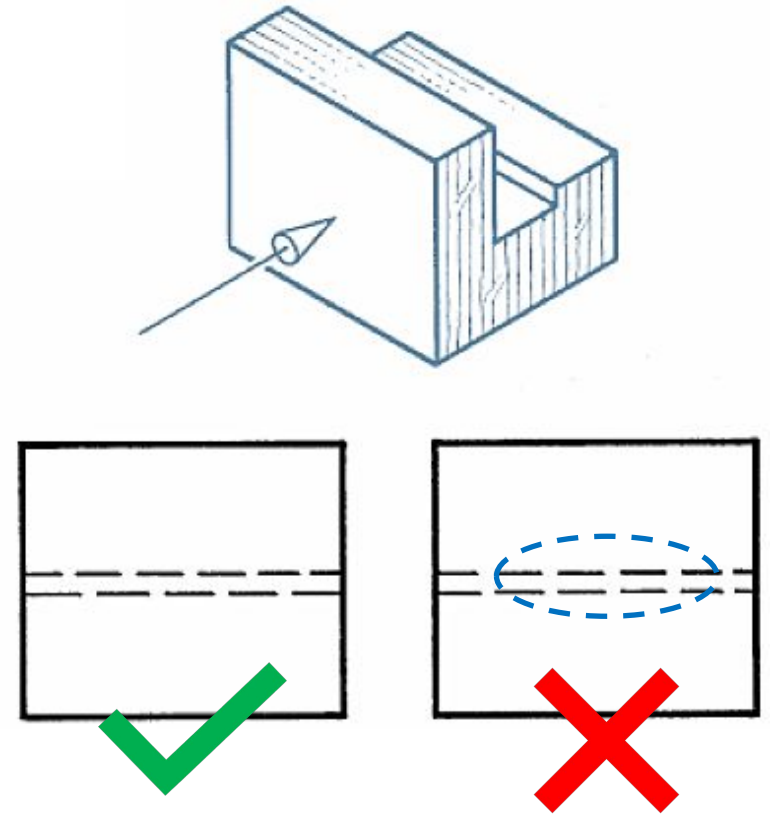
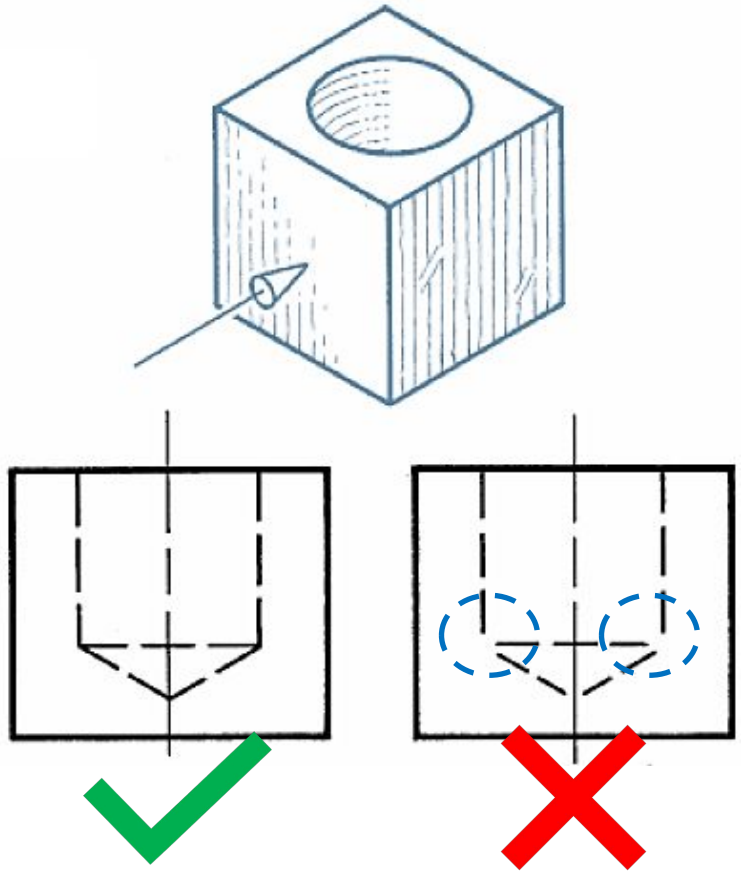
Hidden lines



Parallel hidden lines should be staggered



Hidden lines should join other hidden lines

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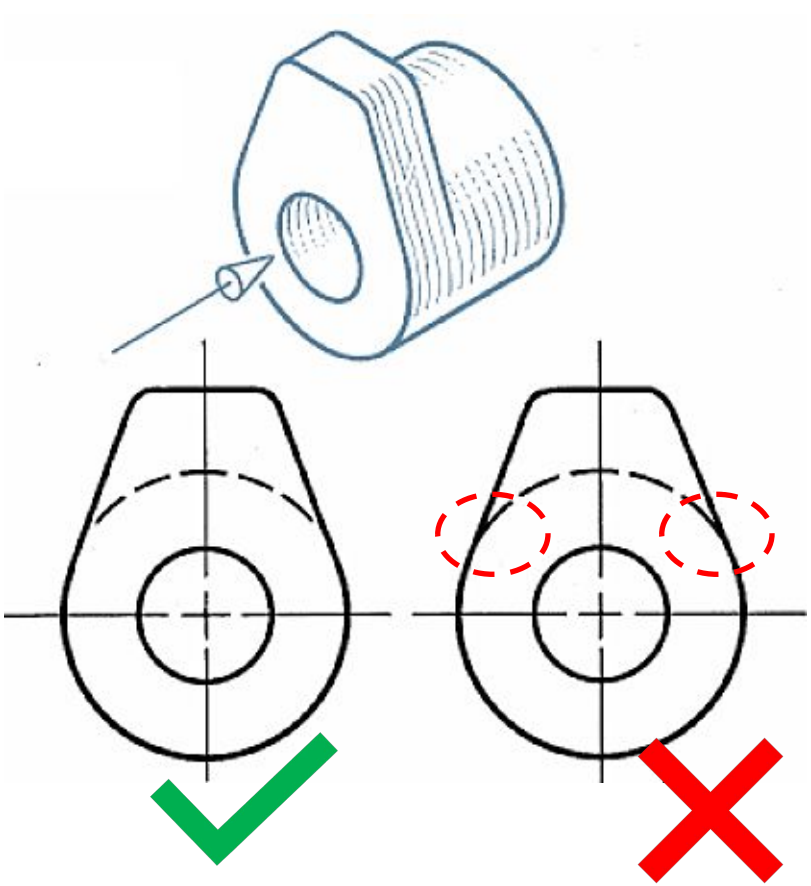
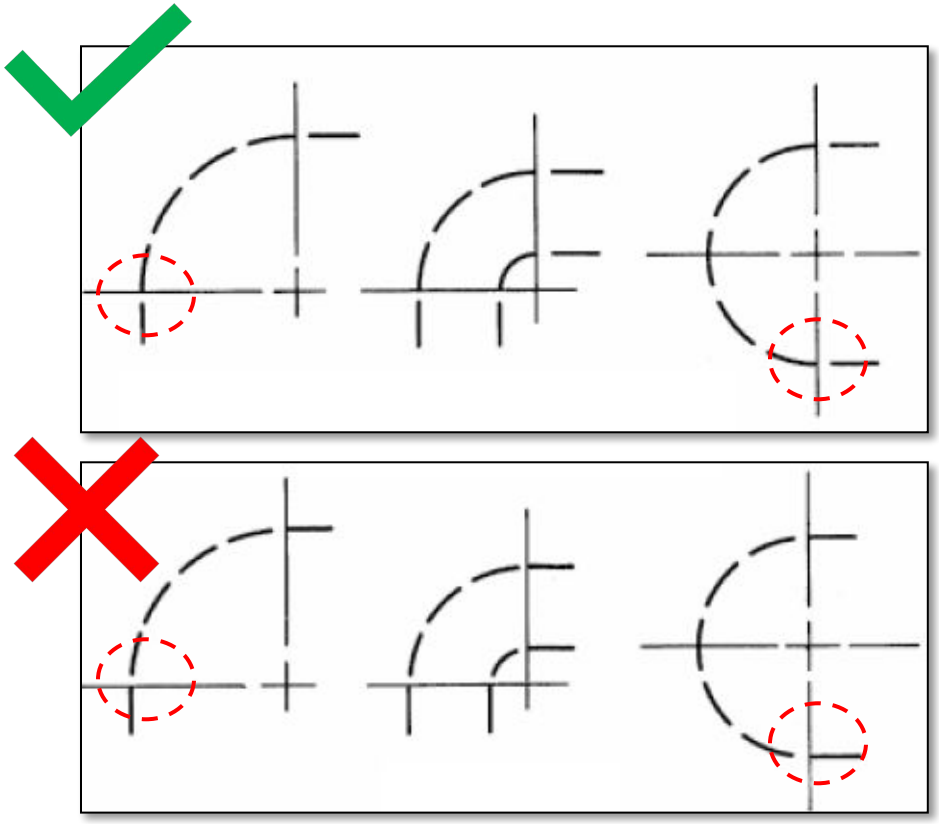
Hidden lines



Hidden line should join object line, except when it appears like an extension of the object line



