# Introduction to Engineering Drawing

# TOPICS

- Graphics language
- Engineering drawing
- Projection methods
- Orthographic projection
- Drawing standards

# TOPICS

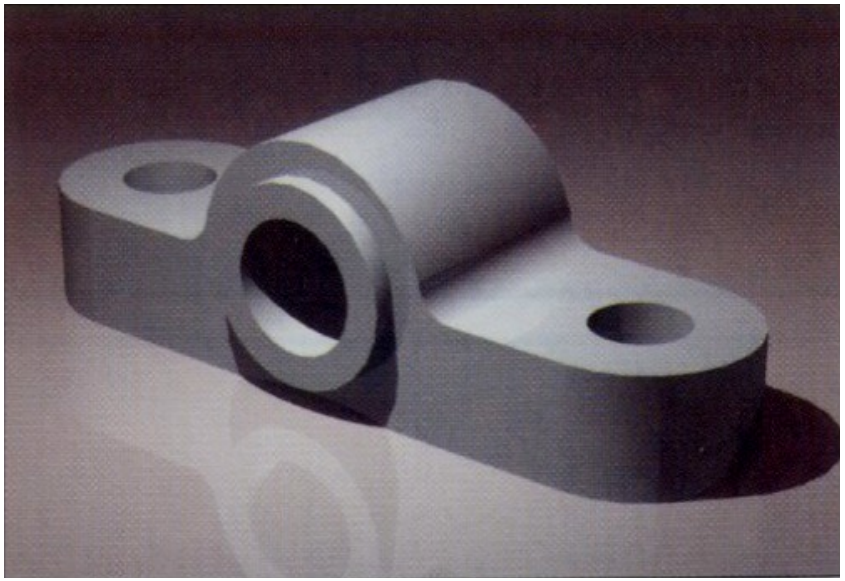
- Traditional Drawing Tools
- Lettering
- Freehand Sketching

# 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

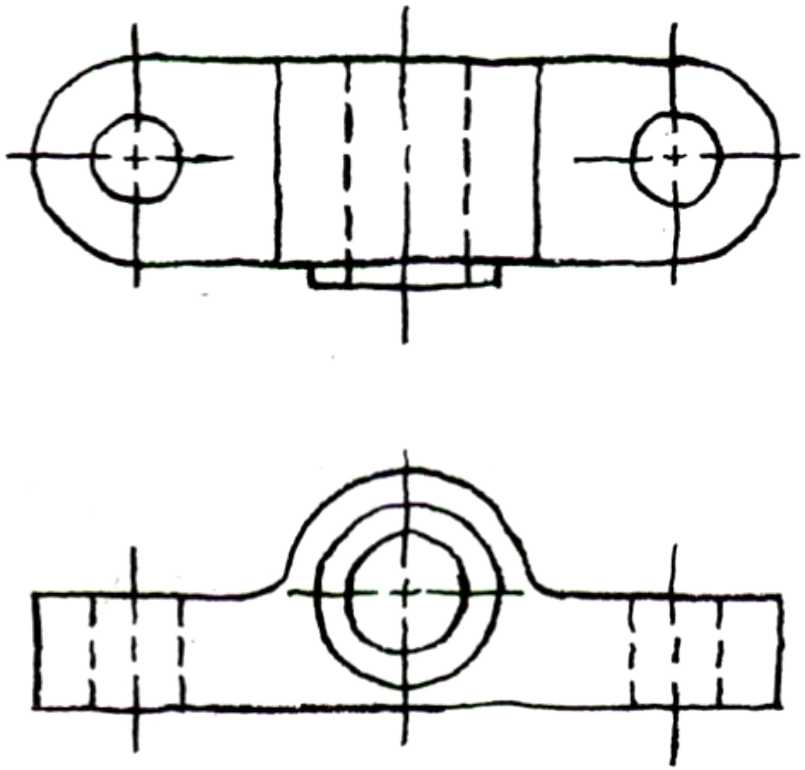
Graphic language in **"engineering application"** use ***lines*** to represent the ***surfaces***, ***edges*** and ***contours*** of objects.

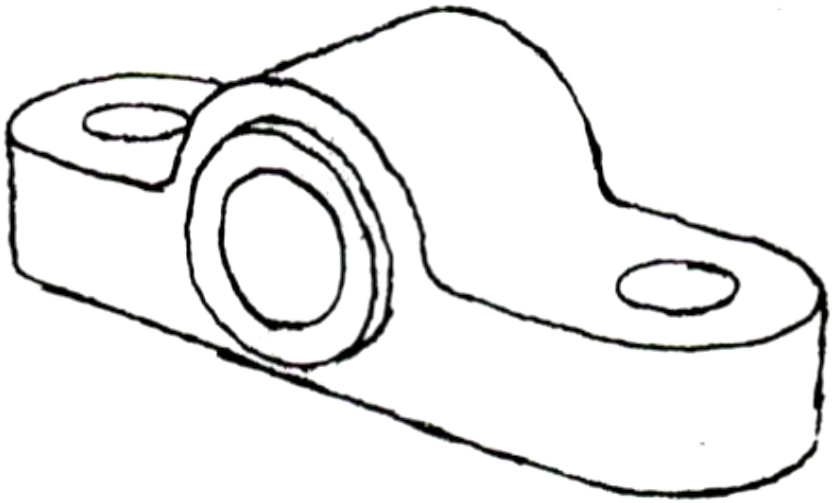
- The language is known as "***drawing***" or "***drafting***" .
- A drawing can be done using ***freehand***, ***instruments*** or ***computer*** methods.

