Introduction to Engineering Drawing

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Text 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

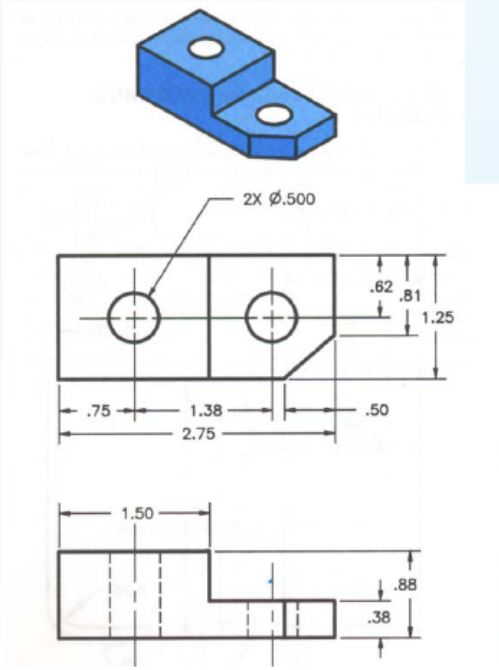
From slides by Bhuiyan Shameem Mahmood

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.

Definition

- An **engineering drawing** is a type of technical drawing used to fully and clearly define requirements for engineered items (from en.wikipedia.org)
  - a formal and precise way (**graphic language**) for communicating information about the shape and size of physical objects.
  - a mean for specifying the precision of physical objects.



Important as it is a legal document, i.e., if the drawings are wrong, it is the fault of the engineers!

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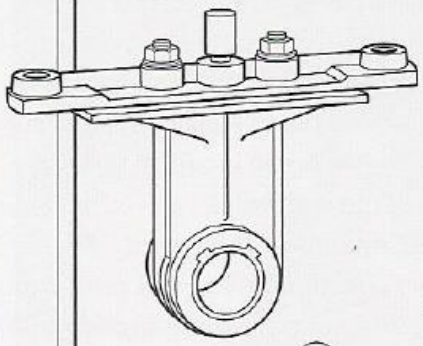
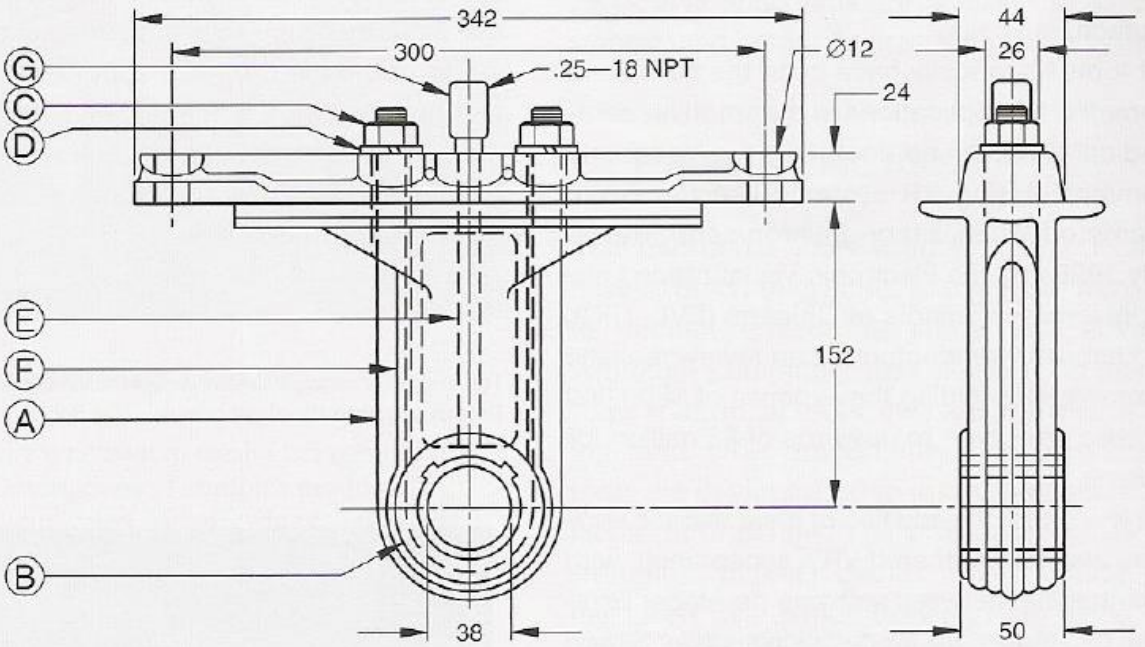


GROUP	QUANTITY	PART NUMBER: DRAWING NO.	PART NUMBER: PIECE OF GROUP	NAME OF PART	MATERIAL	SYMBOL
A	1	126257	20	U - BOLT	✓	A
	1	2 3Y104	K	FRAME	BABBITED	B
	2			HEX NUT	✓	C
	2			LOCK WASHER	✓	D
	1			PIPE NIPPLE	✓	E
	1	1041Y33		FRAME		F
	1			PIPE COUPLING	✓	G



R	W	R	L	R	N	R	C

DIMENSION TOLERANCES EXCEPT AS SPECIFIED

TITLE No. 198 HANGAR ASSEMBLY

R	J			◇		BRONZE CAP NOTE ADDED	E.F.C.
R	D			◇		PART No. 263Y112-C ADDED	R.C.
R	T			◇		GROUP B, NOTES & DIMENSIONS FOR GROUP C, REMOVED - FRAME WAS 1041 Y 33 - B FOR GROUP C ONLY	C.W.
I	M			◇			
O	R			REV	DATE	DESCRIPTION OF REVISION	

DRAWING | CHECKED | APPROVED | FORM | REFERENCE

DATE

SCALE

LINK - BELT COMPANY

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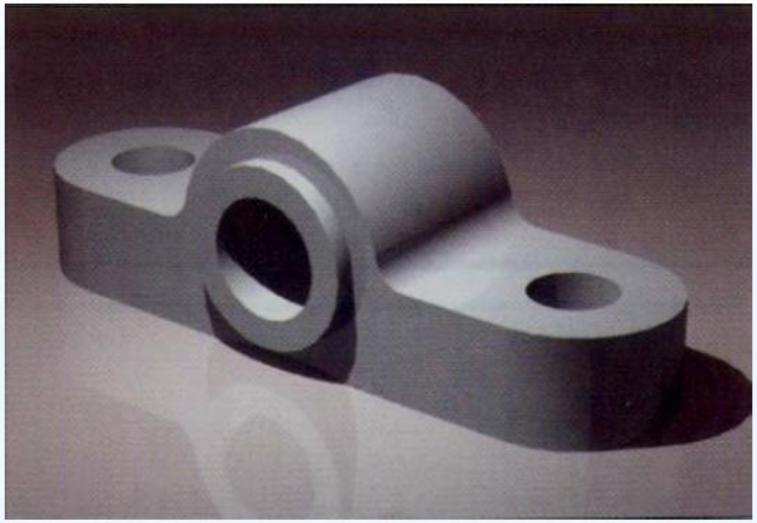
Effectiveness of Engineering Drawing

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 inadequate for describing the ***size***, ***shape*** and ***features*** completely as well as concisely.

Graphic Language

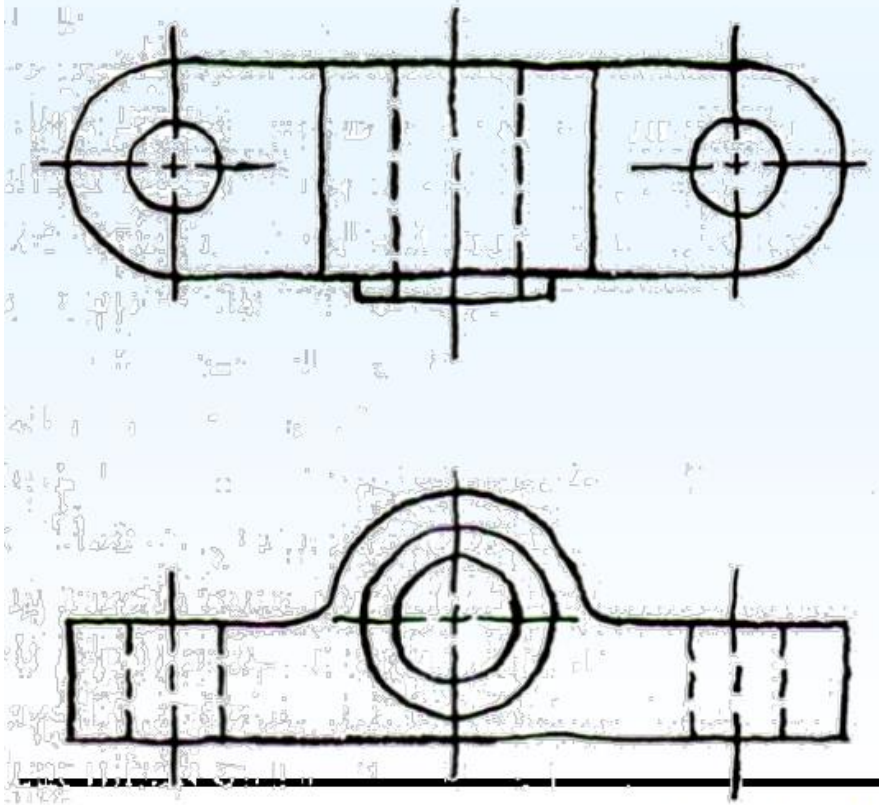
Graphic language in **"engineering applications"** uses ***lines*** to represent the ***surfaces***, ***edges*** and ***contours*** of objects.

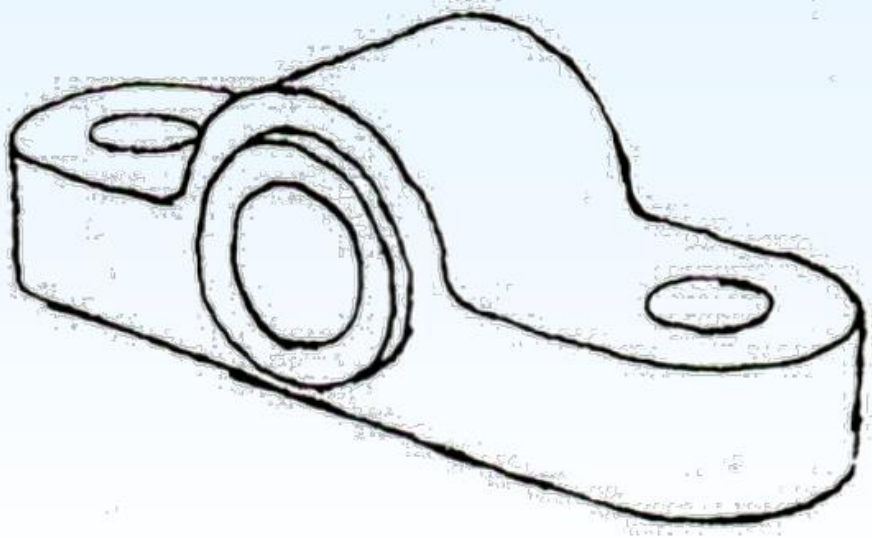
- The language is known as "***drawing***" or "***drafting***".
- A drawing can be done using ***freehand***, ***instruments*** or ***computer*** methods.