Curved hidden lines should join center line

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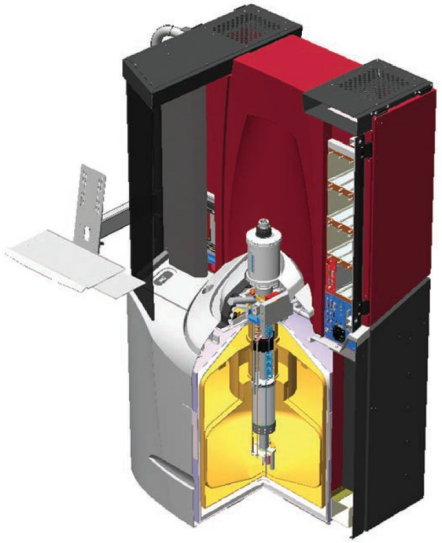
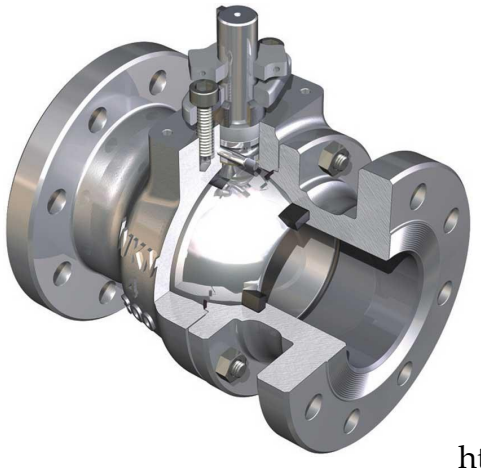
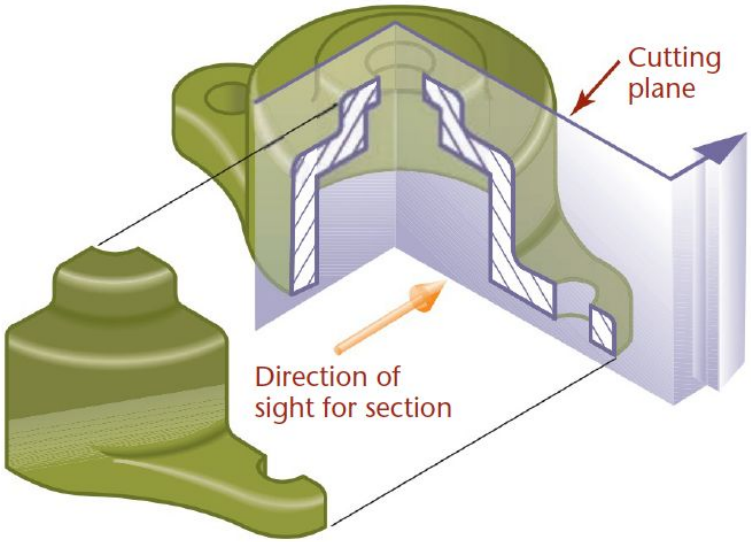
Sectioned views



Section views are used to

- Document the design and manufacture of one piece parts
- Document assembly of multiple parts
- Aid in visualizing the internal working of a design





https://chemicalengineeringworld.com/orbit-valves-introduction/
https://www.wermac.org/images_large/valve_ball.html

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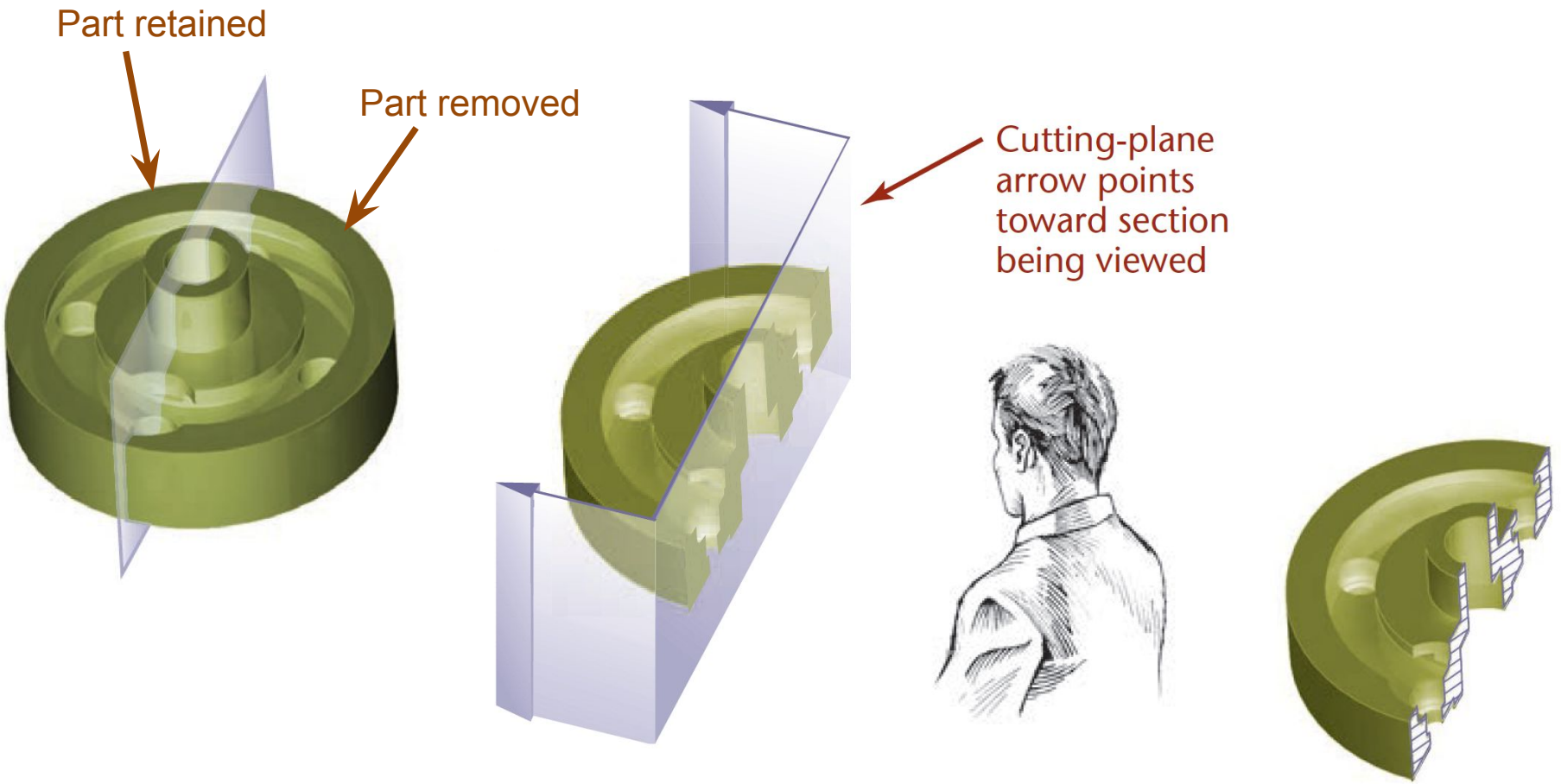
Sectioned views



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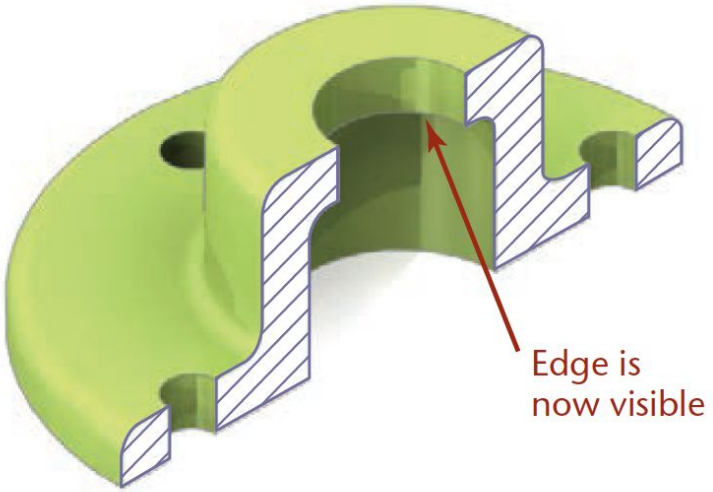
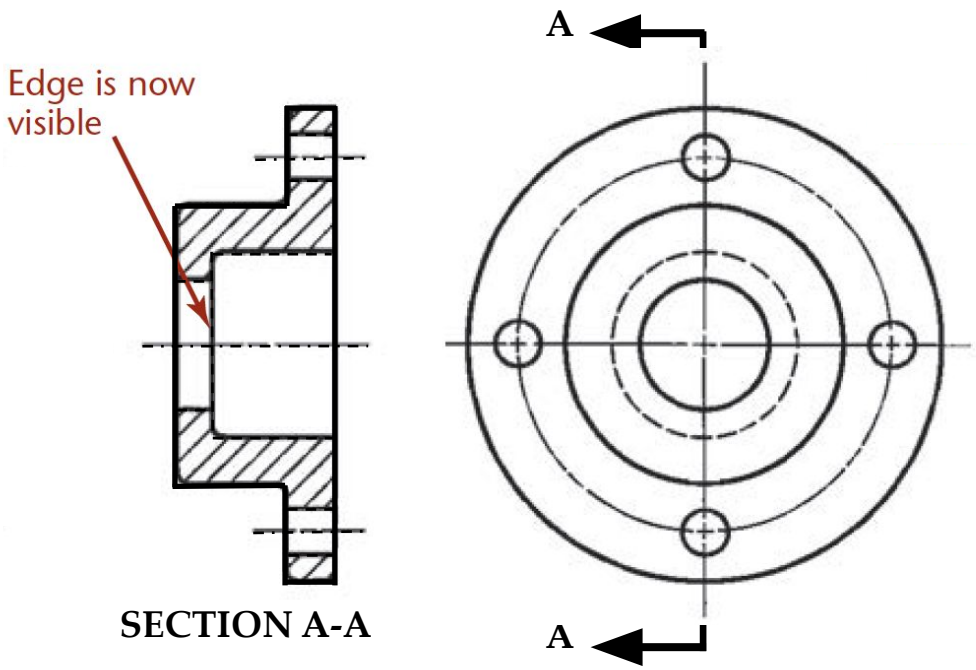
Sectioned views





- The arrows at the ends of the cutting-plane line indicate the direction of sight for the section view
- The arrows point toward the section being viewed