# Freehand drawing

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

## Example

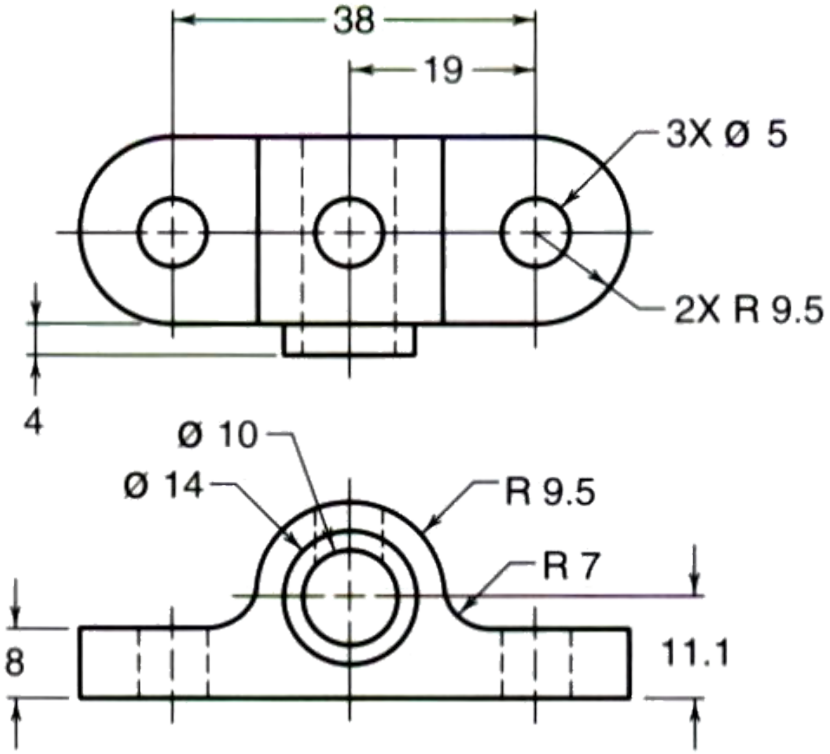




# Instrument drawing

*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

# Elements of Engineering Drawing

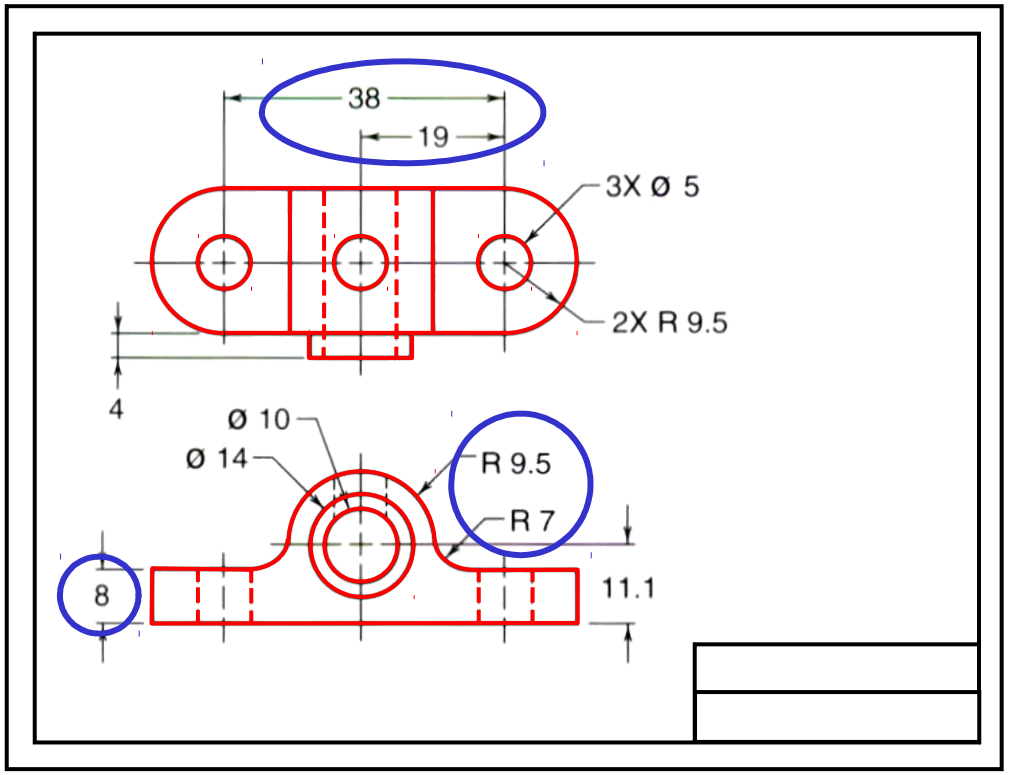
Engineering drawing are made up of ***graphics language*** and ***word language***.