Freehand drawing

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

Example

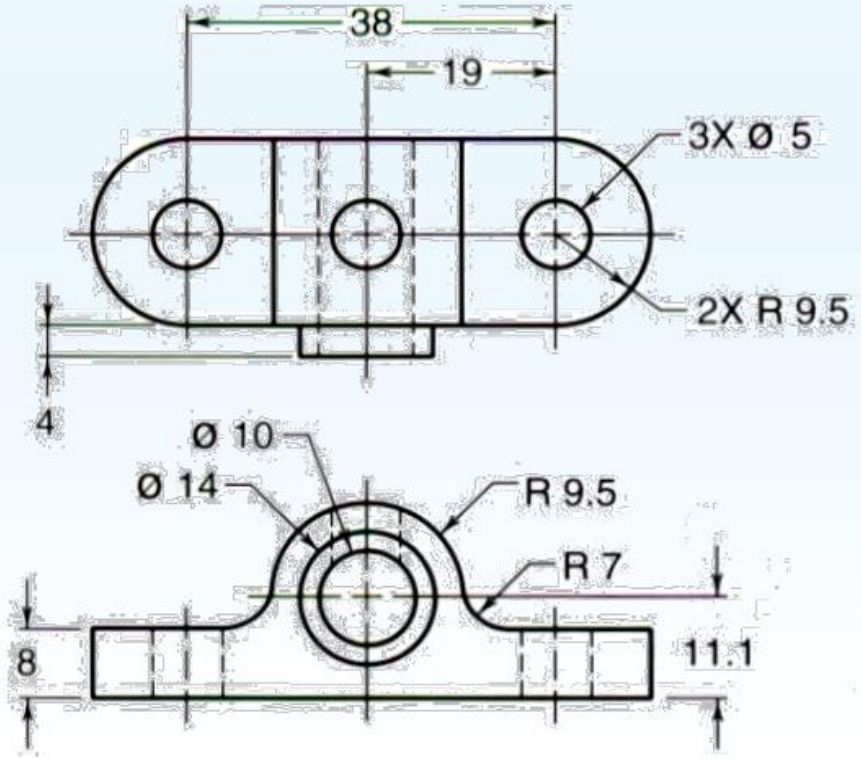




Instrument drawing

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

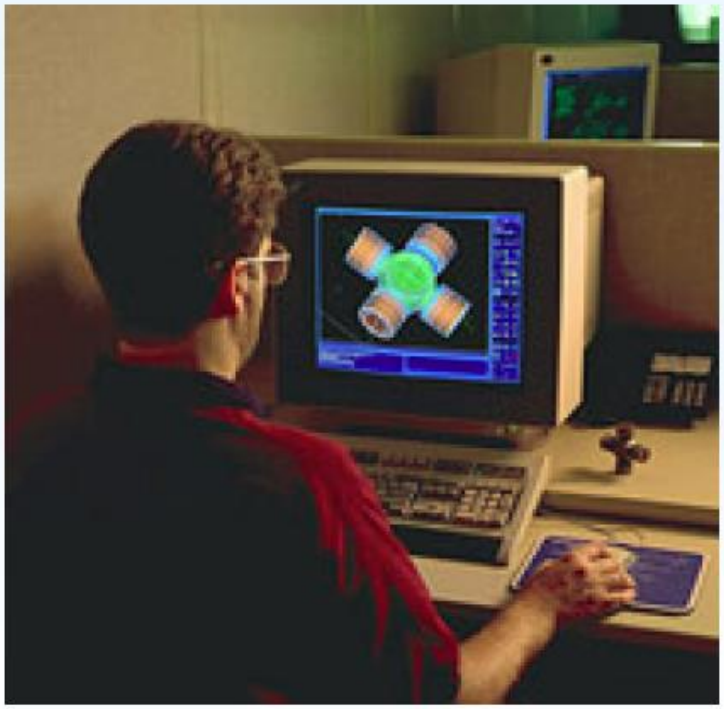
Example

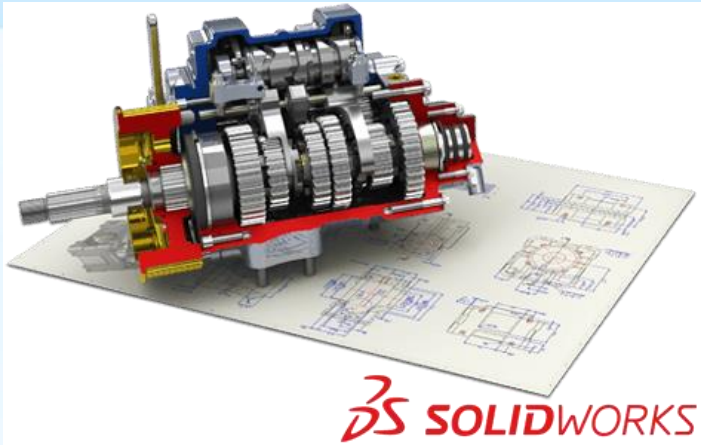


Computer drawing

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

Example





Elements of Engineering Drawing

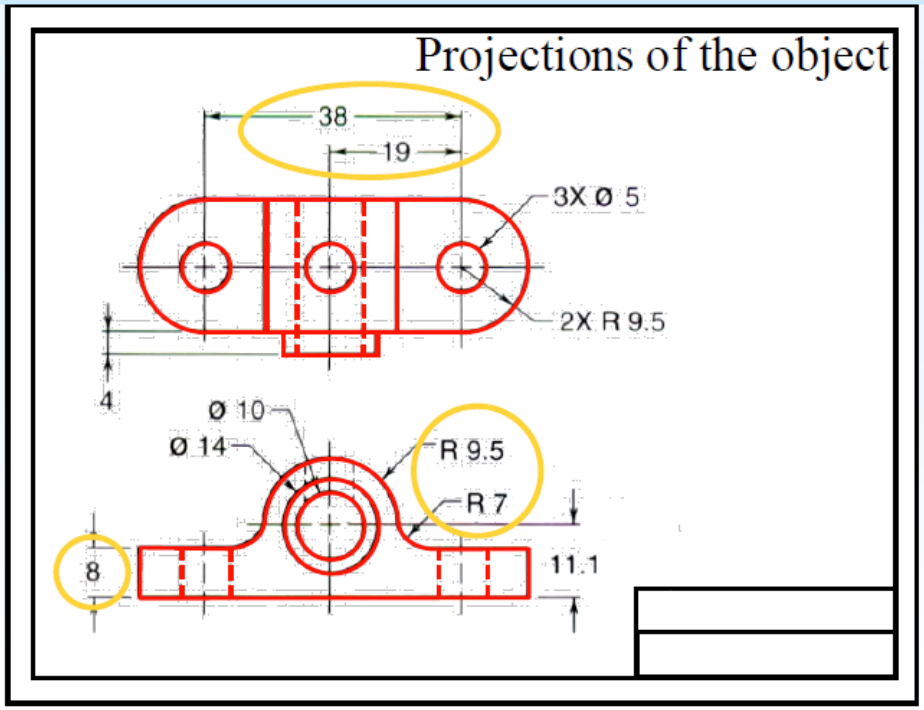
Engineering drawing is made up of ***graphics language*** and ***word language***.

Graphics language

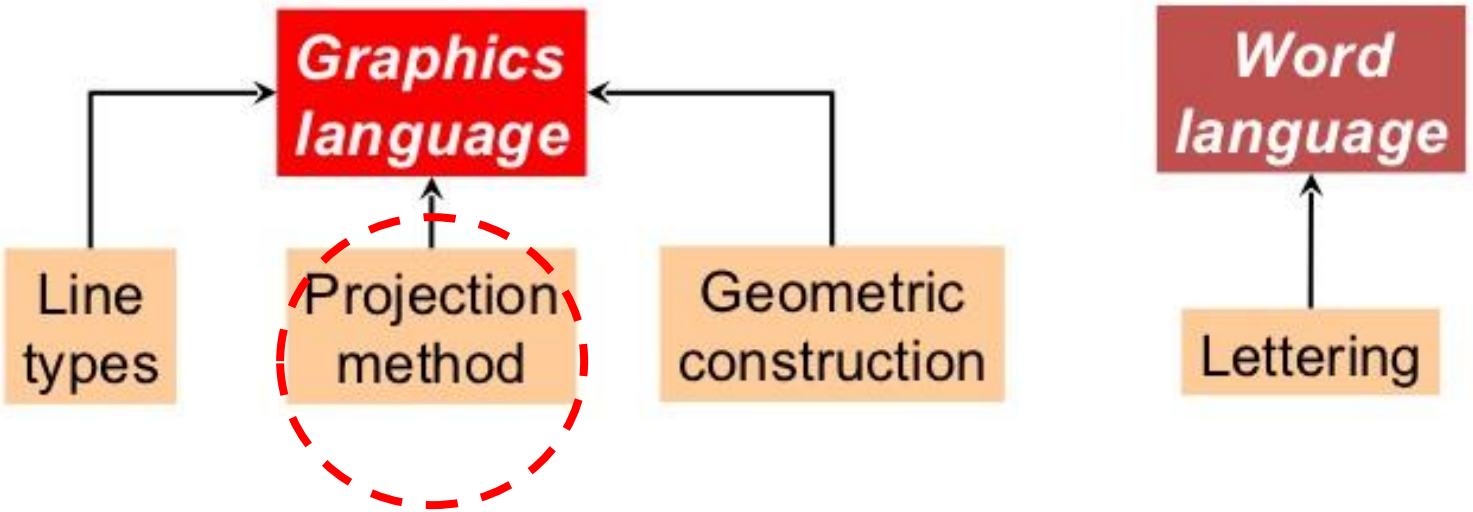
Describe a shape (mainly by projected views).

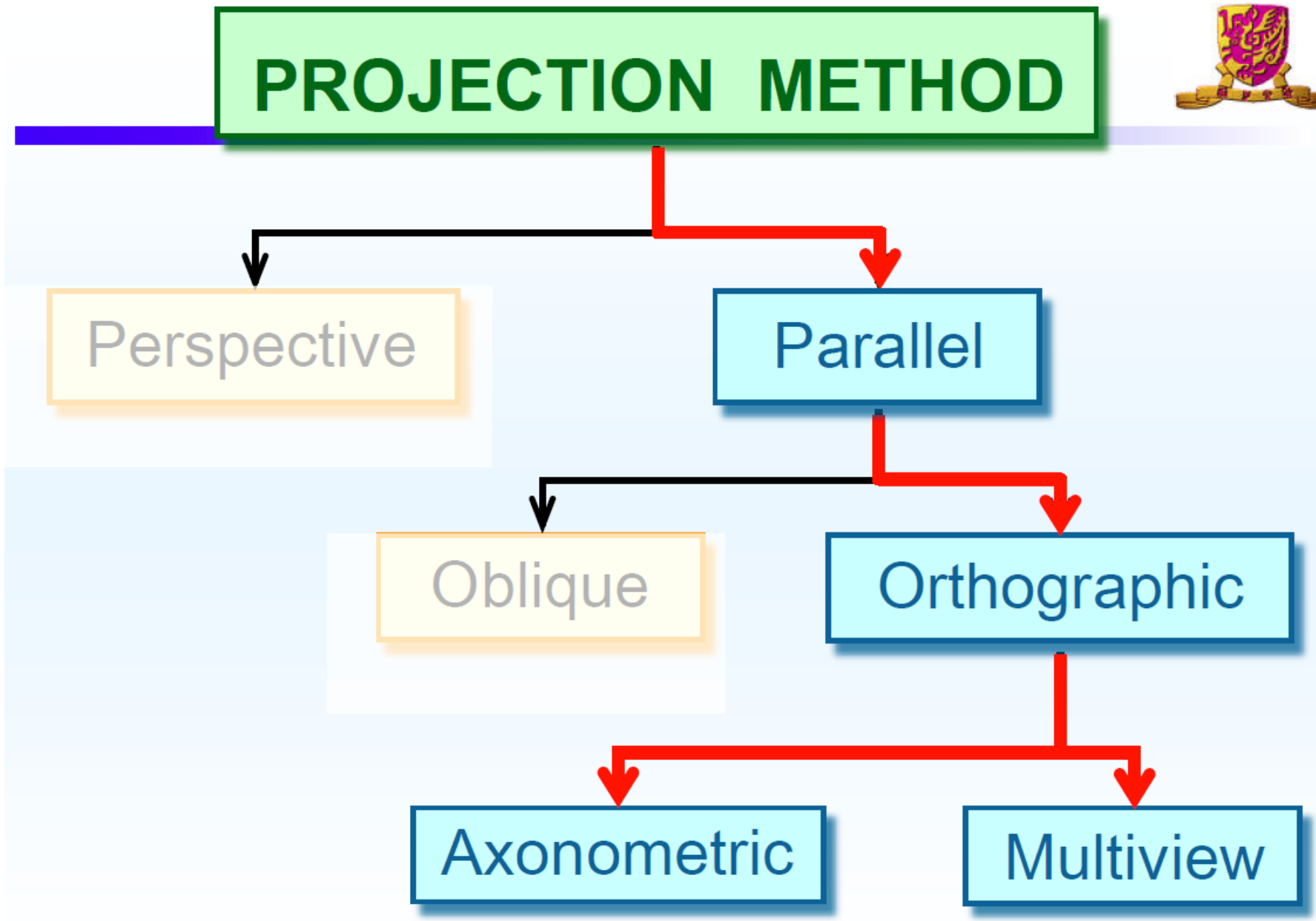
Word language

Describe size, location and specification of the object.