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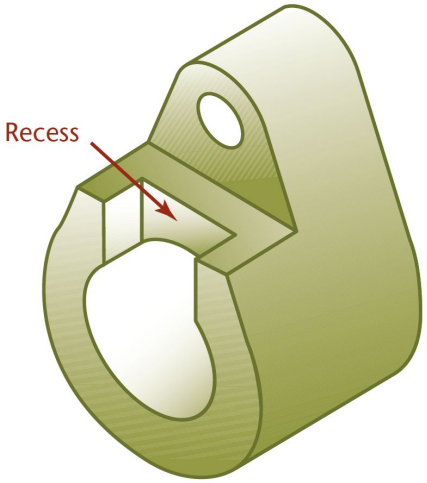
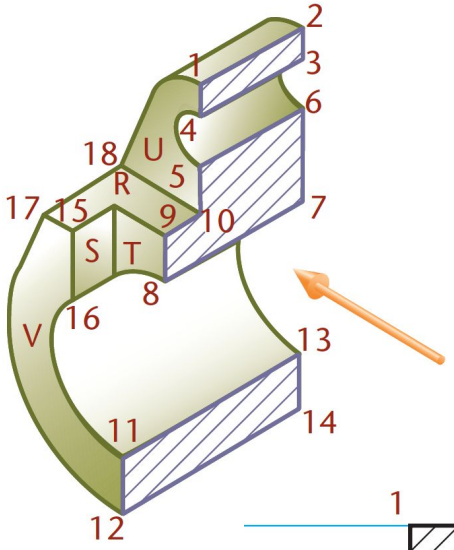
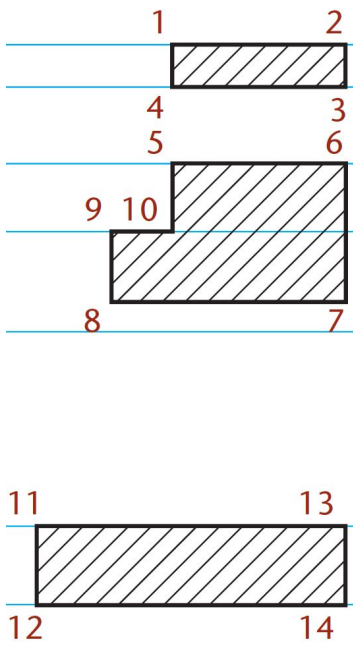
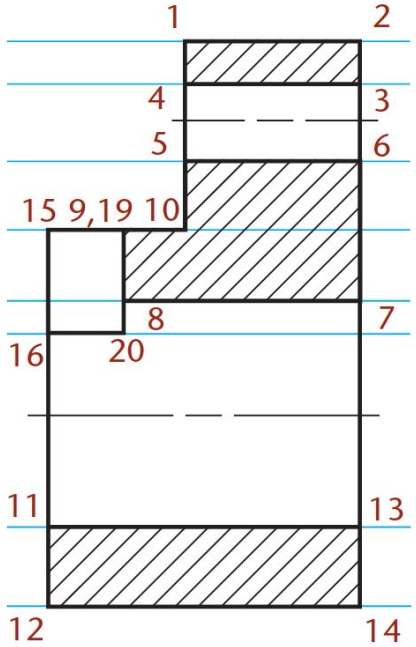
Sectioned views









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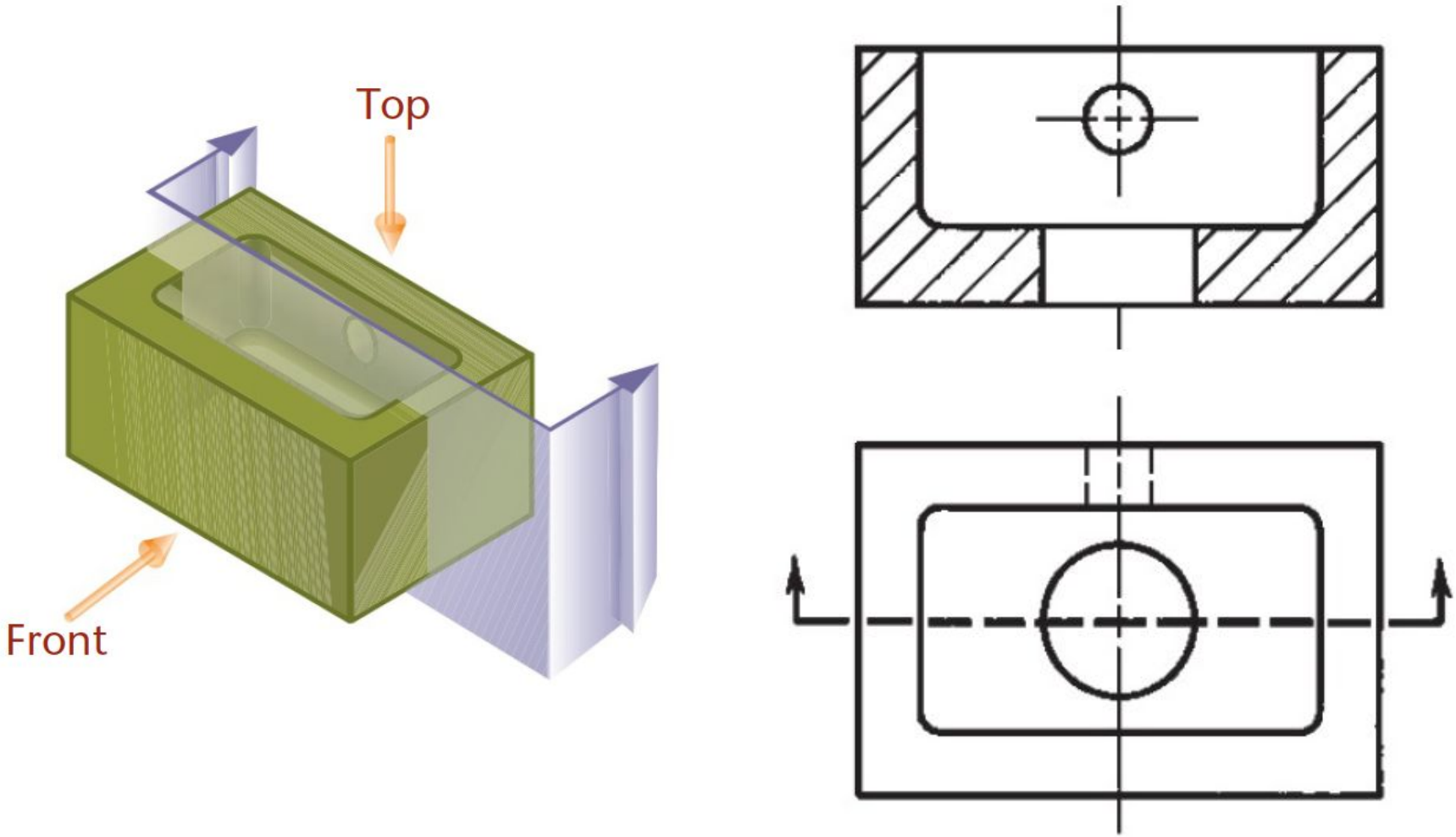
Sectioned views