**Graphics language**

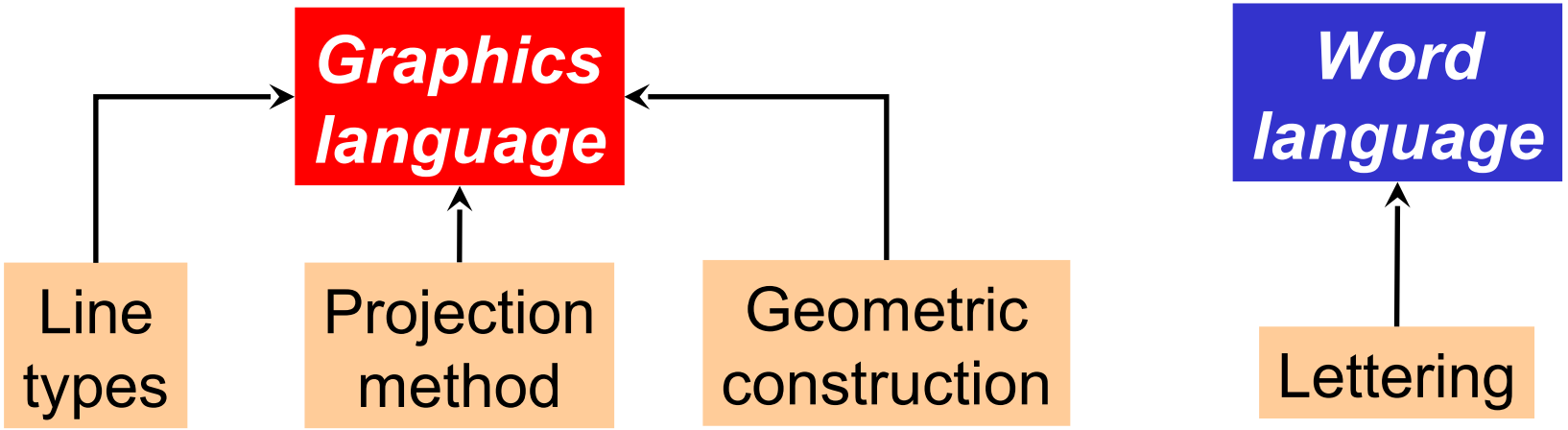
Describe a shape (mainly).

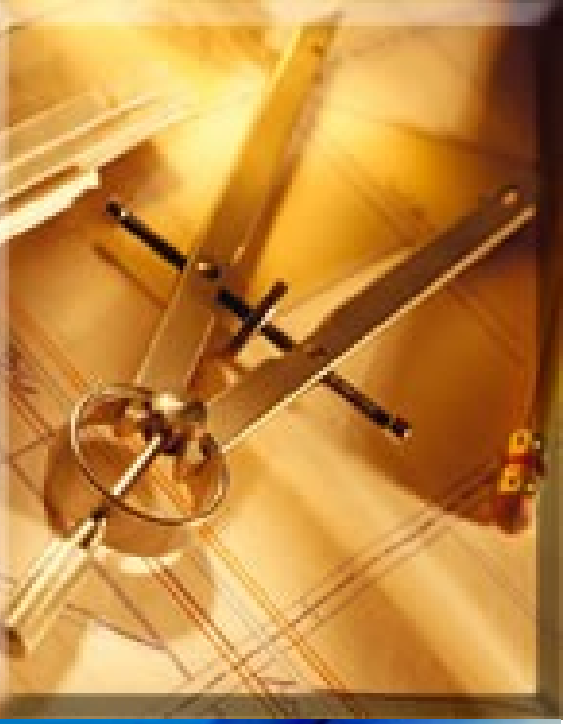
**Word language**

Describe size, location and specification of the object.