Basic Knowledge for Drafting




PROJECTION METHOD
Perspective
Parallel
Oblique
Orthographic
Axonometric
Multiview
(Isometric)

Projection Theory

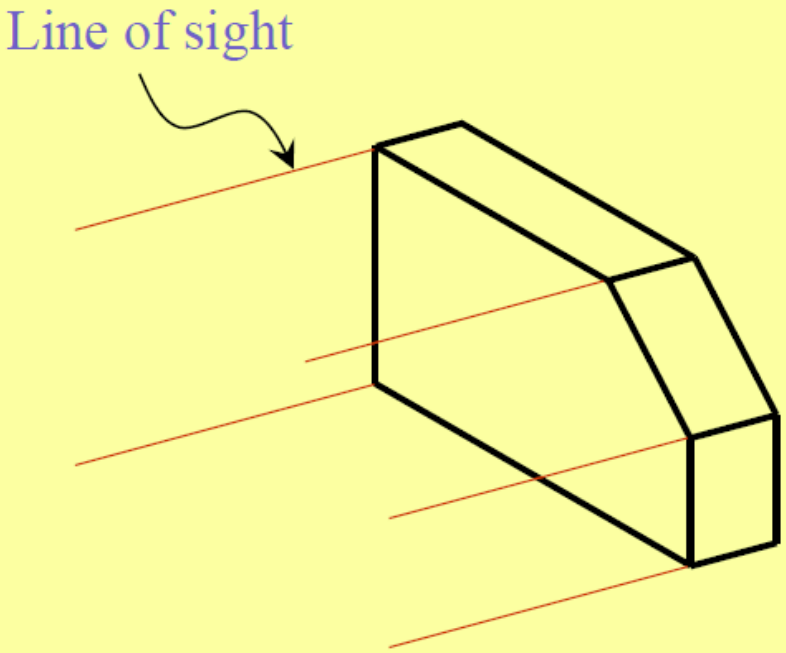
- The projection theory is used to graphically represent 3-D objects on 2-D media (paper, computer screen).

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

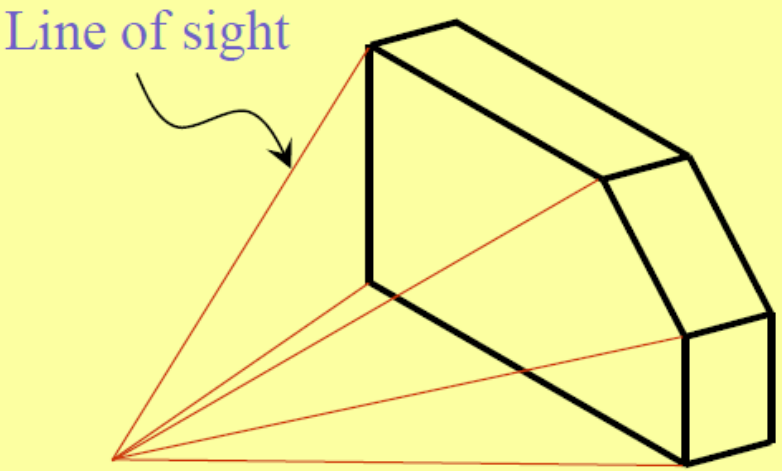
Line of sight is an imaginary ray of light between an observer's eye and an object.

- There are 2 types of LOS : parallel and converge

Parallel projection



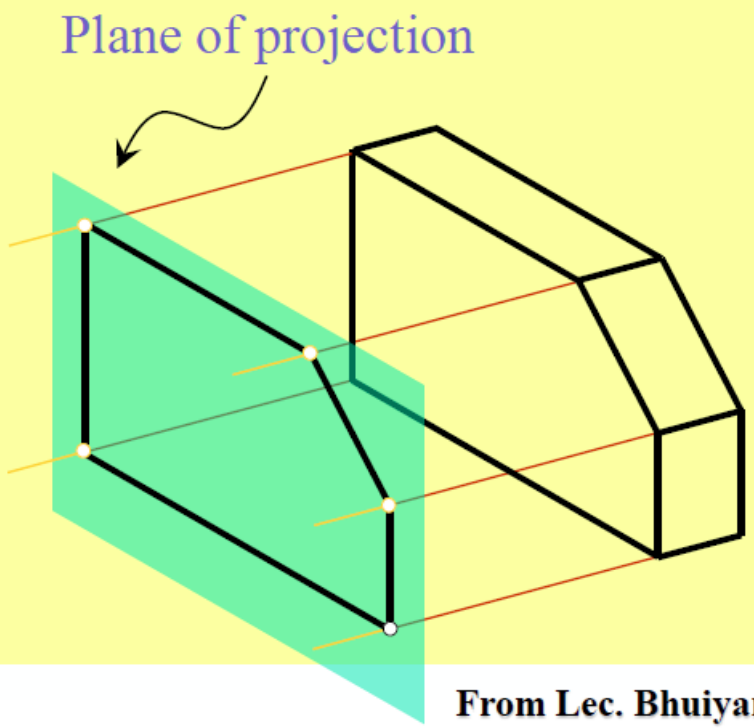
Perspective projection



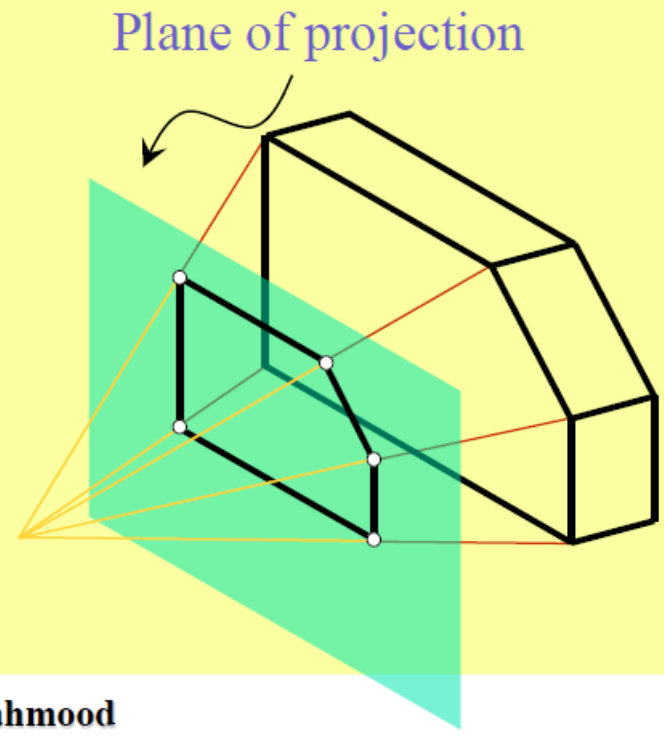
Plane of projection is an imaginary flat plane which the image is created.