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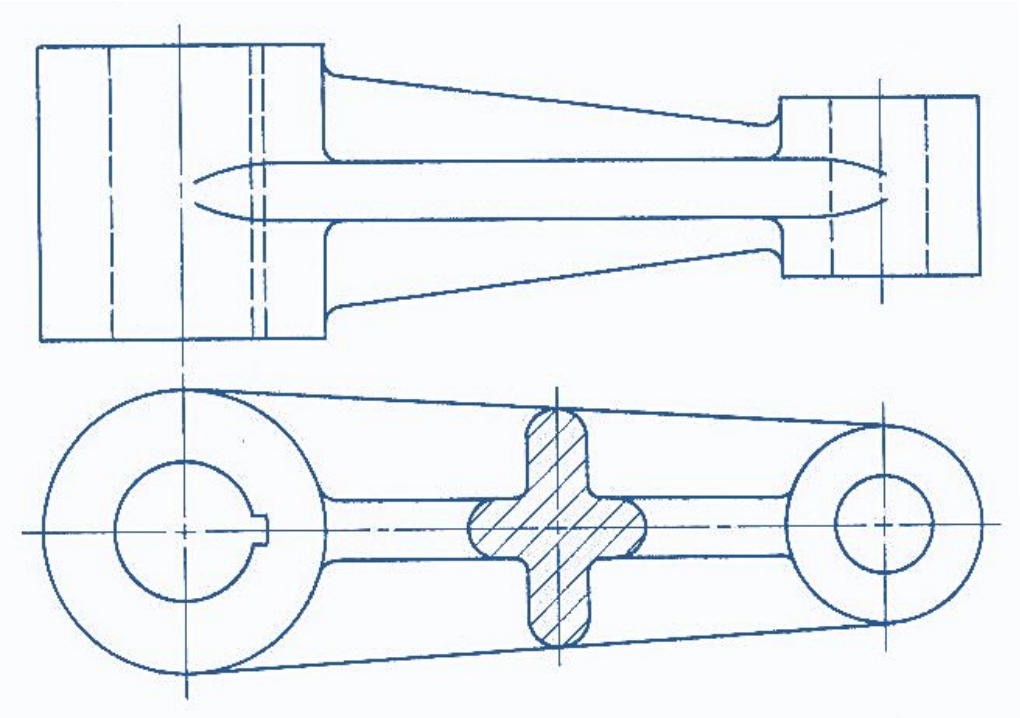
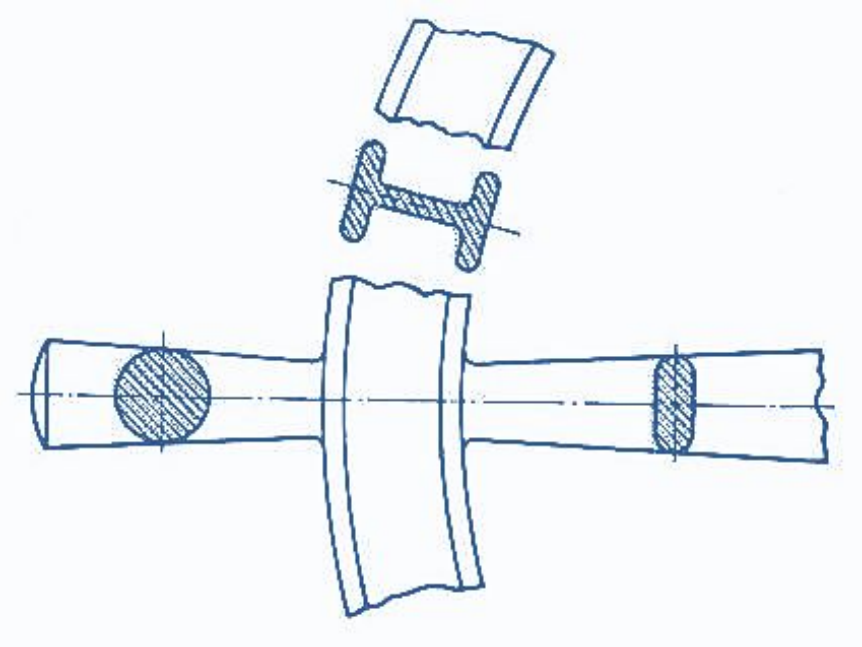
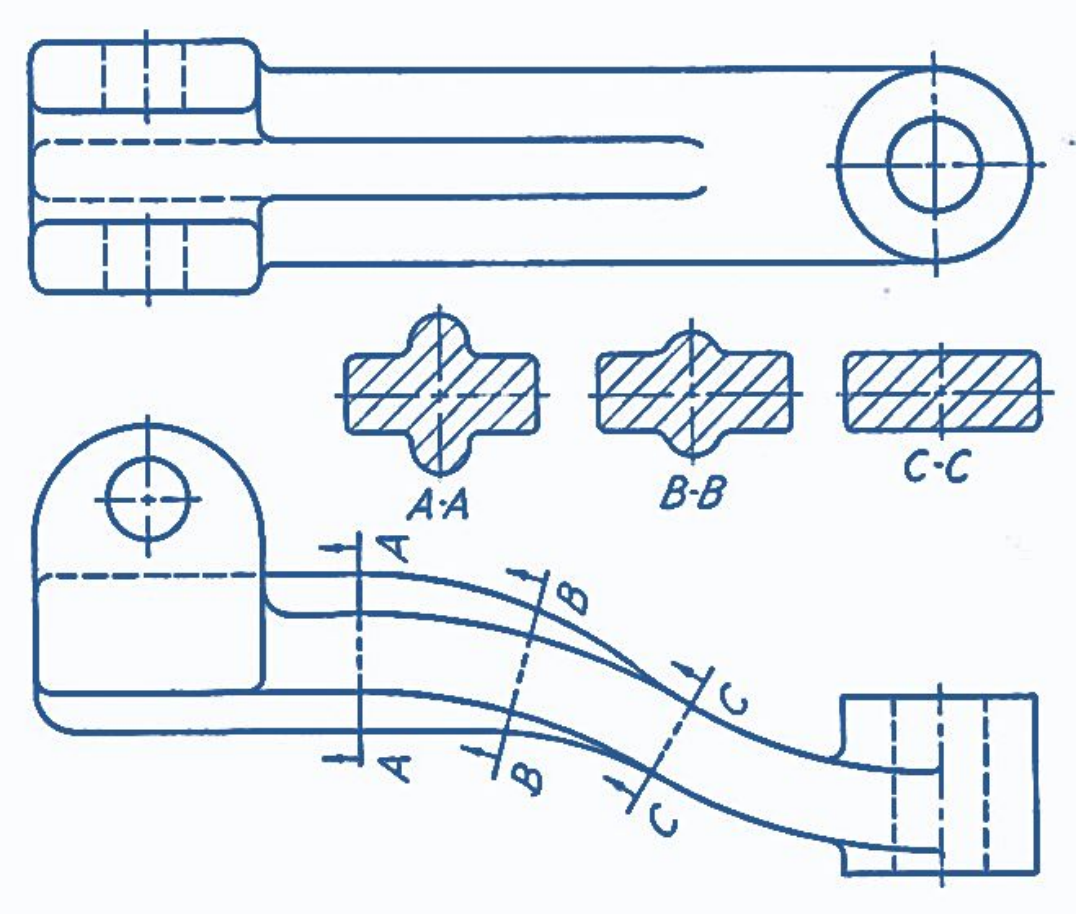
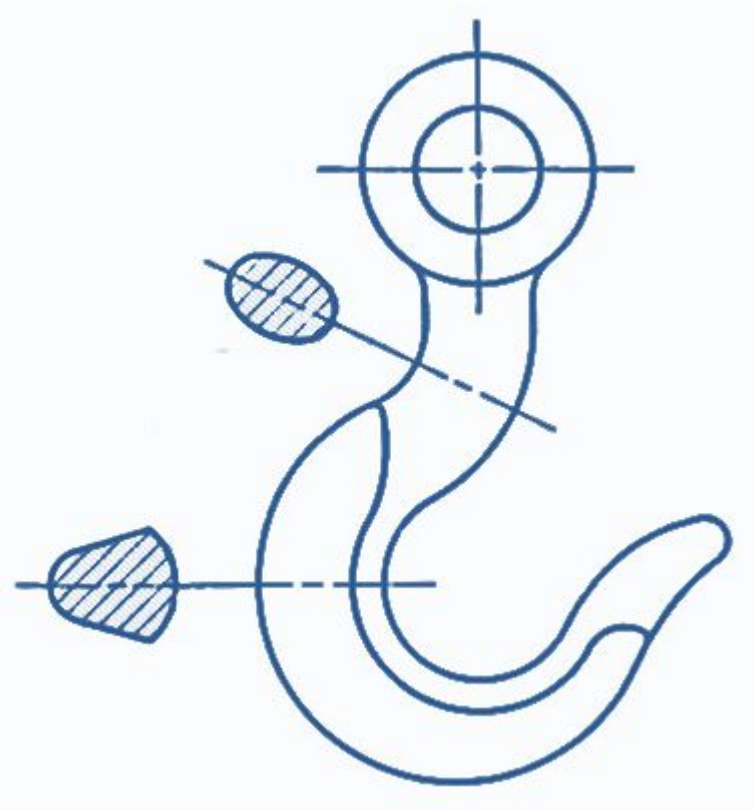
Rotated section