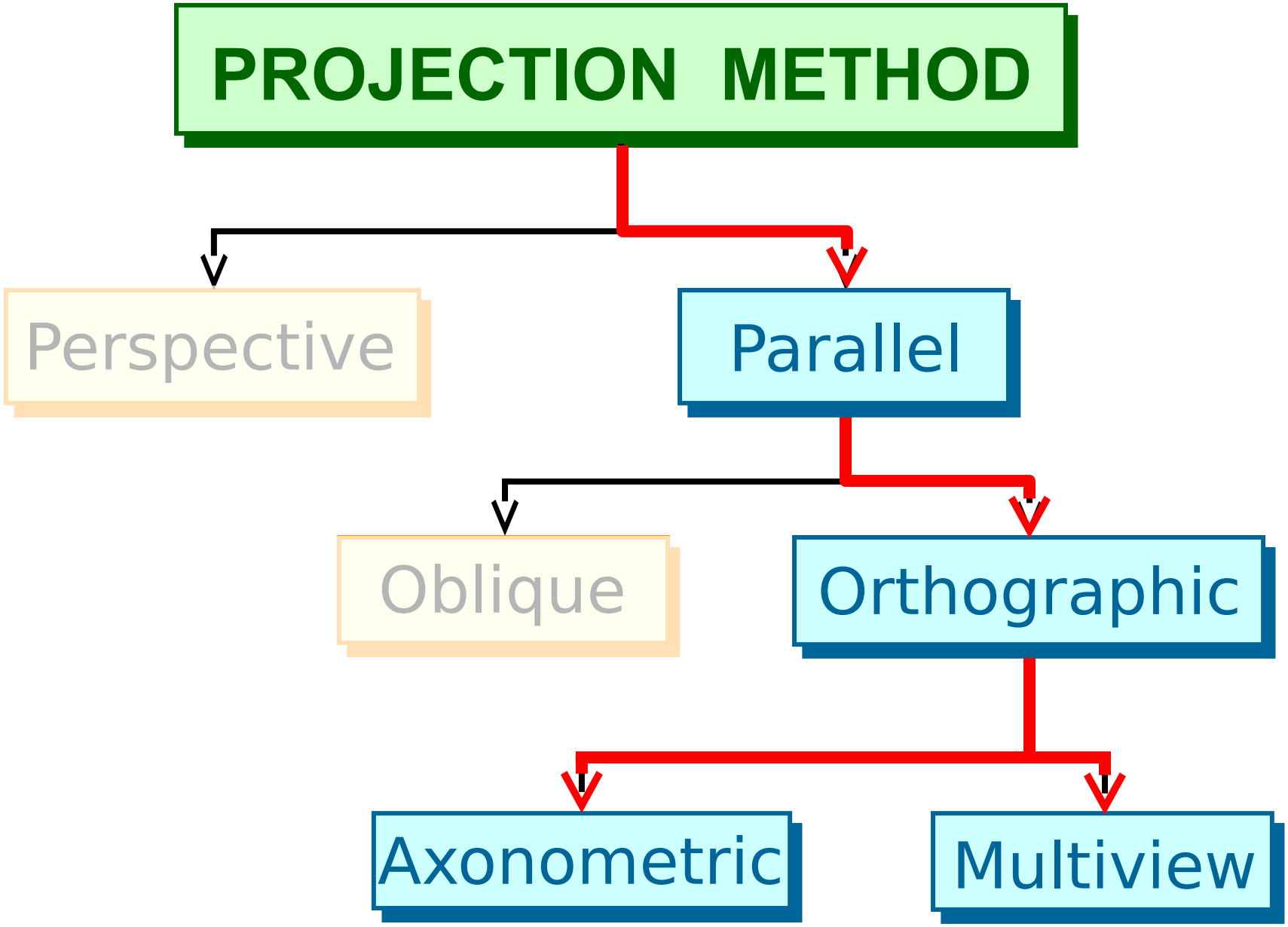


# Basic Knowledge for Drafting





# 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).

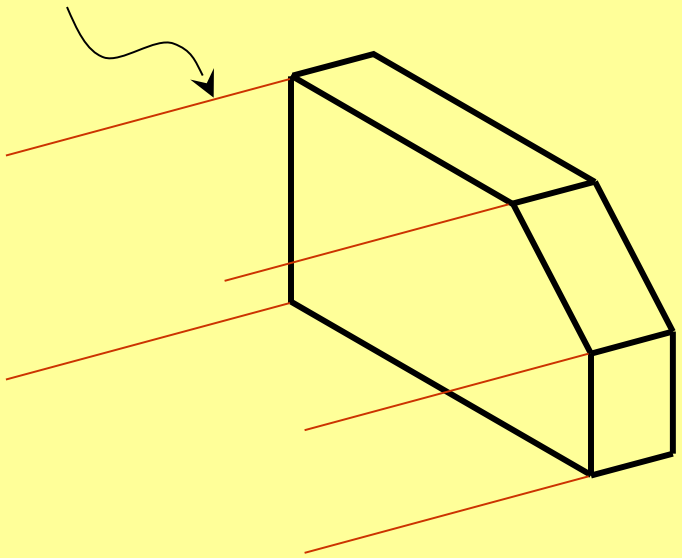
- The projection theory is based on two variables:
  1) Line of sight
  2) Plane of projection (image plane or picture plane)