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

Parallel projection



Perspective projection

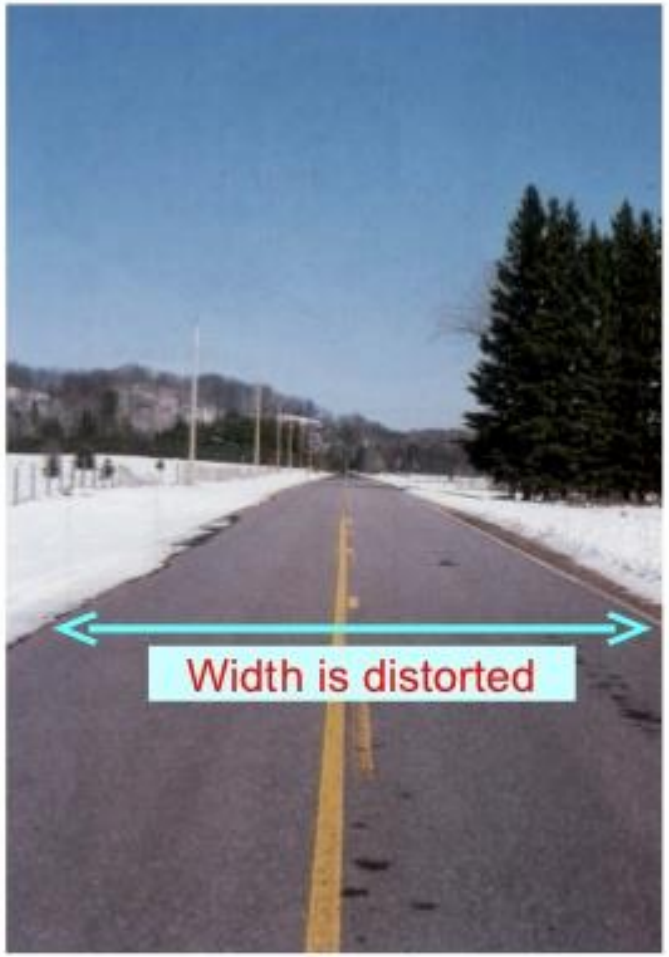


From Lec. Bhuiyan Shameem Mahmood

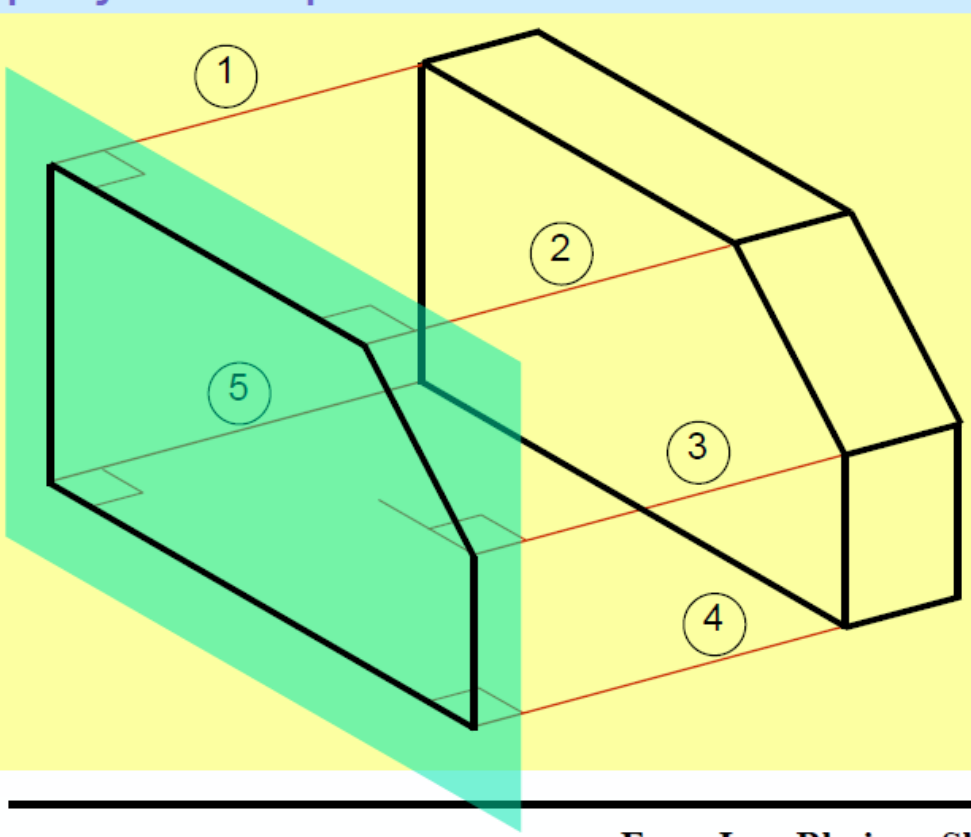
Disadvantage of Perspective Projection

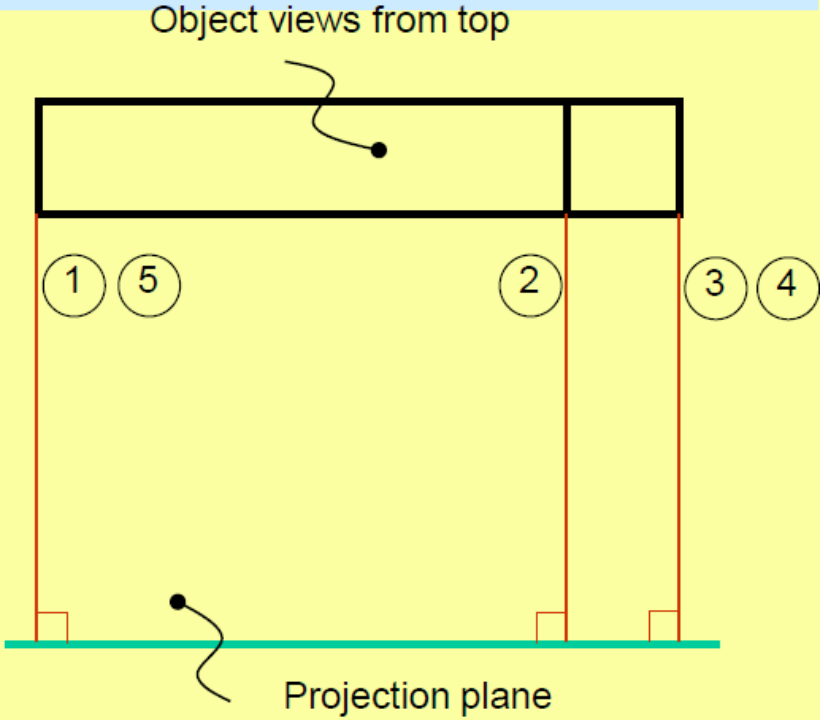
- Perspective projection is ***not*** used by engineer for manu-facturing of parts, because

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



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





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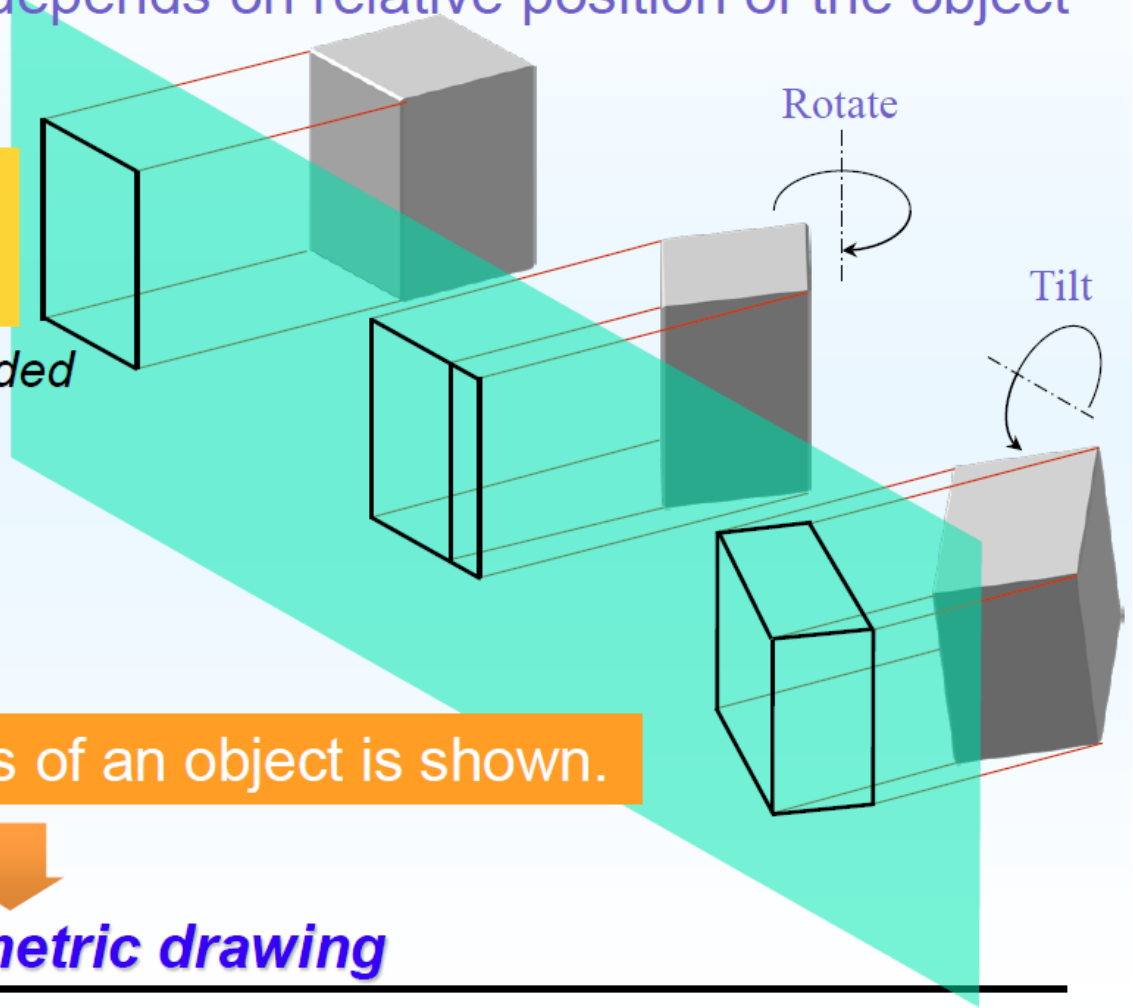
Orthographic View

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

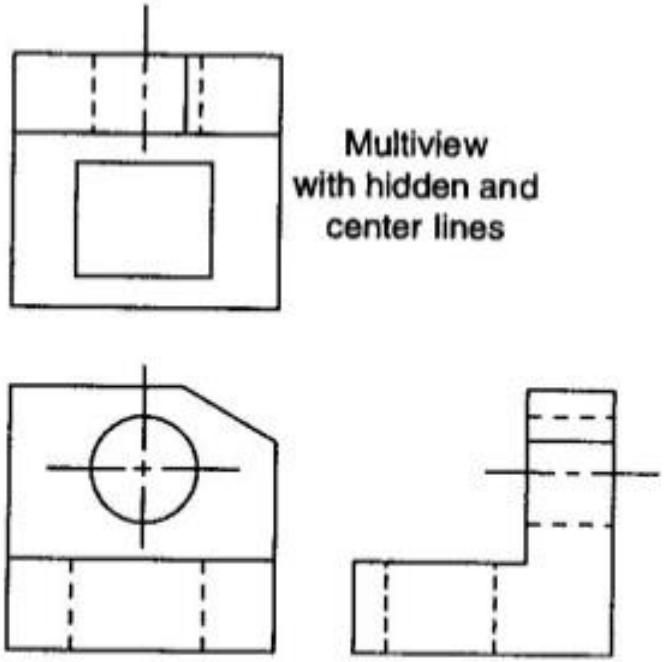


Three dimensions of an object is shown.

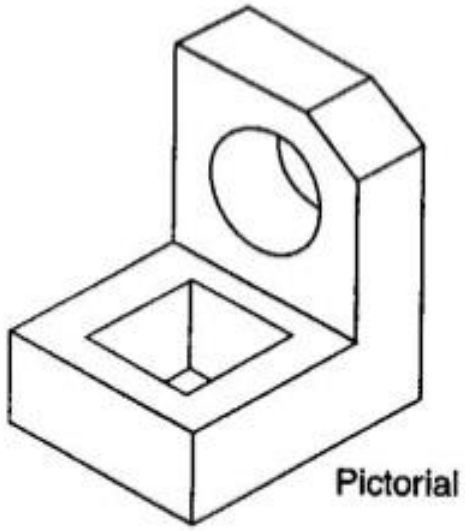
Axonometric drawing

Orthographic / Multiview

- Draw object from two / three perpendicular views



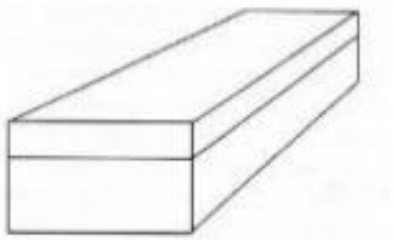
Multiview drawing. / Orthographic

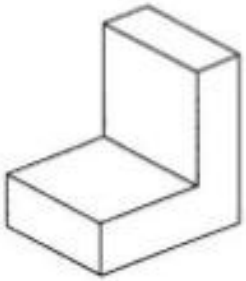


What it looks
like pictorially

Pictorial

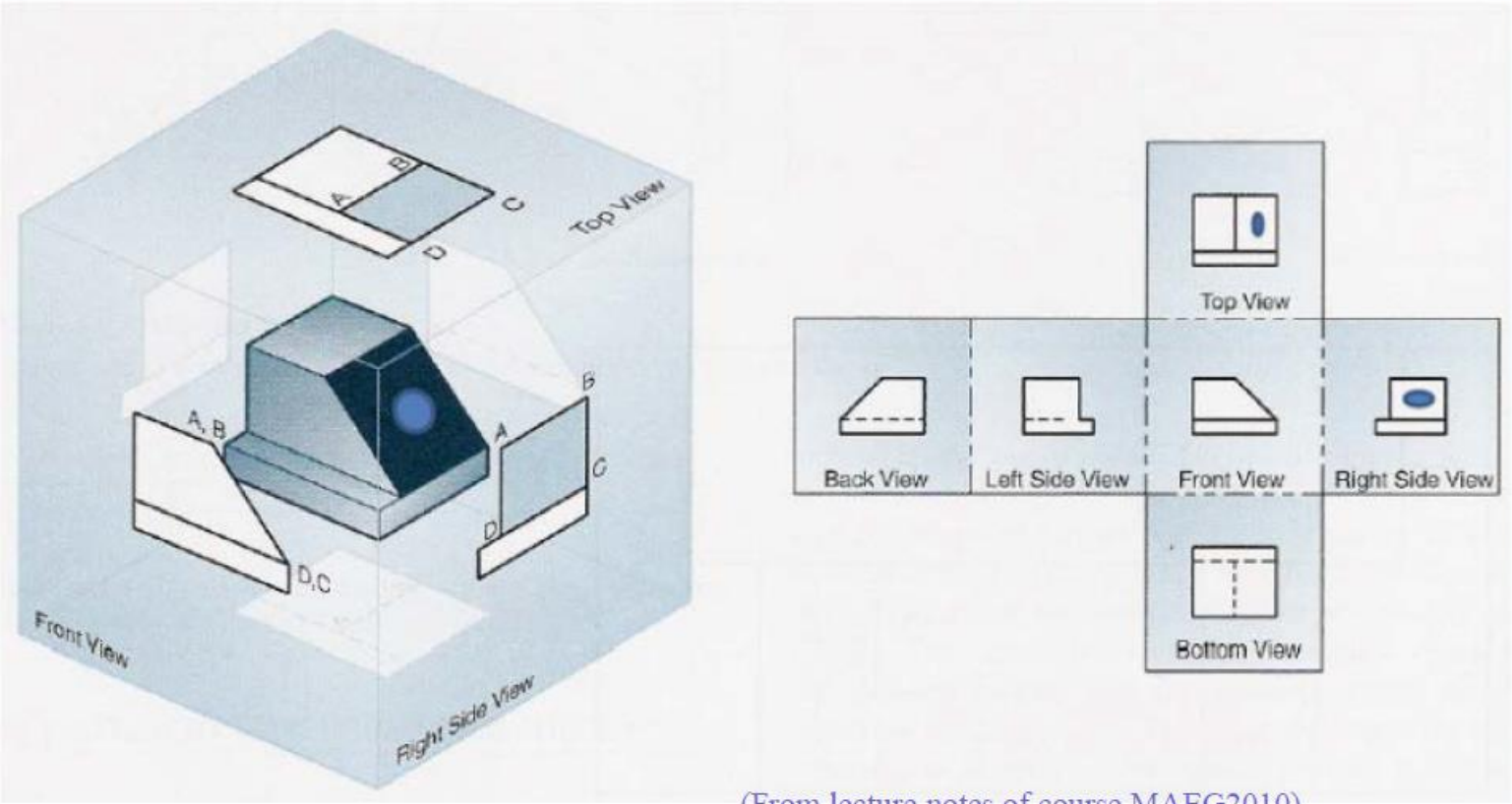
- 3-dimensional representations
  - One-point
    - one vanishing point
    - lines that are not vertical or horizontal converge to single point in distance
  - Two-point or Three-point
    - two or three vanishing points
      - With two points, vertical **or** horizontal lines parallel, but not both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