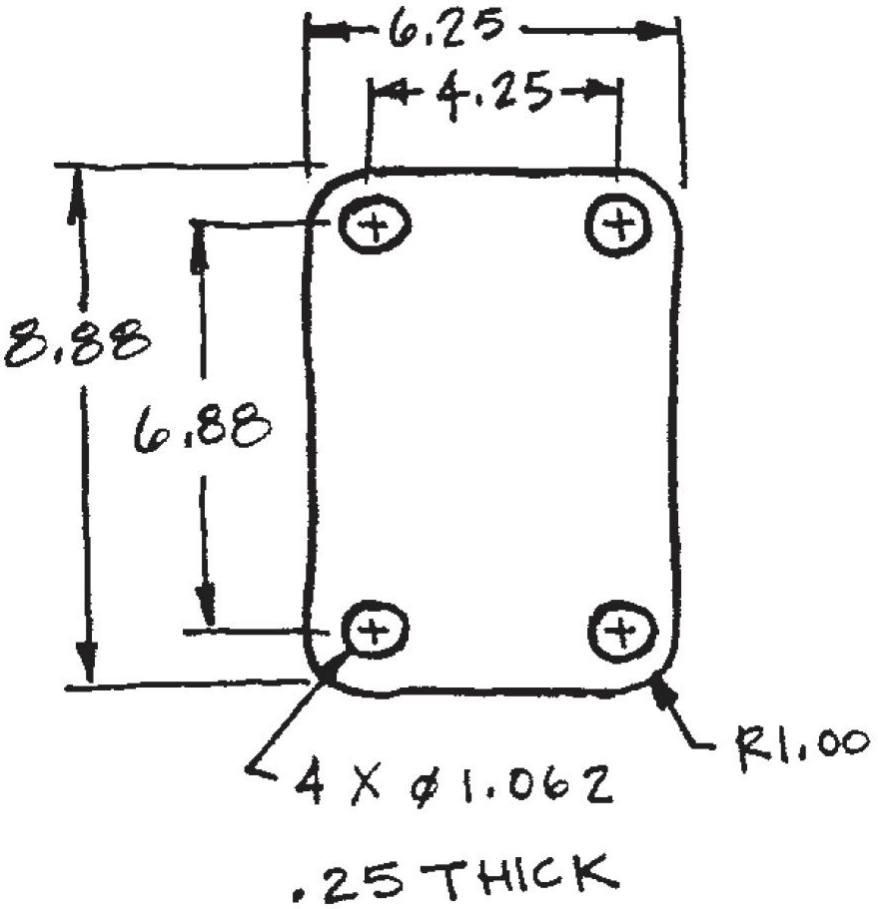


Removed Section

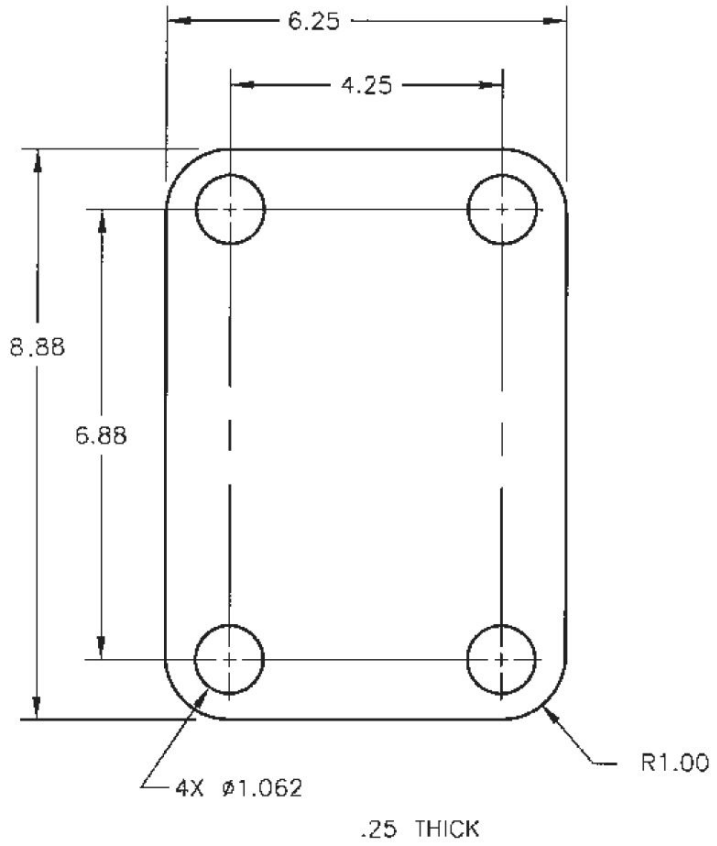




Free-hand sketching



Rough sketch



Engineering drawing

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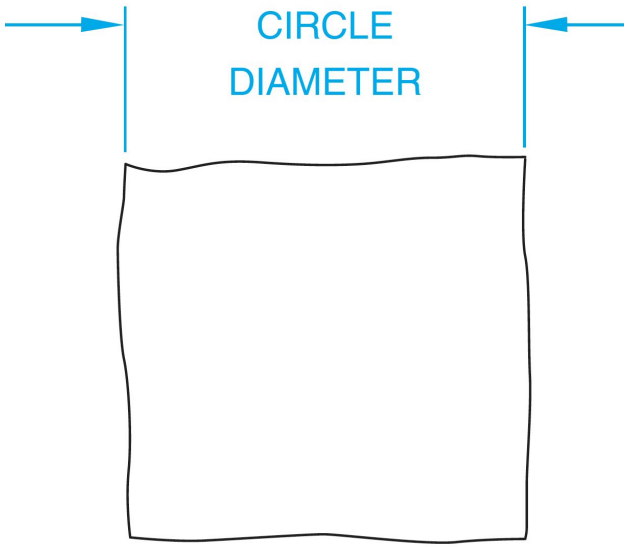
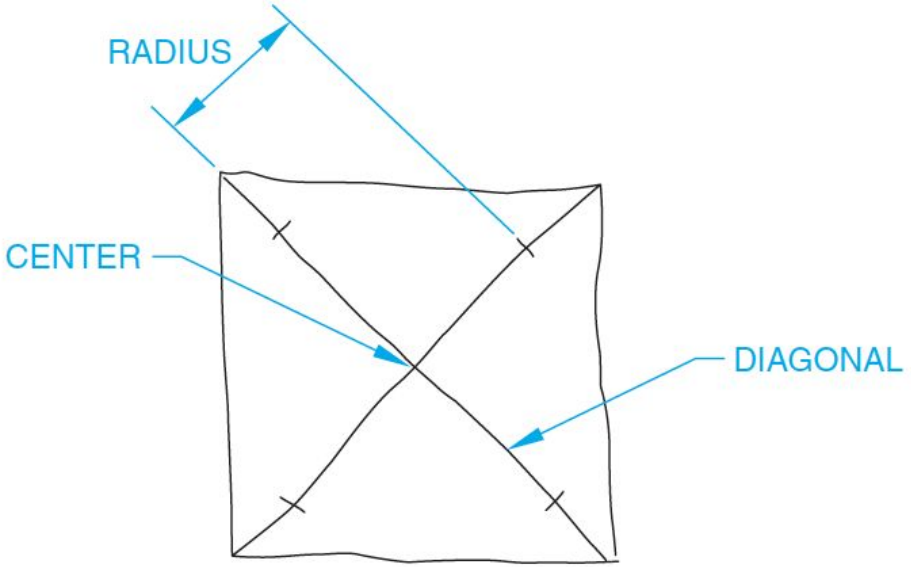
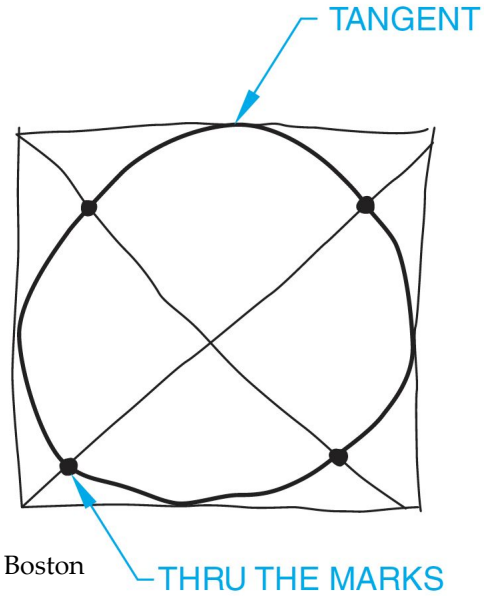
Free-hand sketching







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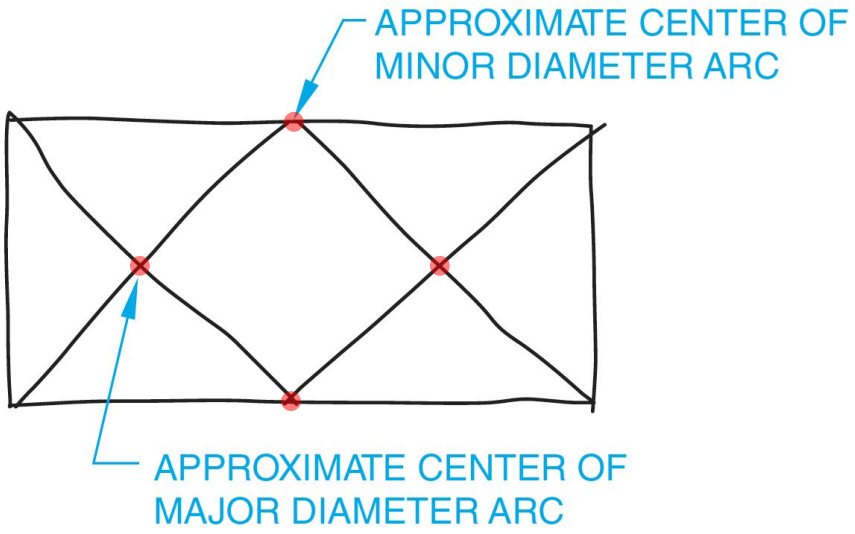
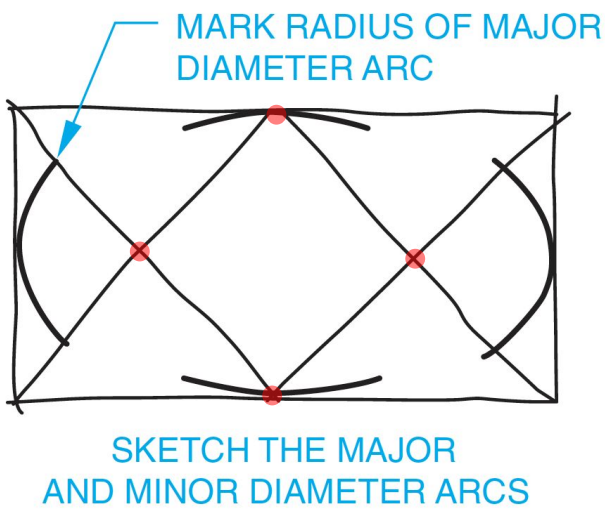
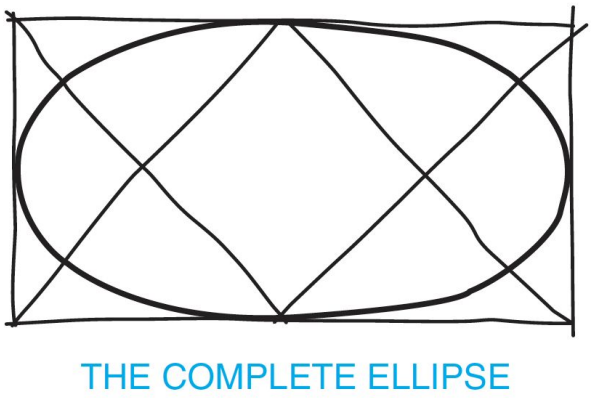
Free-hand sketching