**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

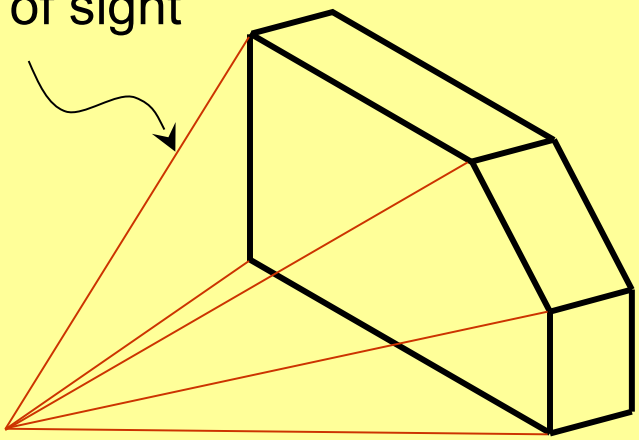
***Parallel projection***

Line of sight



***Perspective projection***

Line of sight

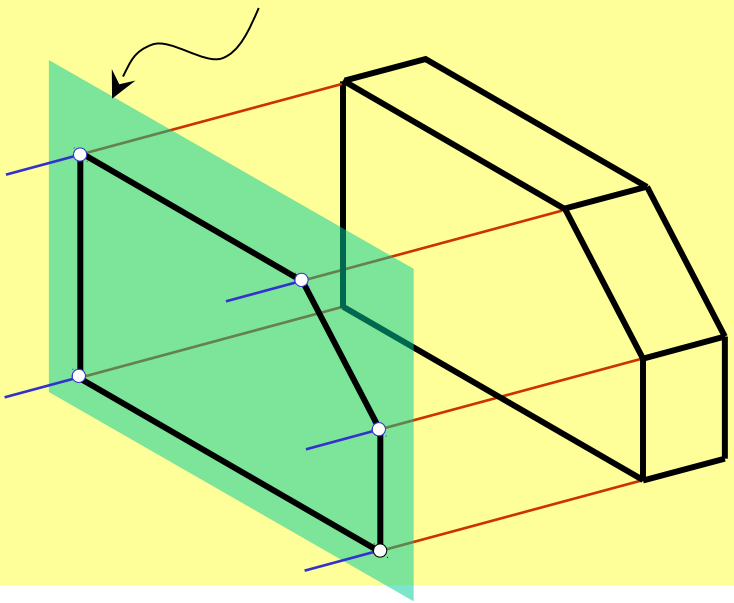


**Plane of projection** is an imaginary flat plane which the image is created.

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