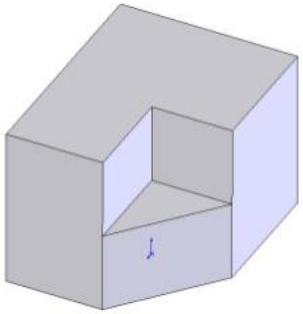


Multi-view Projections

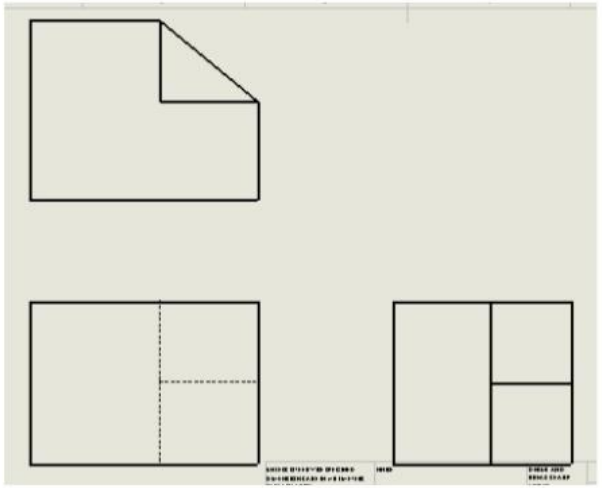
- Project an object from six principal directions (front, back, top, bottom, right, left)



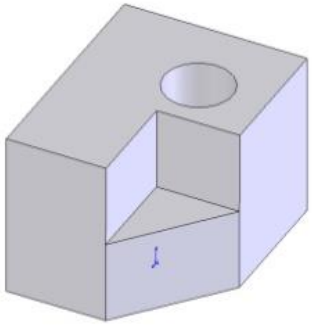
(From lecture notes of course MAEG2010)

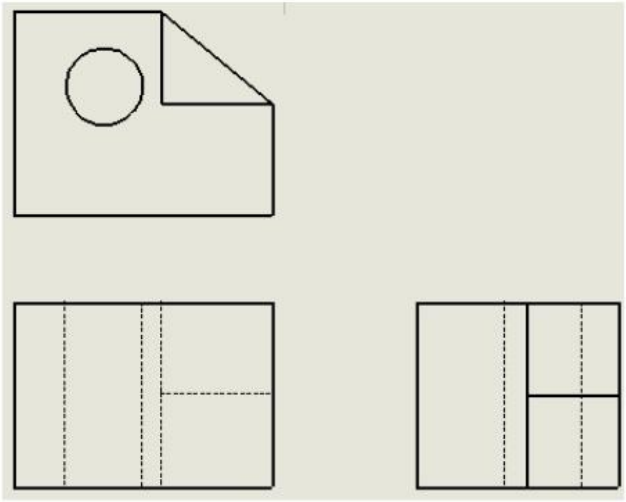


Axonometric view



Multi-view





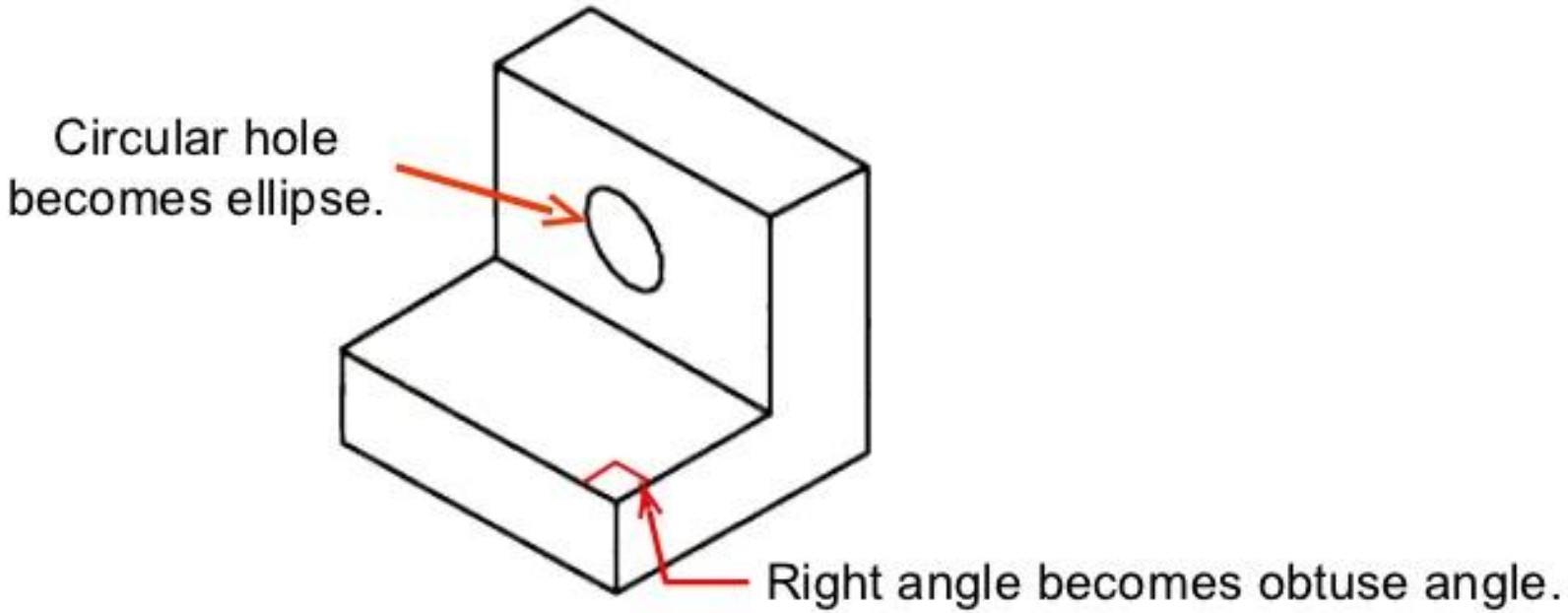
From slides by Bhuiyan Shameem Mahmood

Axonometric (Isometric) Drawing

Advantage Easy to understand

Disadvantage Shape and angle distortion

Example Distortions of shape and size in isometric drawing

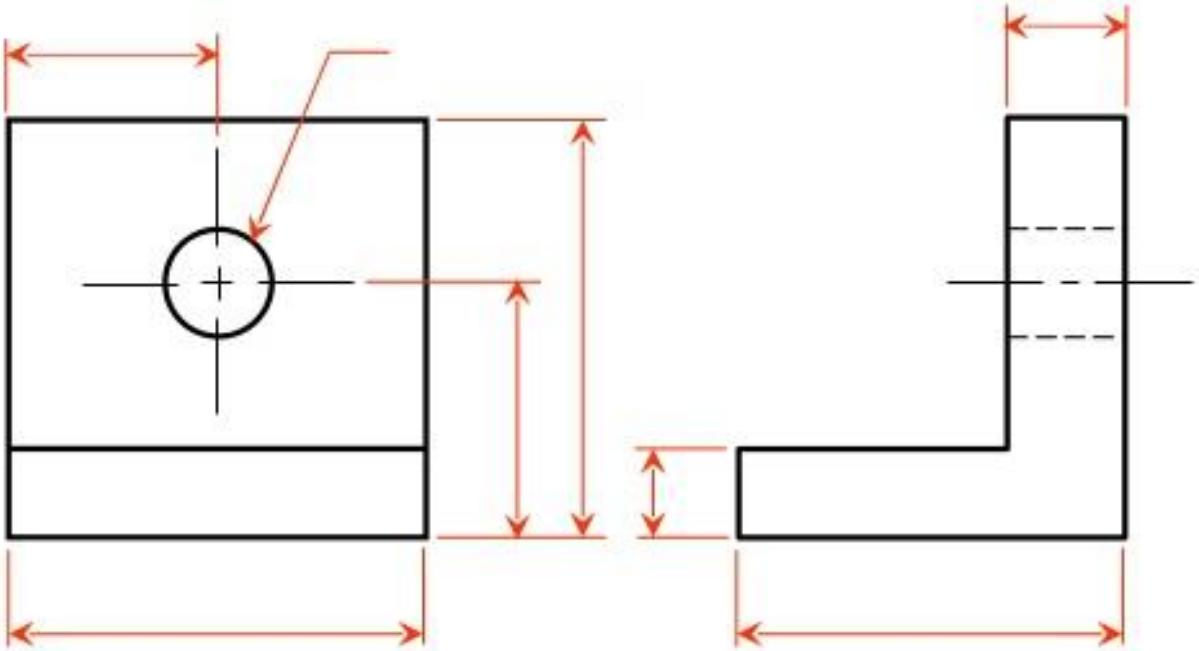


Multiview Drawing

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

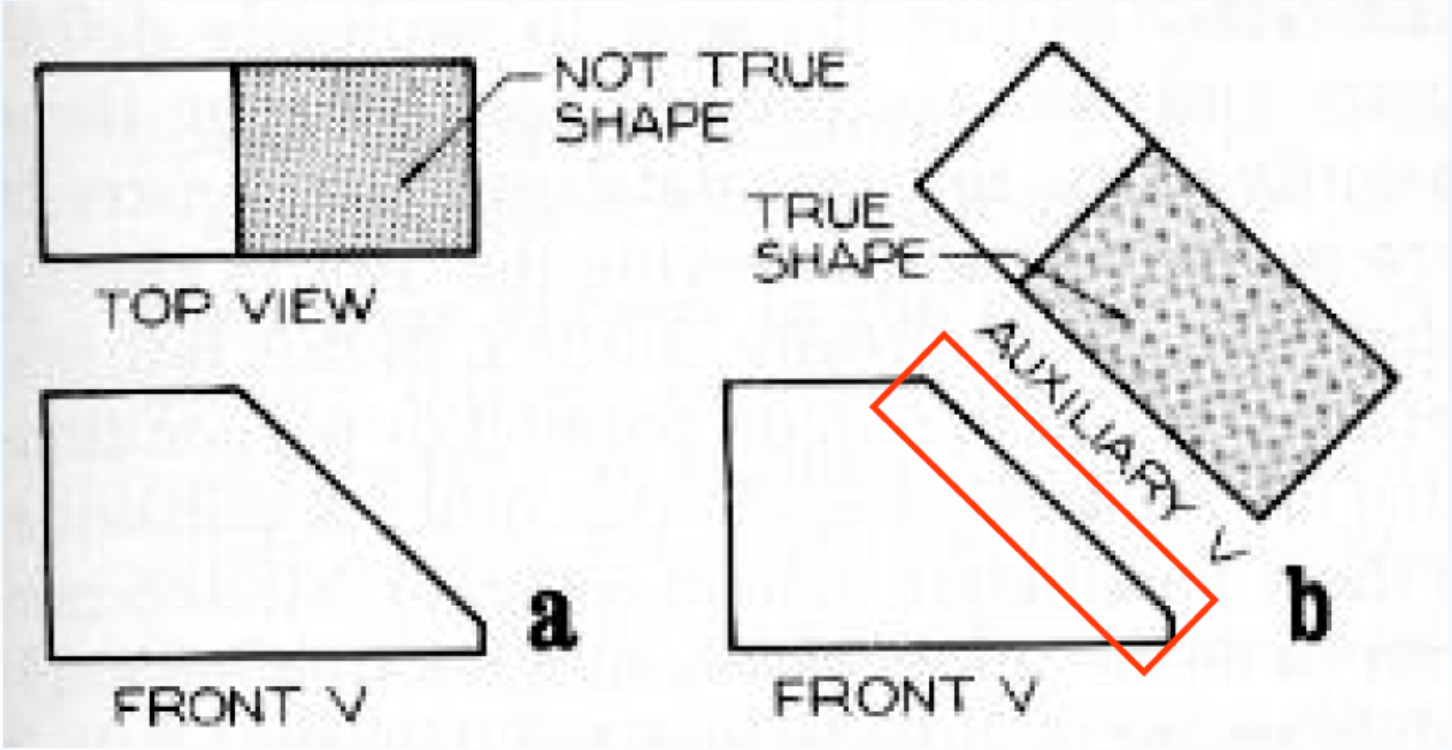
Disadvantage Require practice in writing and reading.