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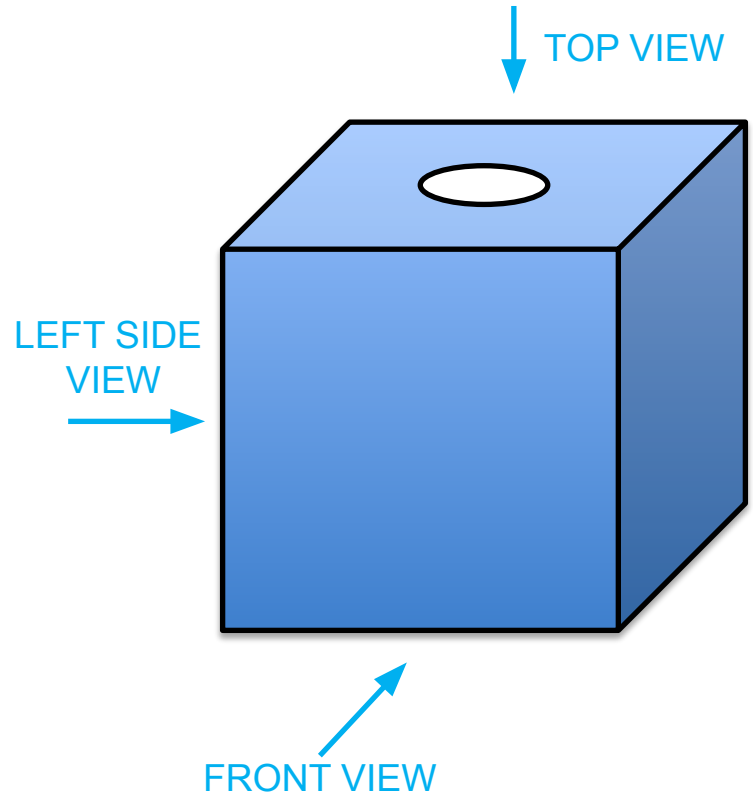
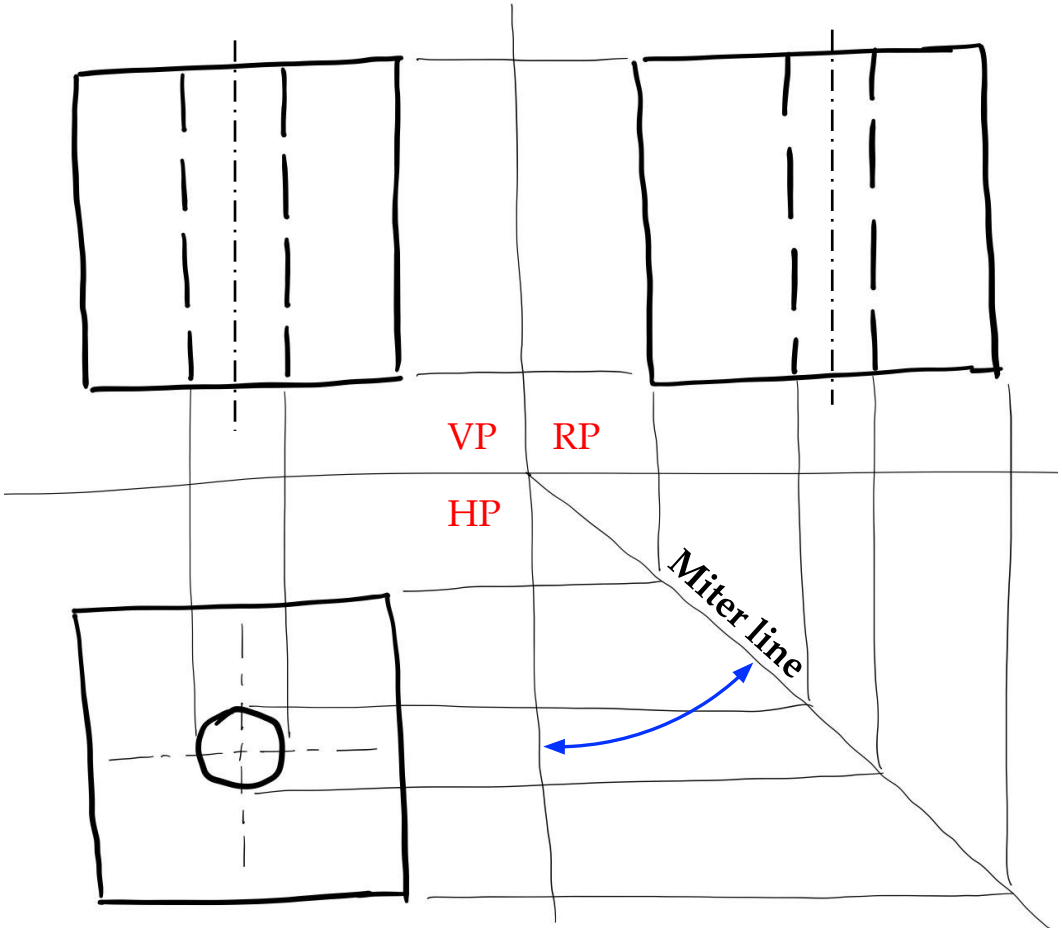
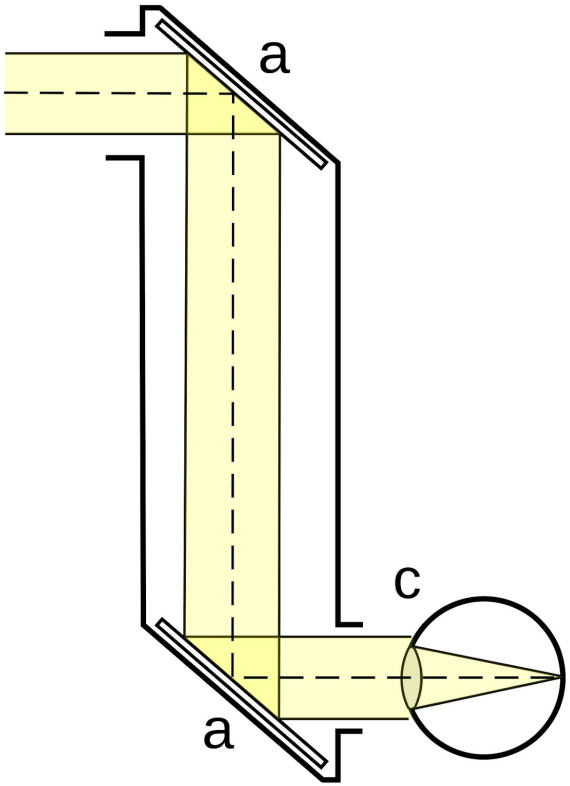
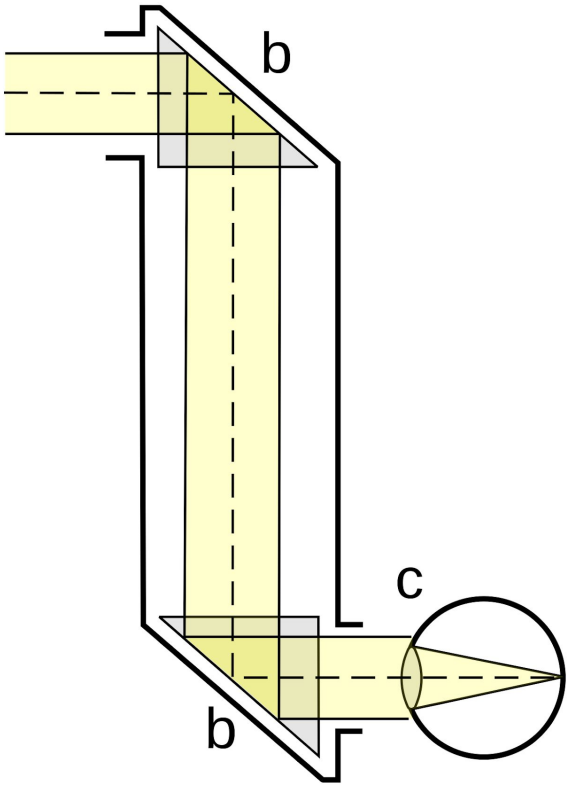
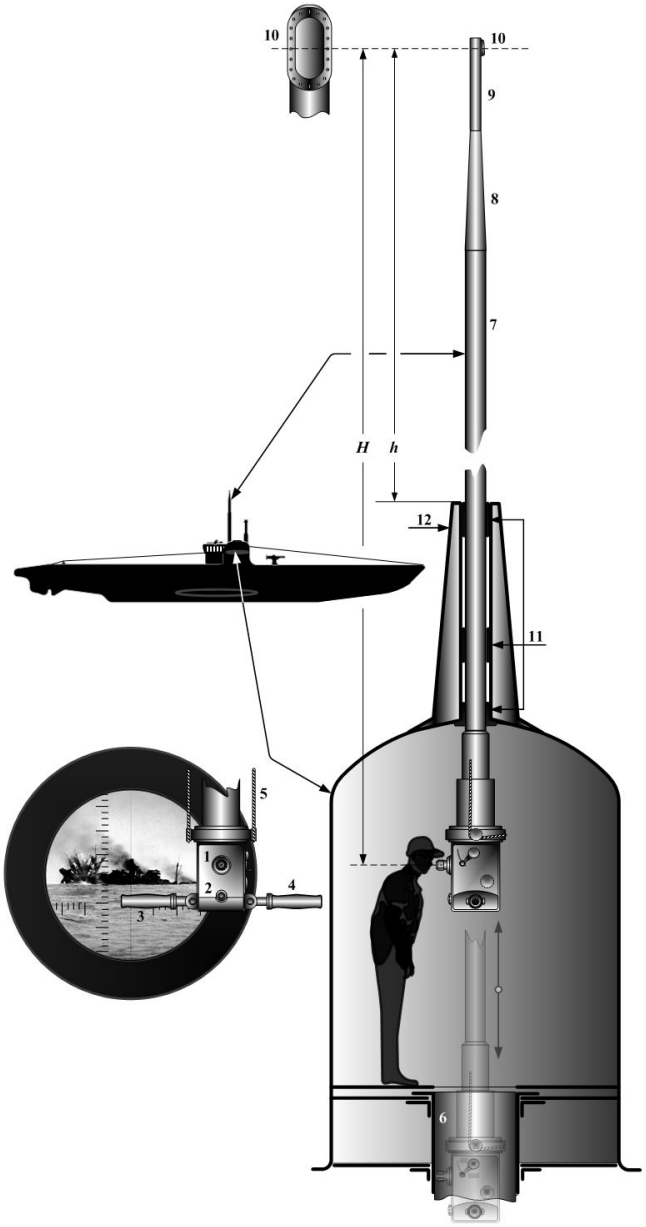