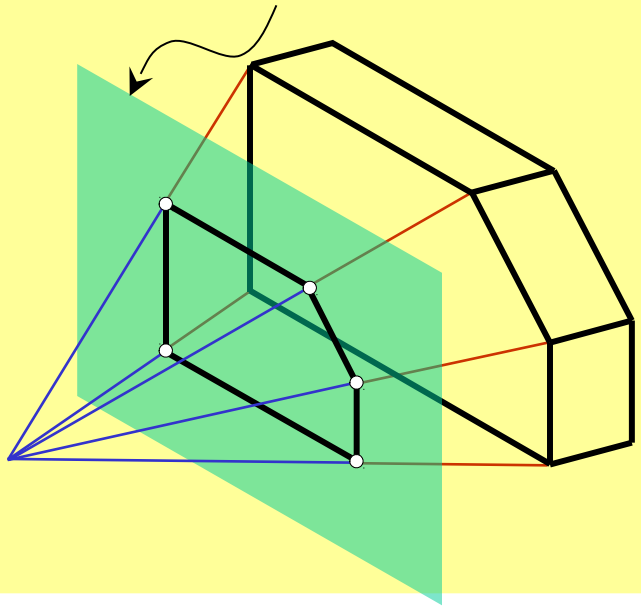
***Parallel projection***

Plane of projection



***Perspective projection***

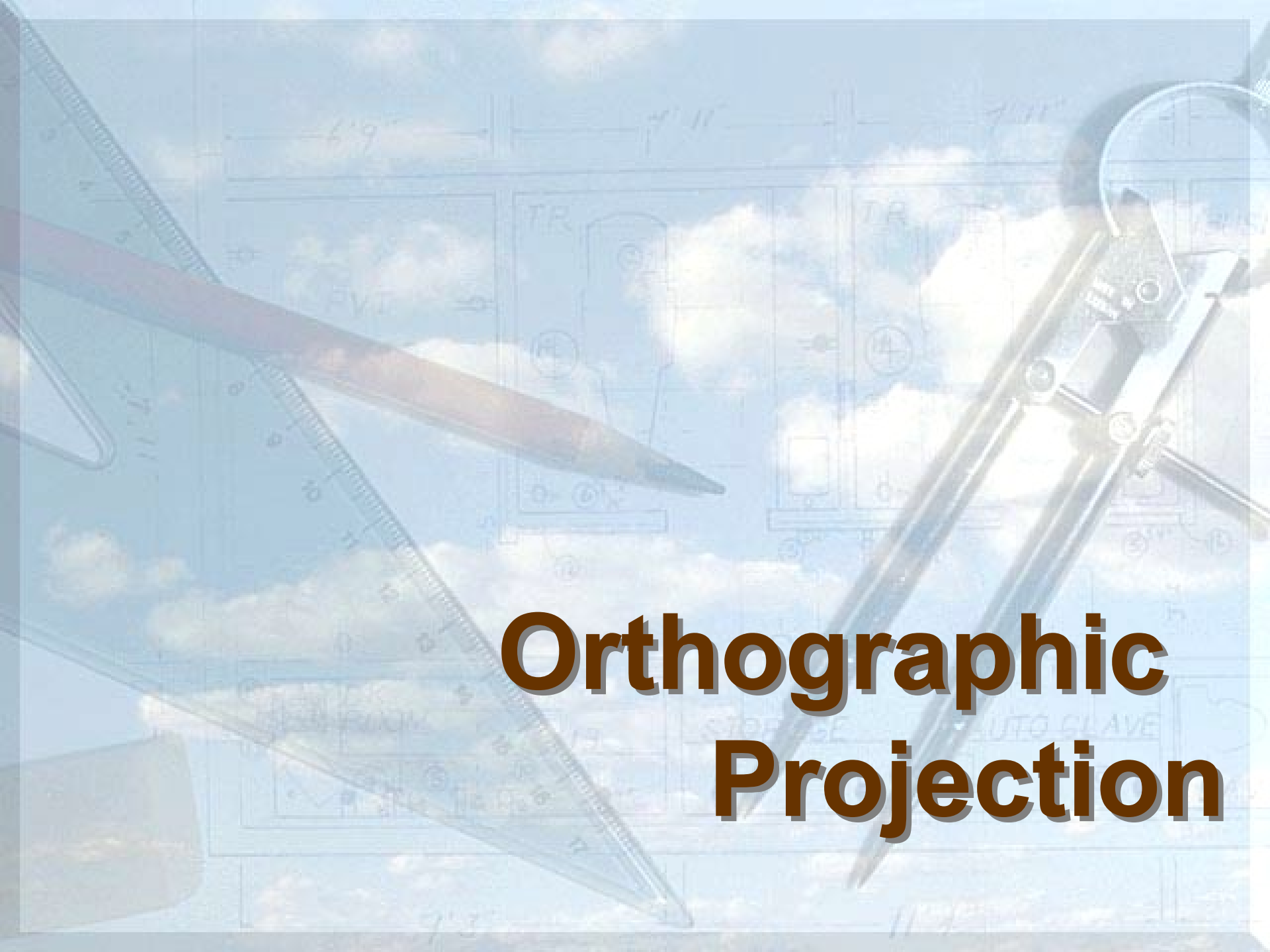
Plane of projection



# Disadvantage of Perspective Projection

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

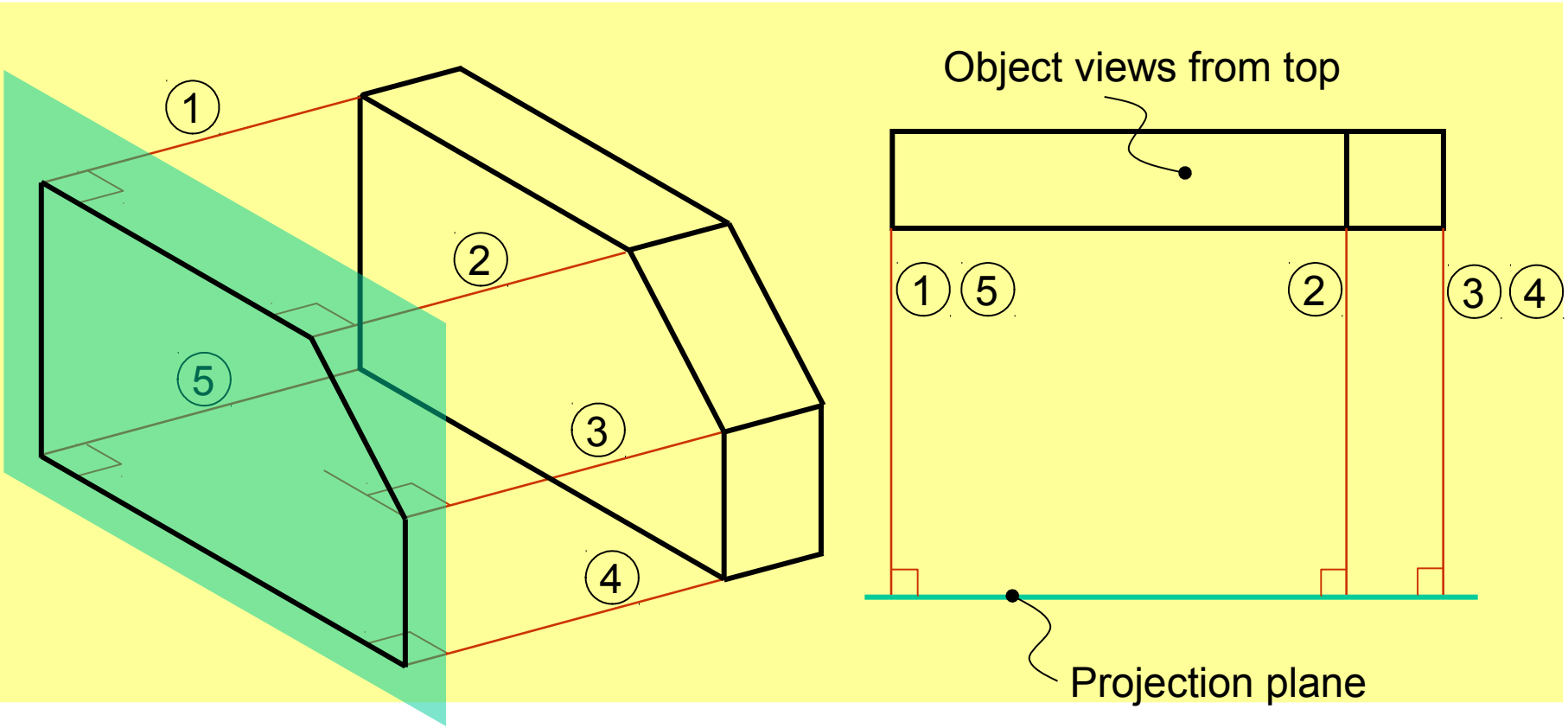
  1) It is difficult to create.
  2) It does not reveal exact shape and size.