Example Multiviews drawing (2-view drawing)



Auxiliary Views

- Used to show true dimensions of an inclined plane.



Drawing Standards

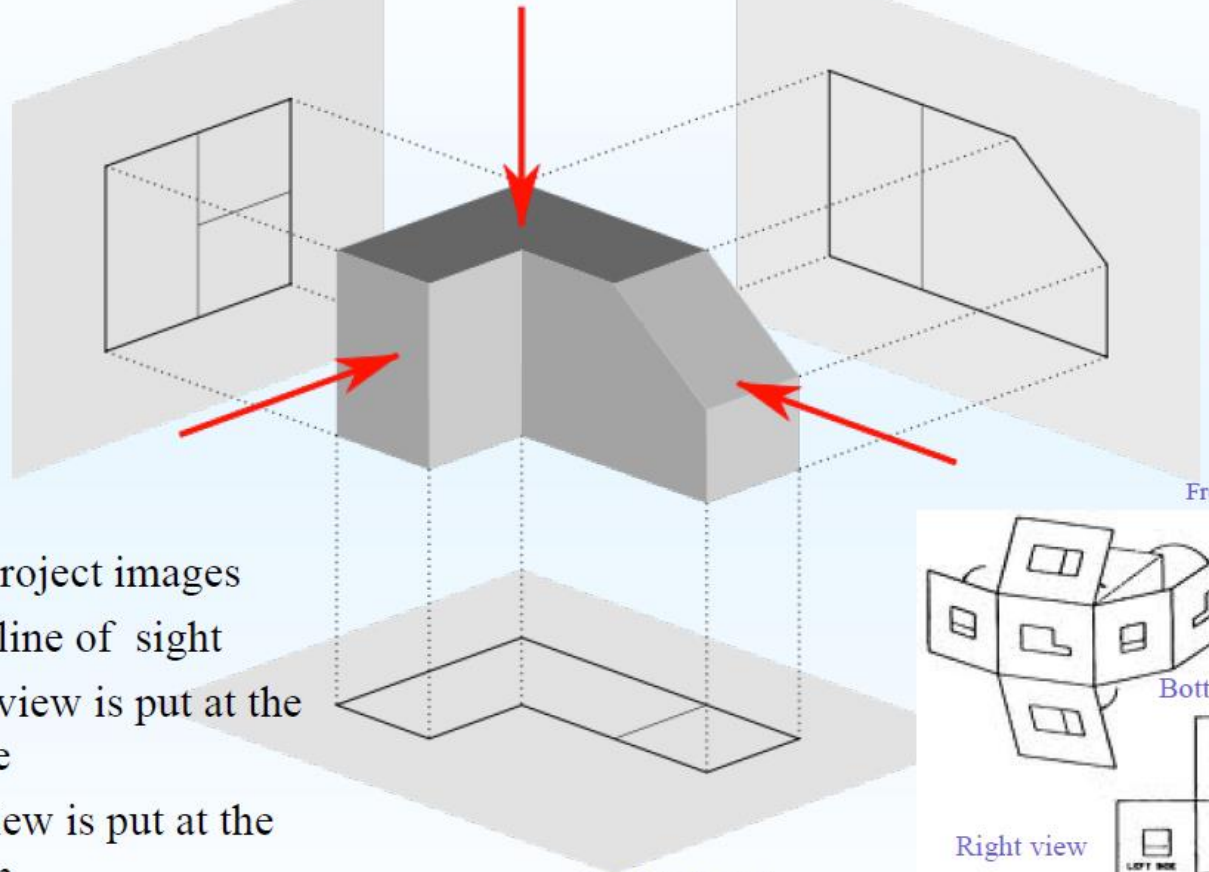
Standards are set of rules that govern how technical drawings are represented.

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

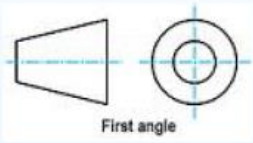
Drawing Standards

- Standards on
  - ***Sizes and Format of Drawings***
  - ***Lines***
  - ***Scales***
  - ***Projection methods***
  - ***Presentation of view and sections***
  - ***Lettering***
  - ***Dimensioning***
  - …

First-Angle Projection



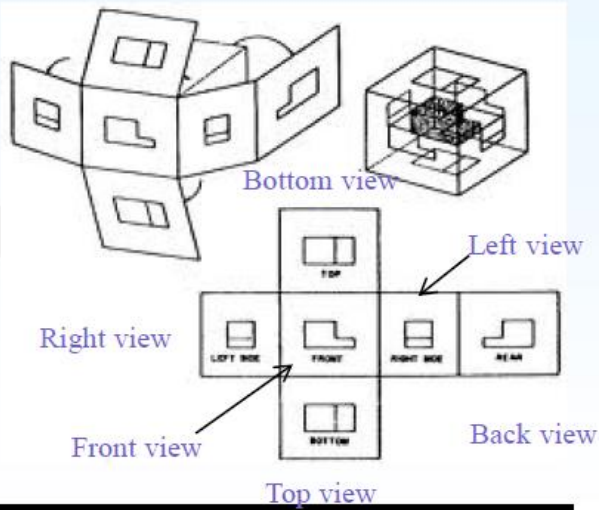
(En.wikipedia.com)



ISO standard

Used in Europe,

From mytvmoments.com

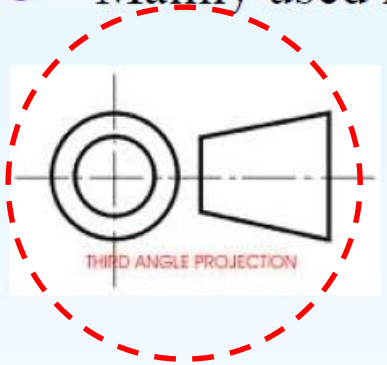


Directly project images along the line of sight

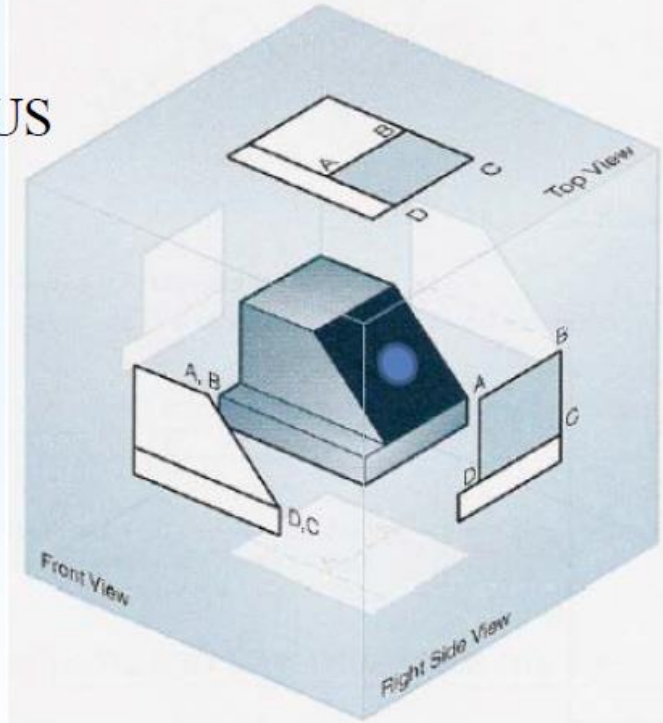
- Front view is put at the middle
- Top view is put at the bottom
- Right view is put on the left

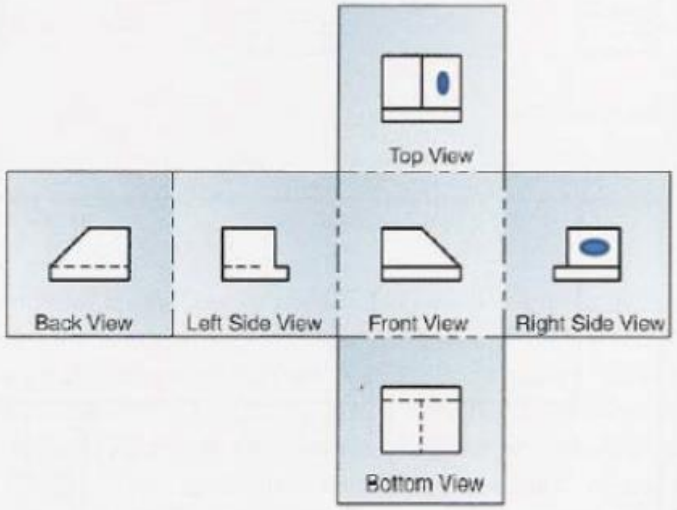
Third-Angle Projection

- The positions of the viewpoint and location of the projection view are the same
  - Right side view is located at right
  - Left side view is located at left
  - …
- Mainly used in US



(Third-angle Viewing point)