RP: Right profile plane

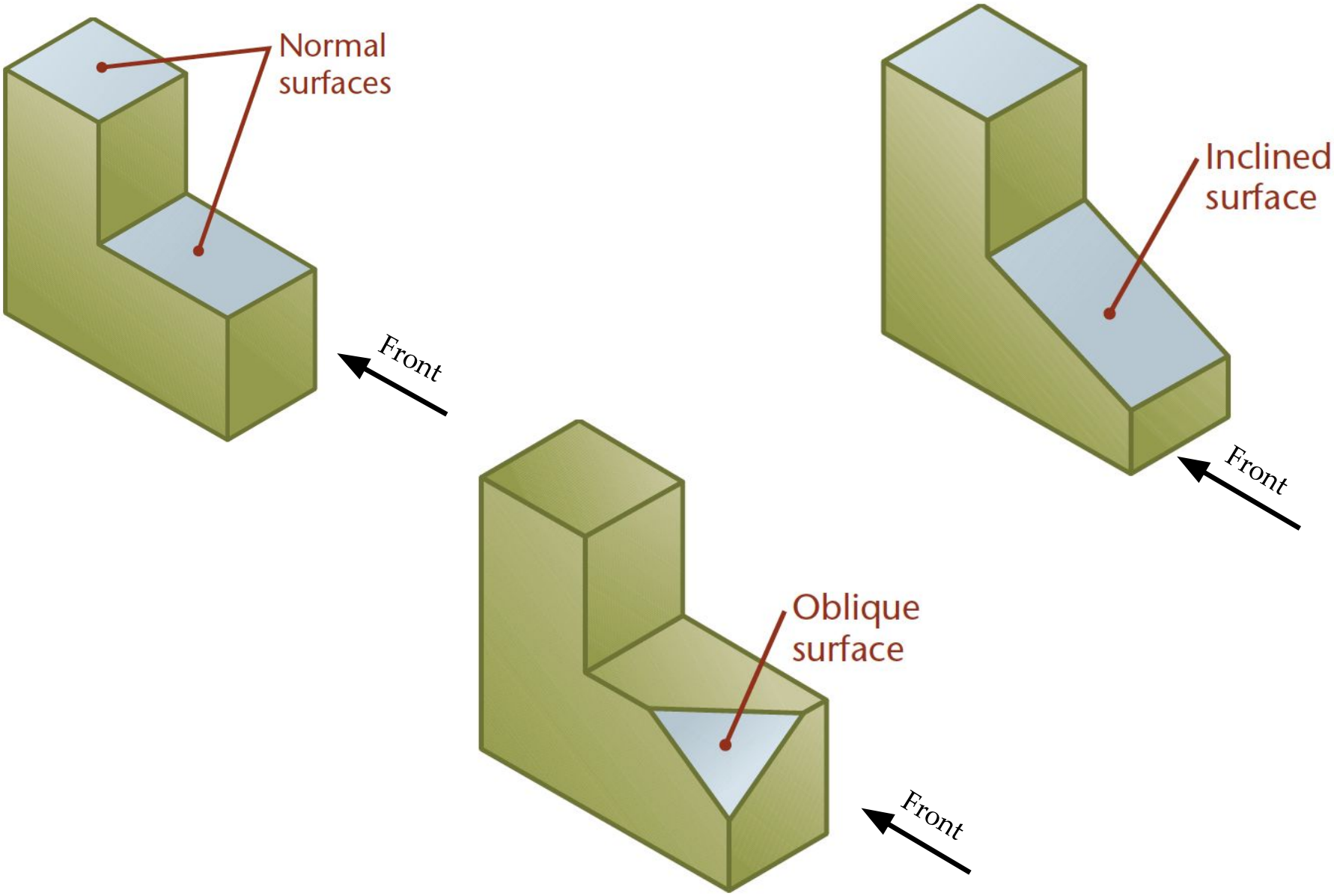








https://en.wikipedia.org/wiki/Periscope#/



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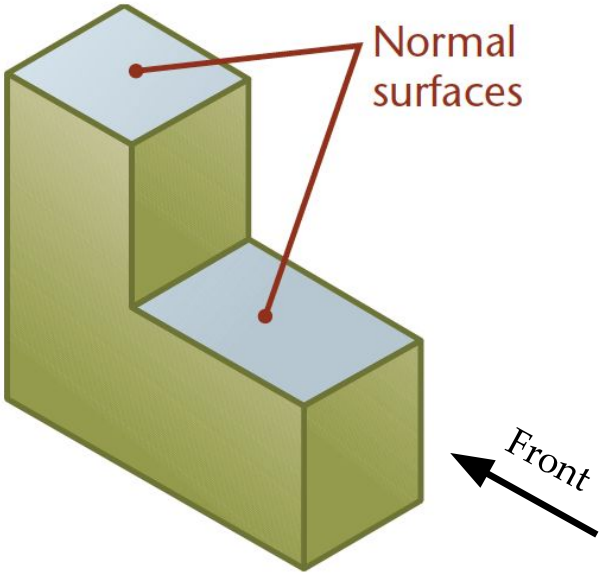

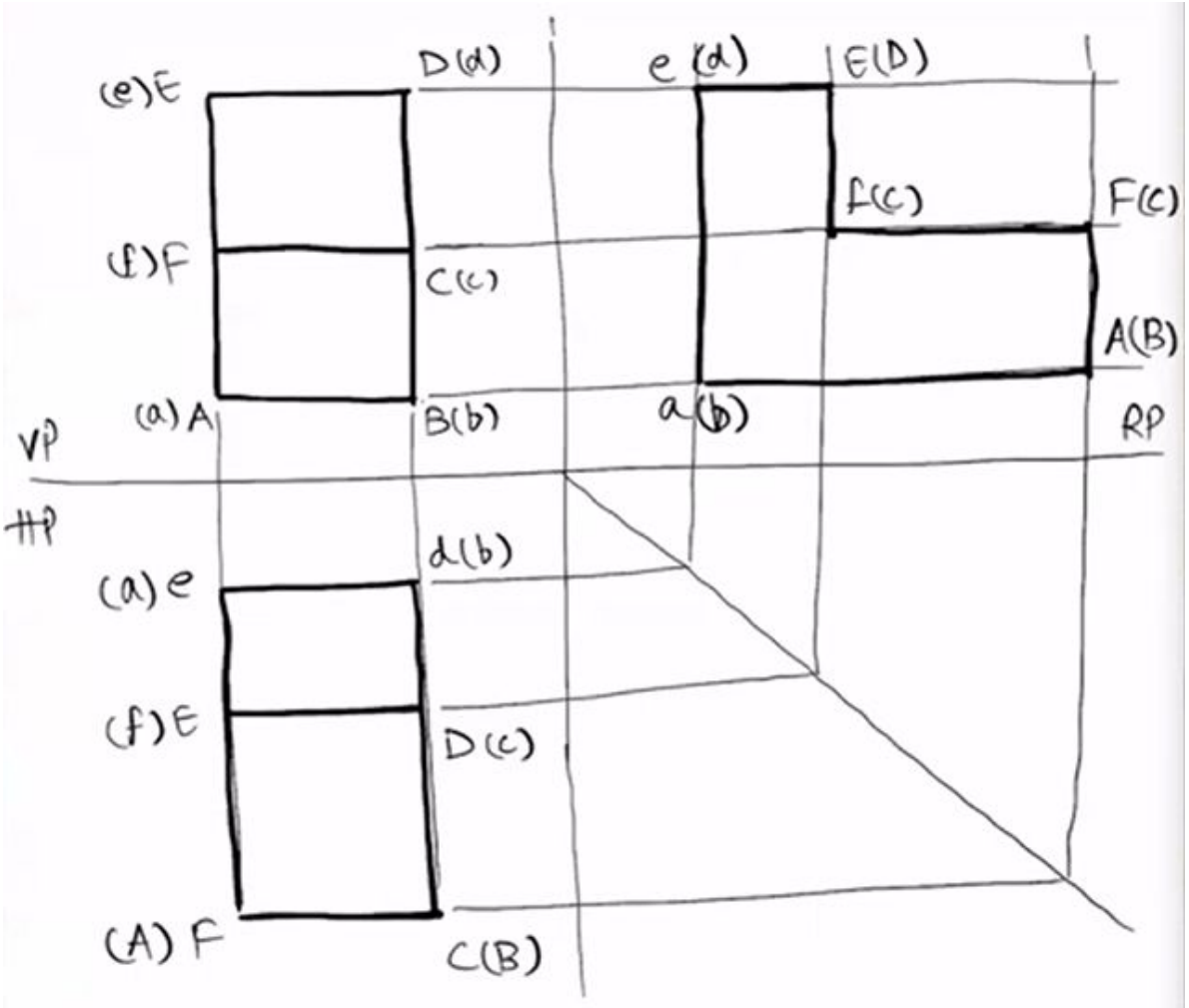

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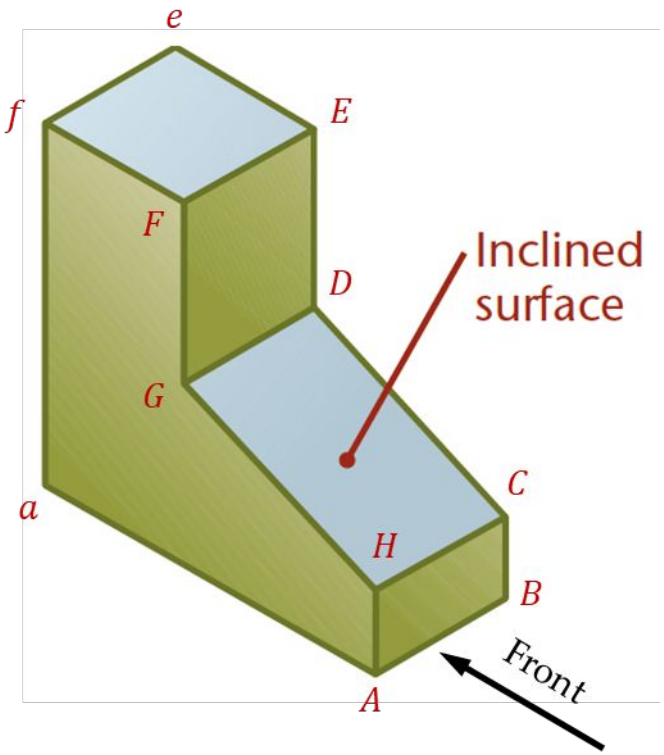

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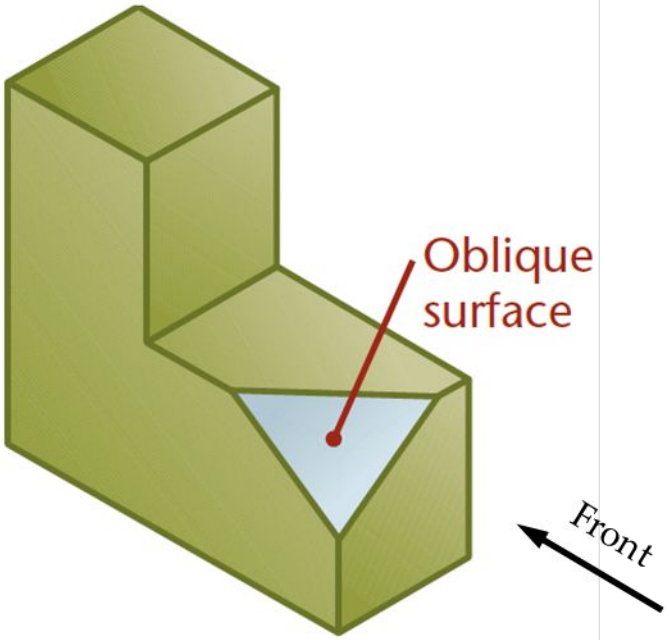