# Orthographic Projection

# MEANING

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



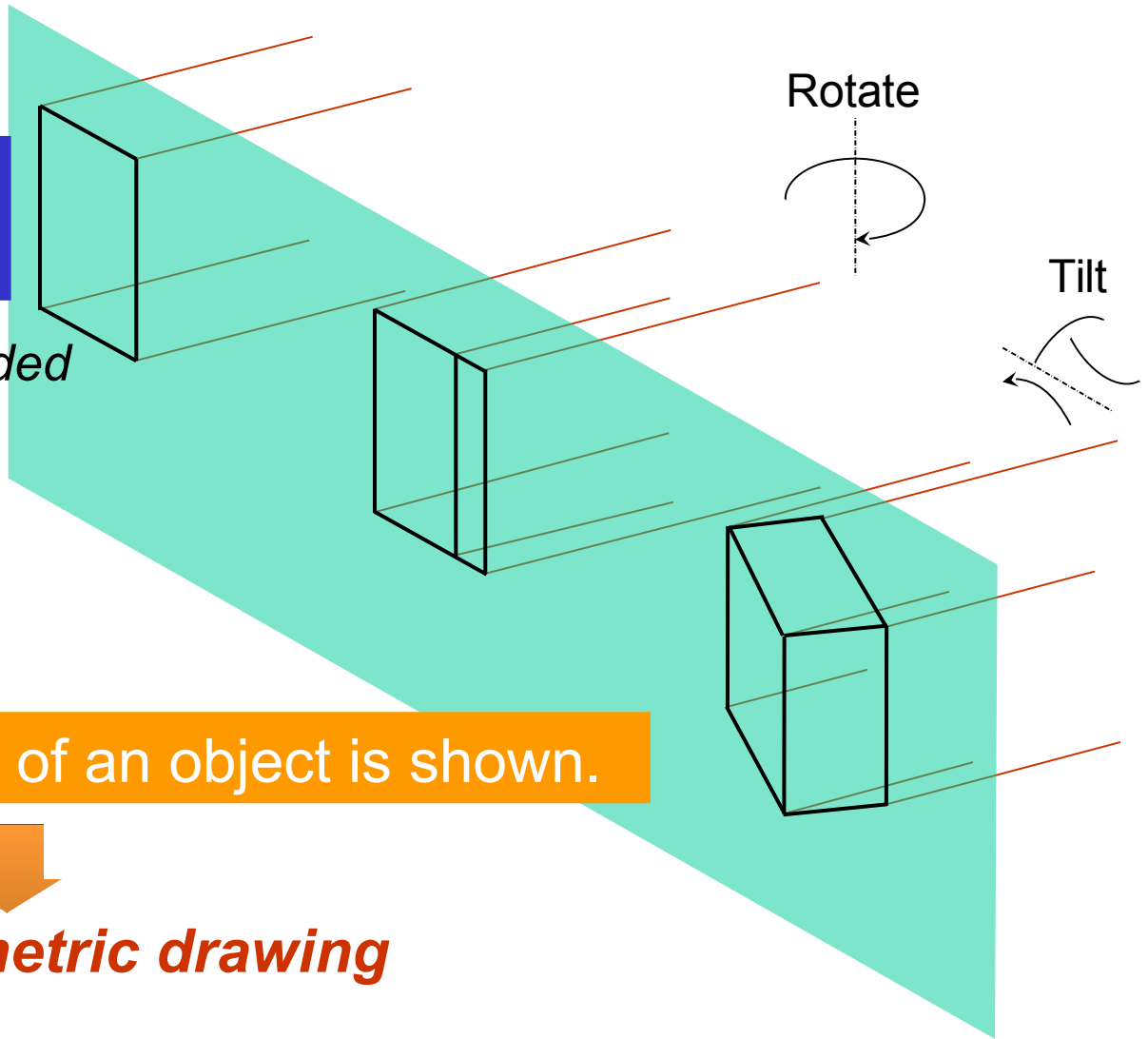
# ORTHOGRAPHIC VIEW

***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 VIEW

**NOTES**

- Orthographic projection technique can produce either

  1. ***Multiview drawing***
     that each view show an object in two dimensions.

  2. ***Axonometric drawing***
     that show all three dimensions of an object in one view.

- Both drawing types are used in technical drawing for communication.