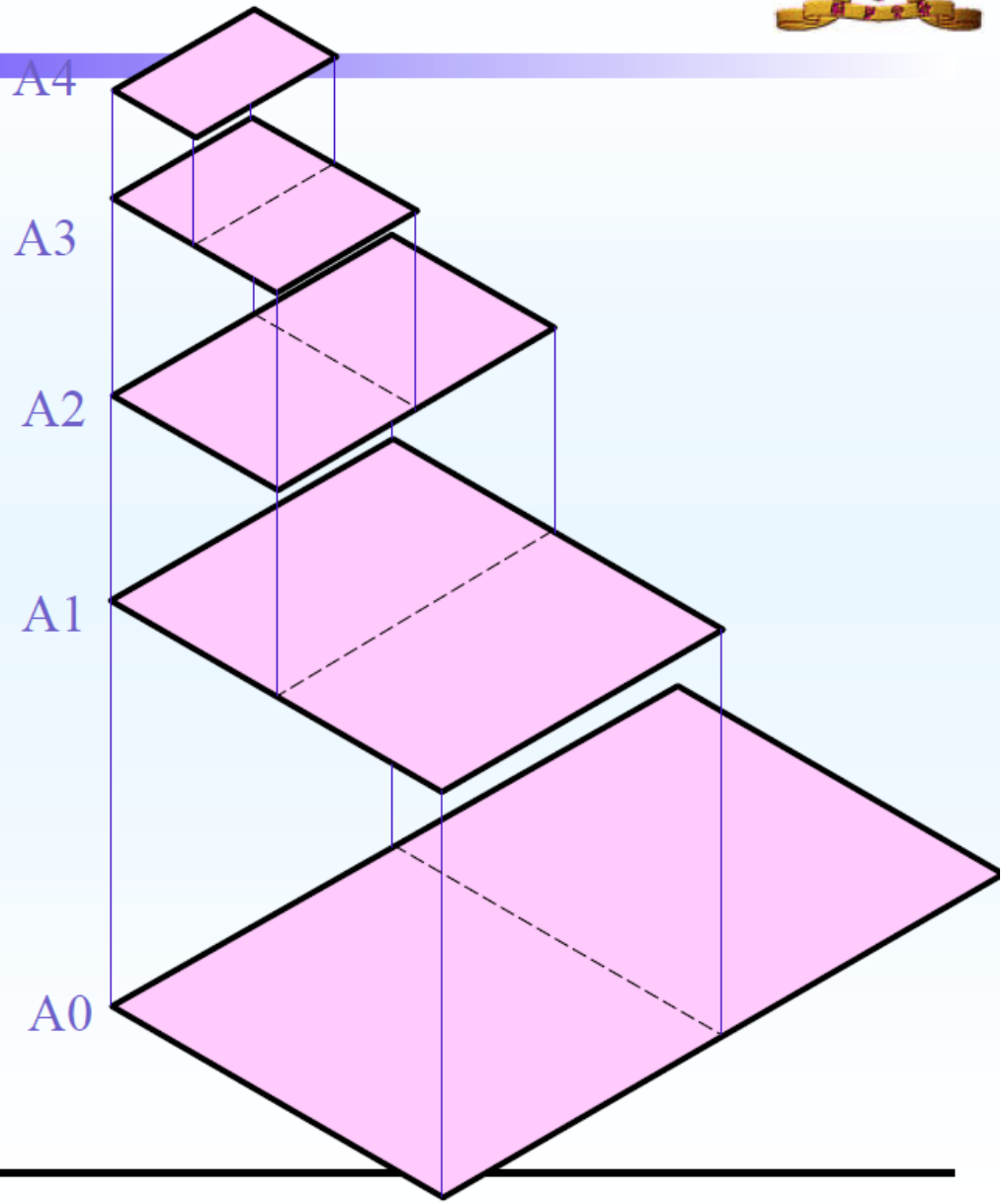


Drawing Sheet

- Trimmed paper of a size A0 ~ A4.
- Standard sheet size

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

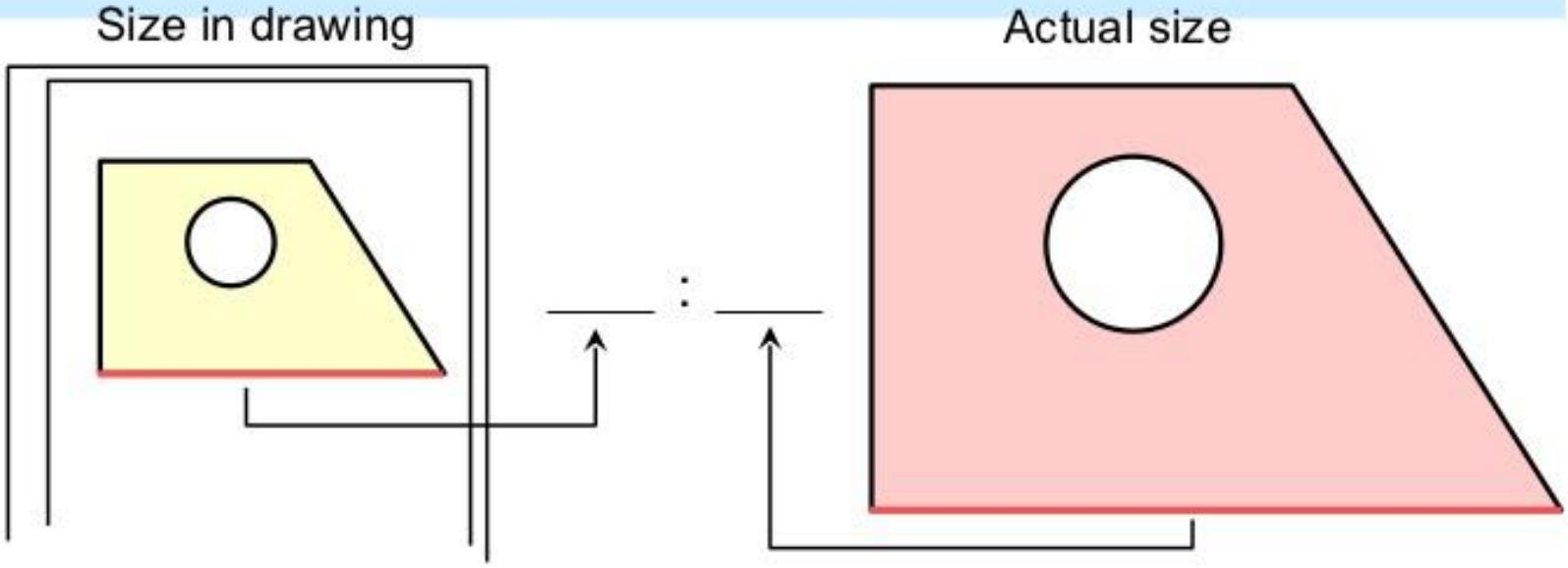
(Dimensions in millimeters)



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.



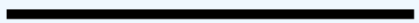
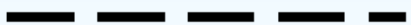
Drawing Scales

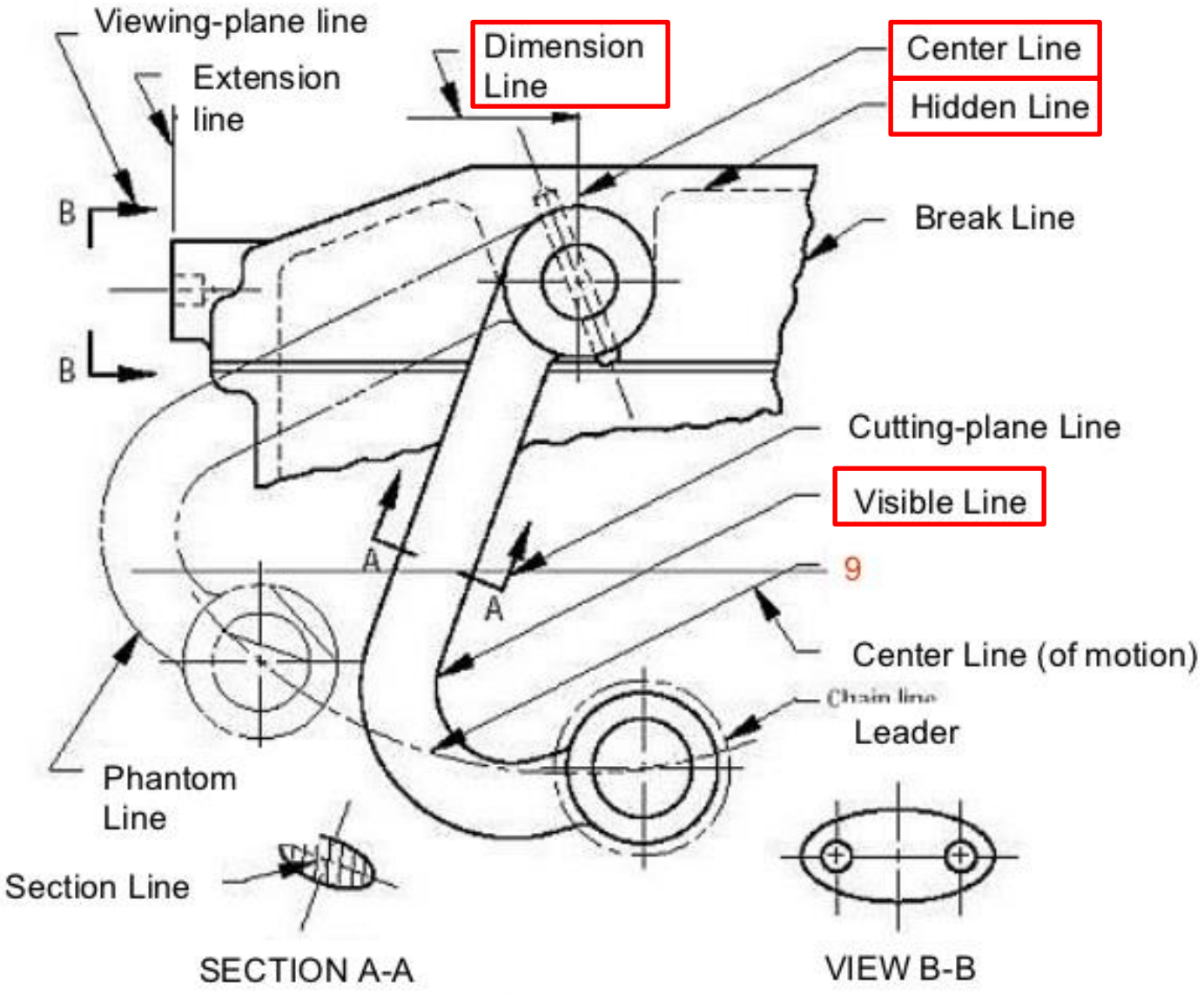
- Designation of a scale consists of the word "SCALE" followed by the indication of its ratio, as follow

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


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

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.

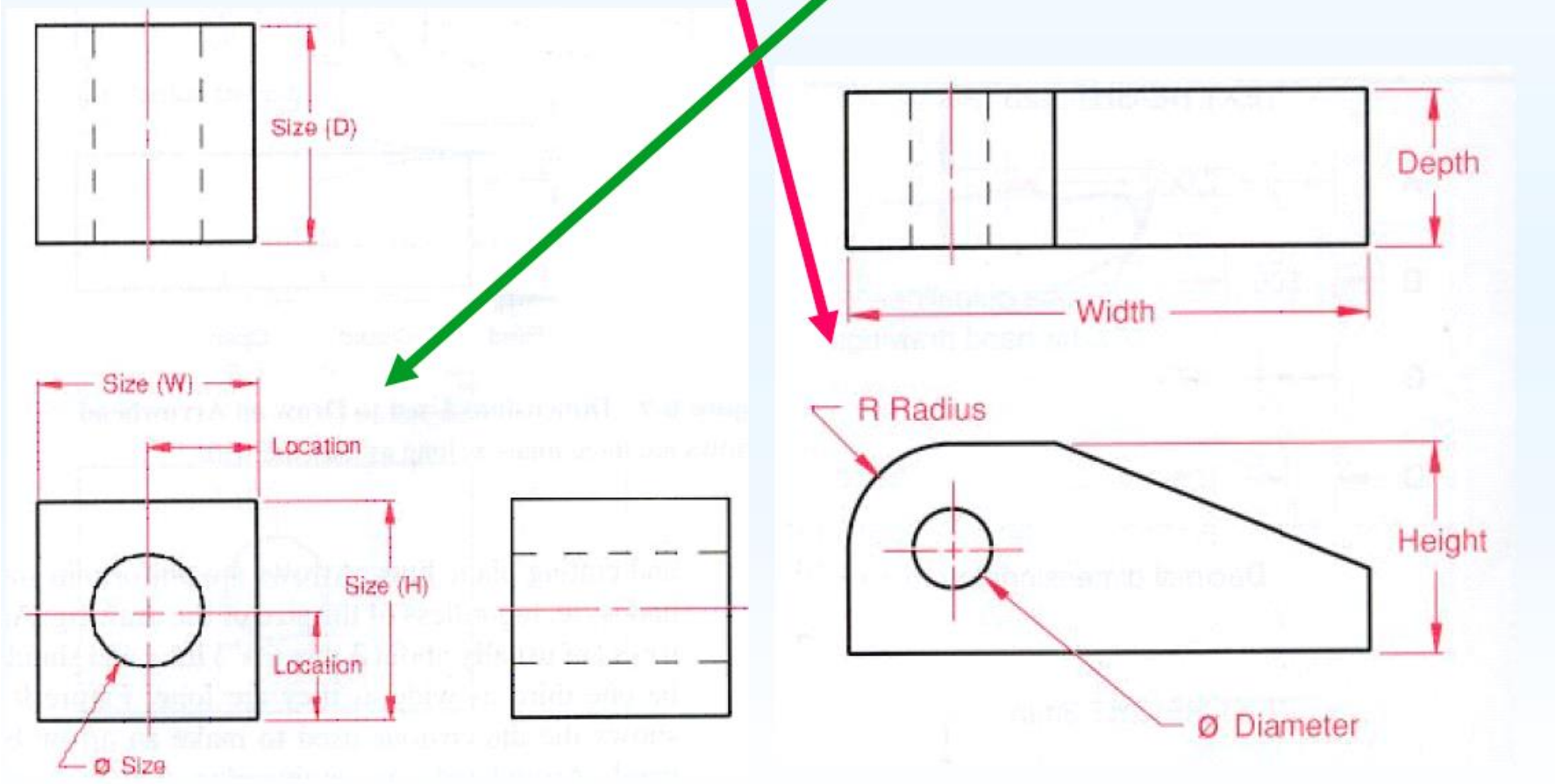
Thus, it must be written with

Legibility - shape
- space between letters and words

Uniformity - size
- line thickness

Dimensioning

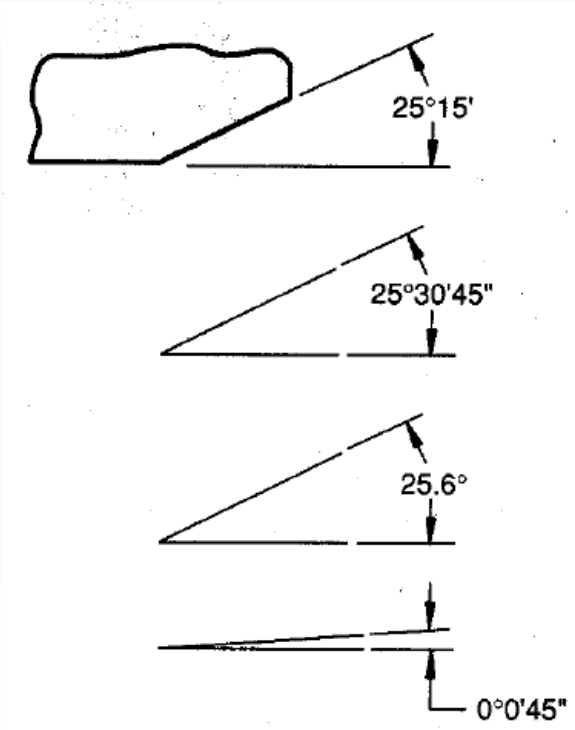
Two types of dimensioning: (1) Size and location dimensions and (2) Detail dimensioning