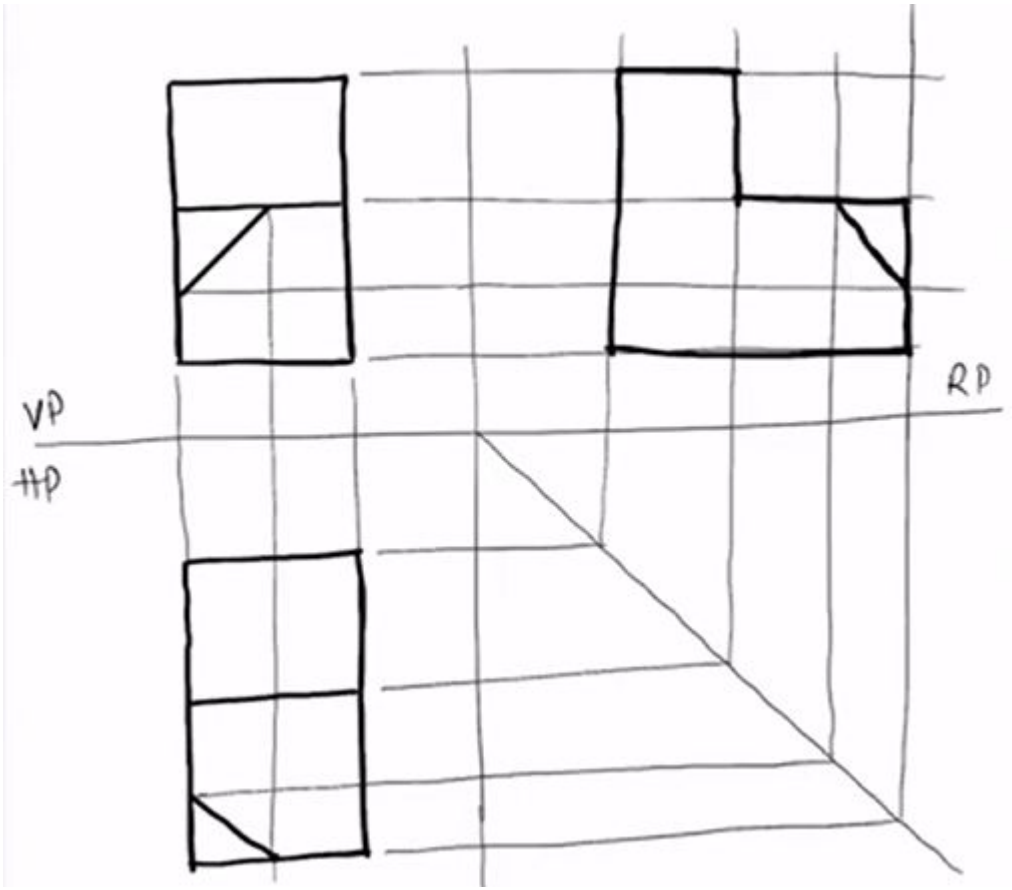

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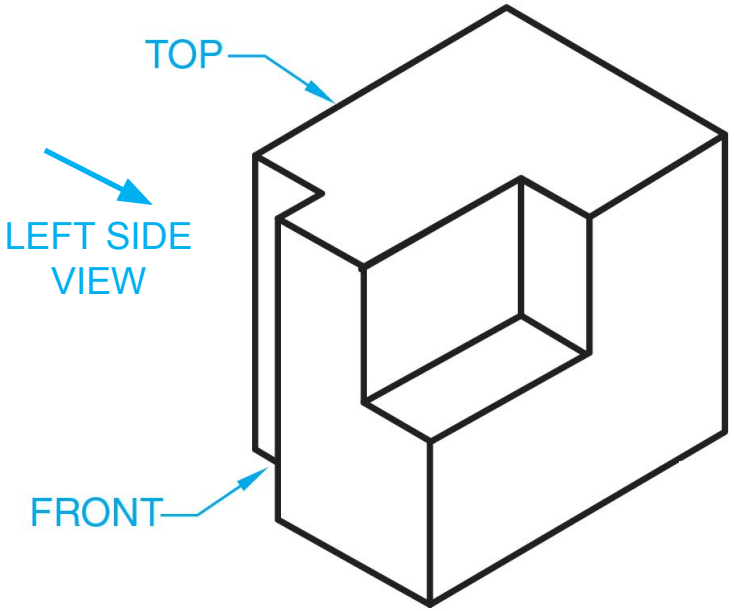
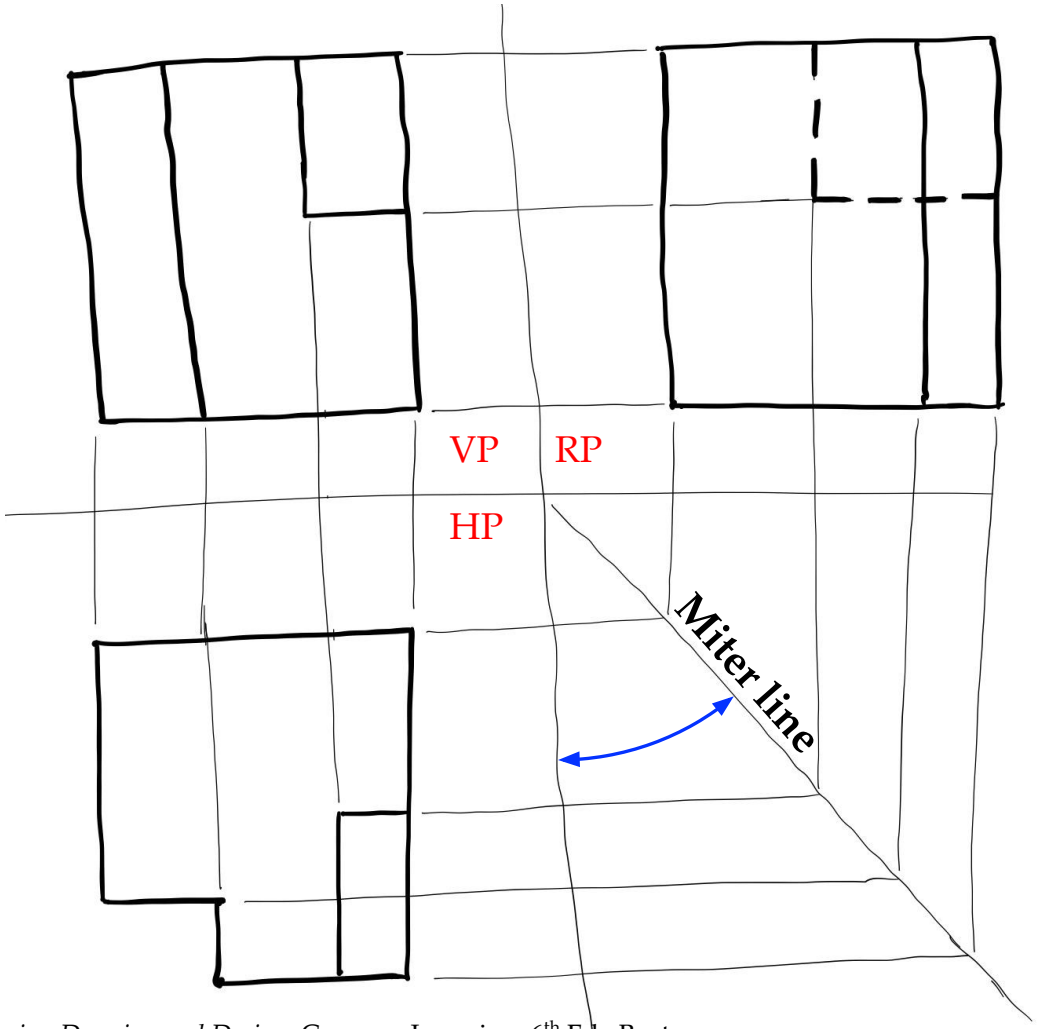


RP: Right profile plane



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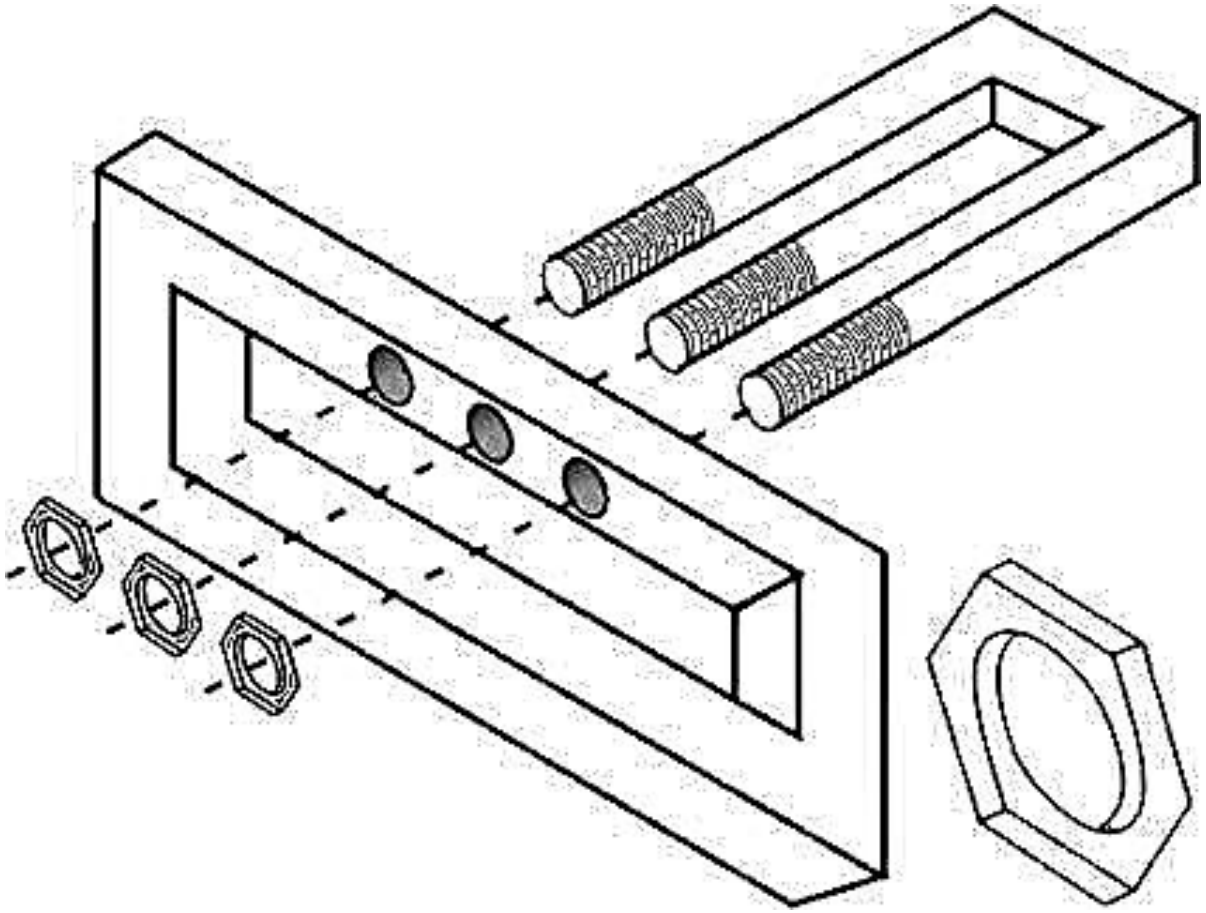

Thank you

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