Units of Dimension

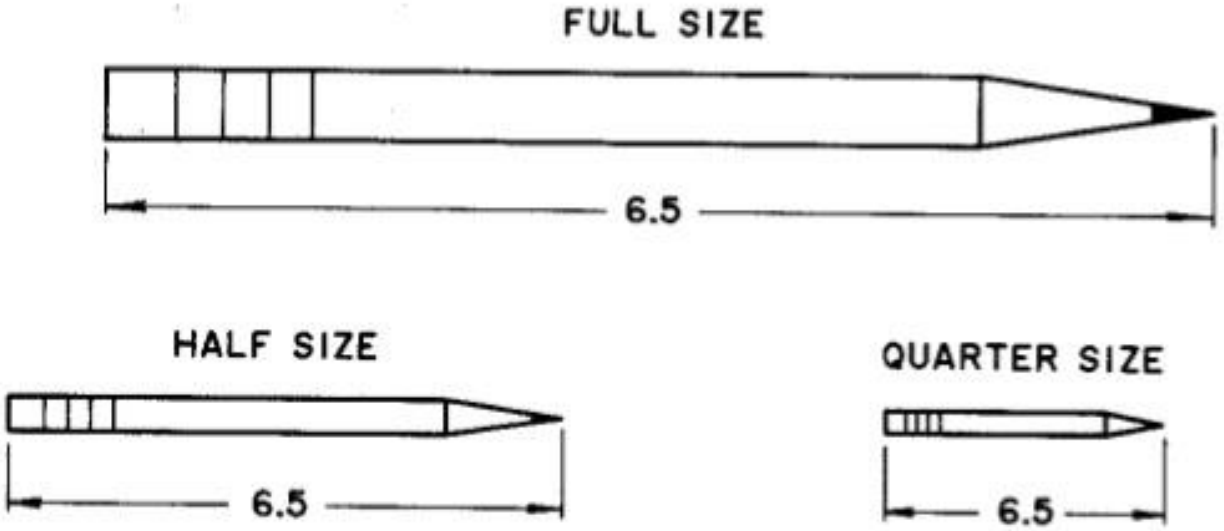
- Length
  - English - Inches, unless otherwise stated
  - SI – millimeter, mm
- Angle
  - degrees, minutes, seconds

Angle Dimensions



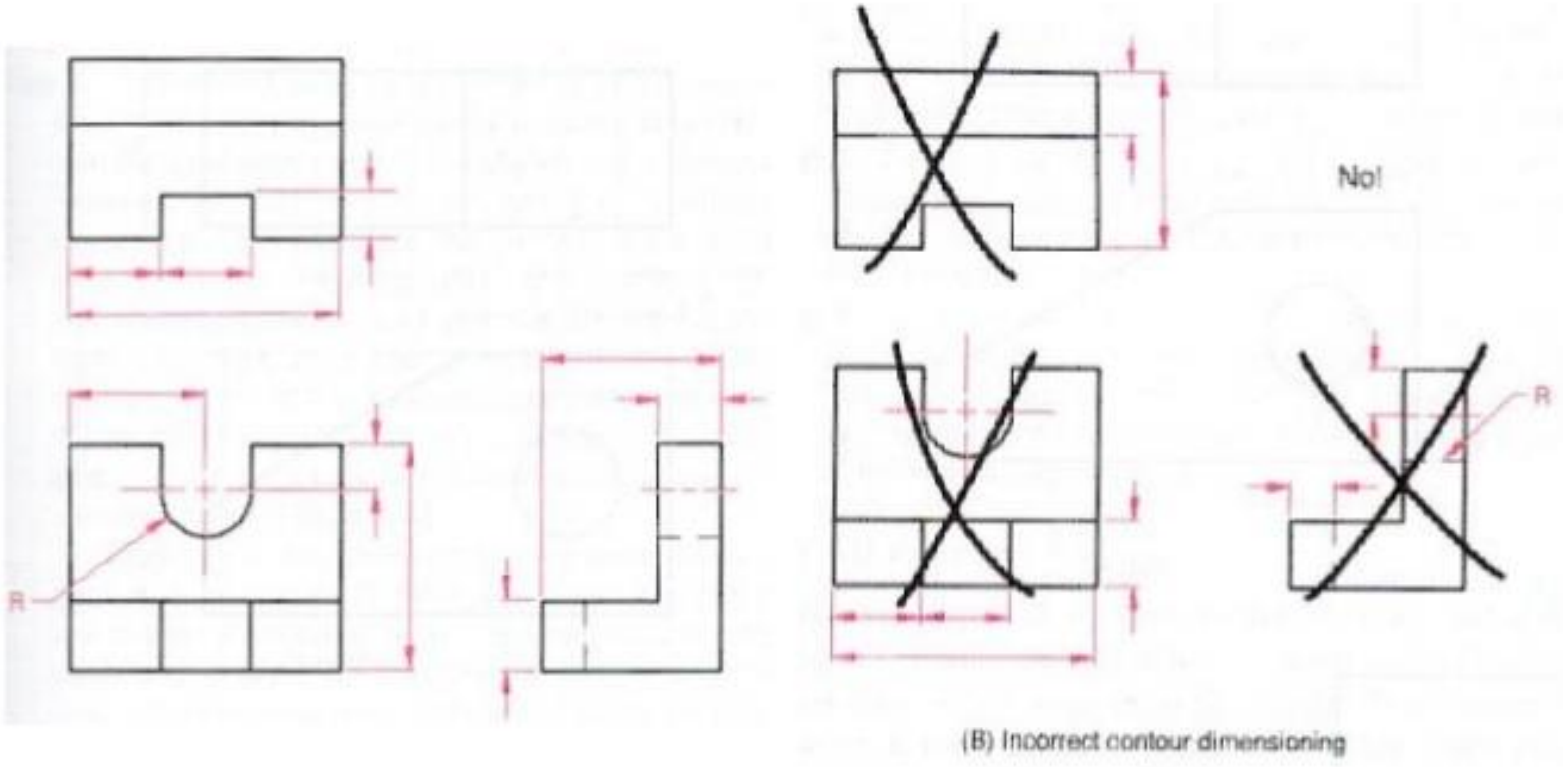
Scaling vs. Dimensioning

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



Dimension guidelines

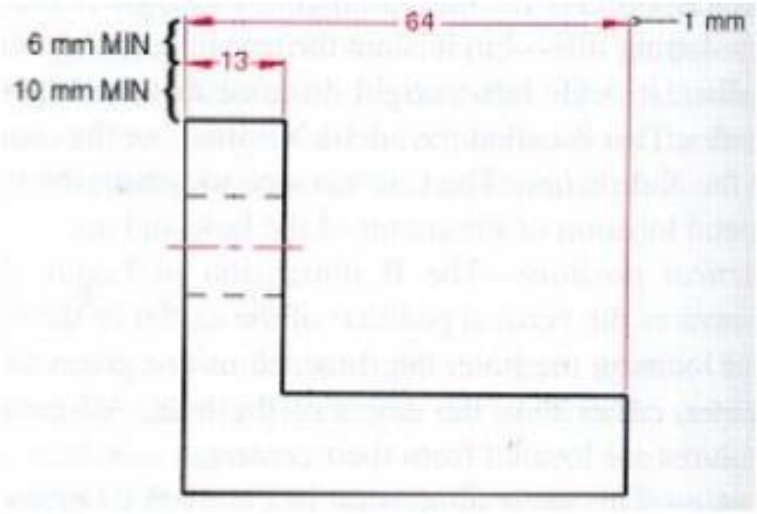
Dimensions should be placed in the view that most clearly describes the feature being dimensioned (contour (shape) dimensioning)



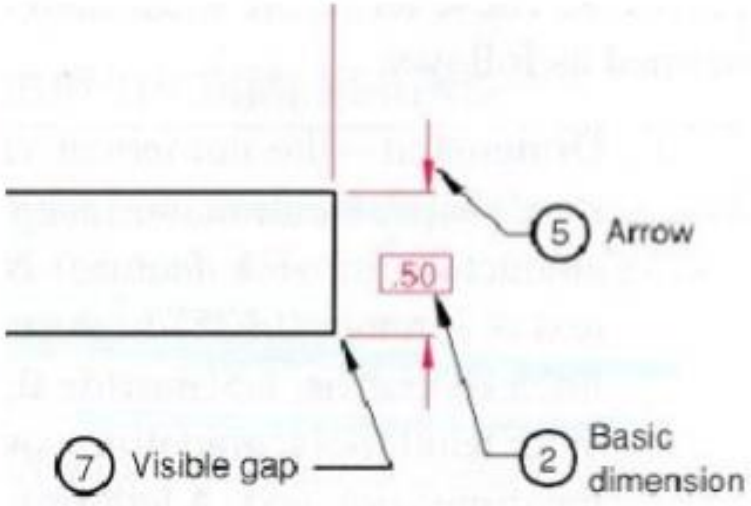
(B) Incorrect contour dimensioning

Dimension guidelines

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

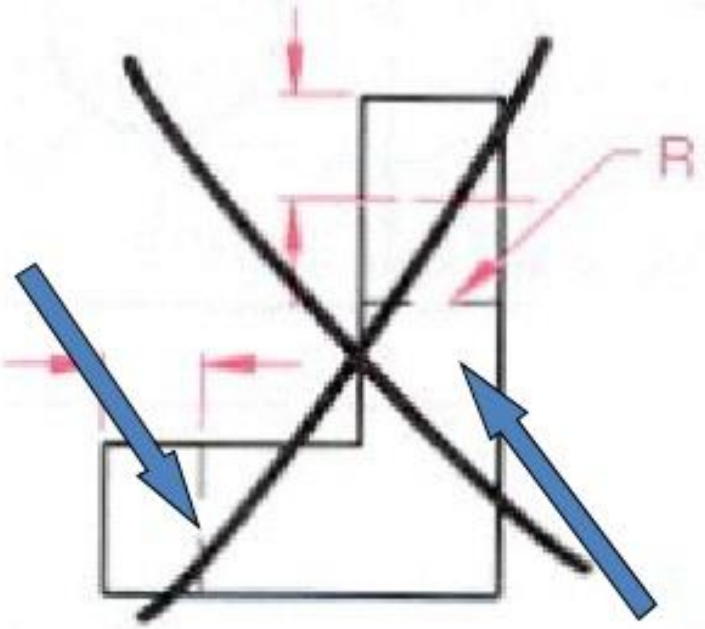


A visible gap shall be placed between the ends of extension lines and the feature to which they refer.



Dimension guidelines

Avoid dimensioning hidden lines.



Leader lines for diameters and radii should be radial lines.