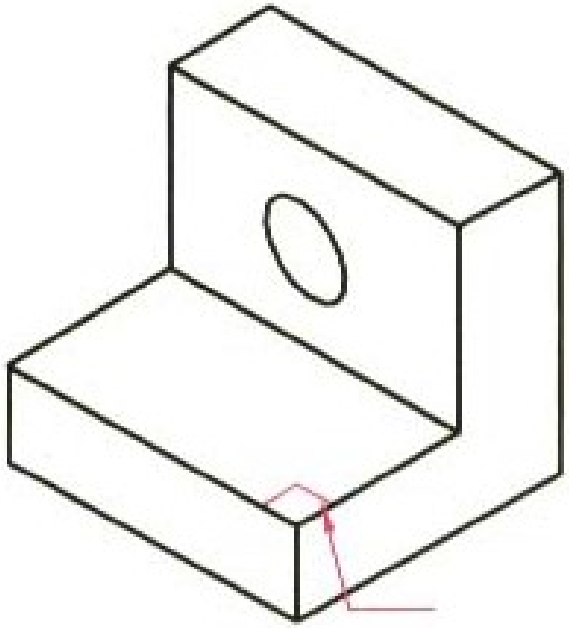
# Axonometric (Isometric) Drawing

***Advantage*** Easy to understand

***Disadvantage*** Shape and angle distortion

**Example** Distortions of shape and size in isometric drawing

Circular hol
becomes ellip



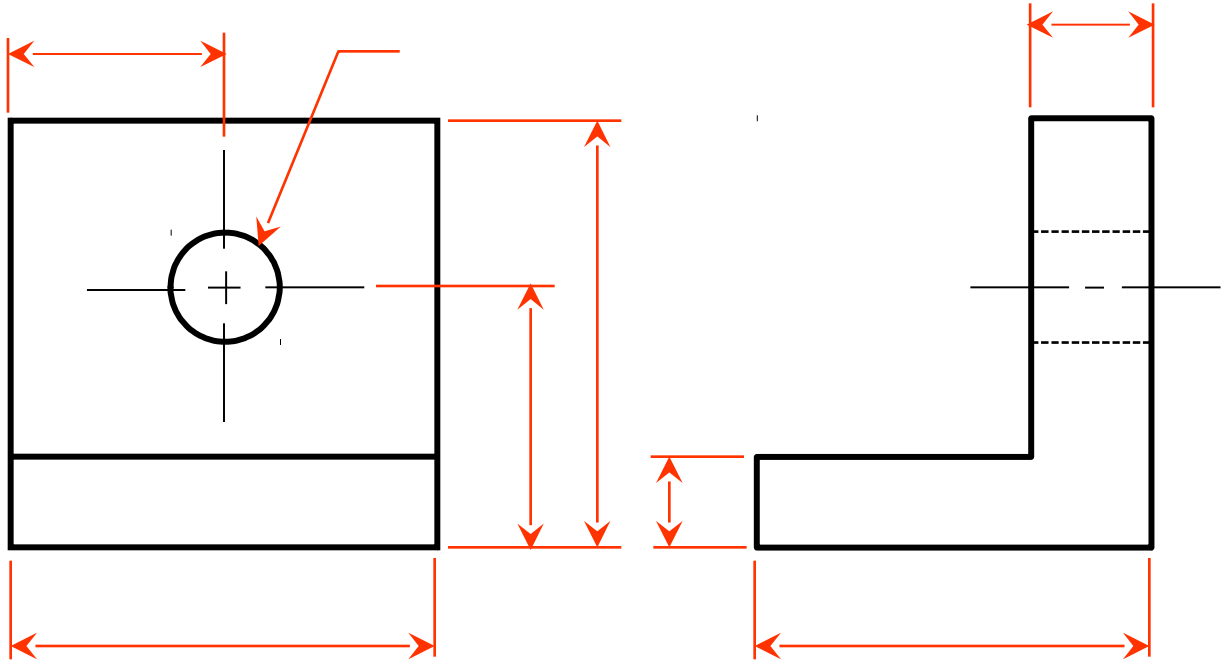
angle becomes obtuse angle.

# Multiview Drawing

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

***Disadvantage*** Require practice in writing and reading.

**Example** Multiviews drawing (2-view drawing)



# 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. | สำนักงานมาตรฐานผลิตภัณฑ์อุตสาห |
| USA | ANSI | American National Standard Institute |
| Japan | JIS | Japanese Industrial Standard |
| UK | BS | British Standard |
| Australia | AS | Australian Standard |
| Germany | DIN | Deutsches Institut für Normung |
| | ISO | International Standards Organization |

# Partial List of Drawing Standards

| Code number | Contents |
|---|---|
| ก. 210 2520 | วิธีเขียนแบบทั่วไป : ทางเครื่องกล |
| . 440 ล.1 2541 | การเขียนแบบก่อสร้างเล่ม 1 ทั่วไ |
| . 446 ล.4 2532 | ข้อแนะนำสำหรับการเขียนแผนภ วงจรไฟฟ้า |
| อก. 1473 2540 | การเขียนแบบเทคนิค การติดตั้ง สัญลักษณ์สำหรับระบบท่อของเหลว ระบบทำความร้อน การระบายอากาศ และระบบท่ออากาศ |

**ที่มา** : http://library.tisi.go.th/data/lib_resources/pdf/catalog-online49/tis/02_ICS.pdf

# Partial List of Drawing Standards

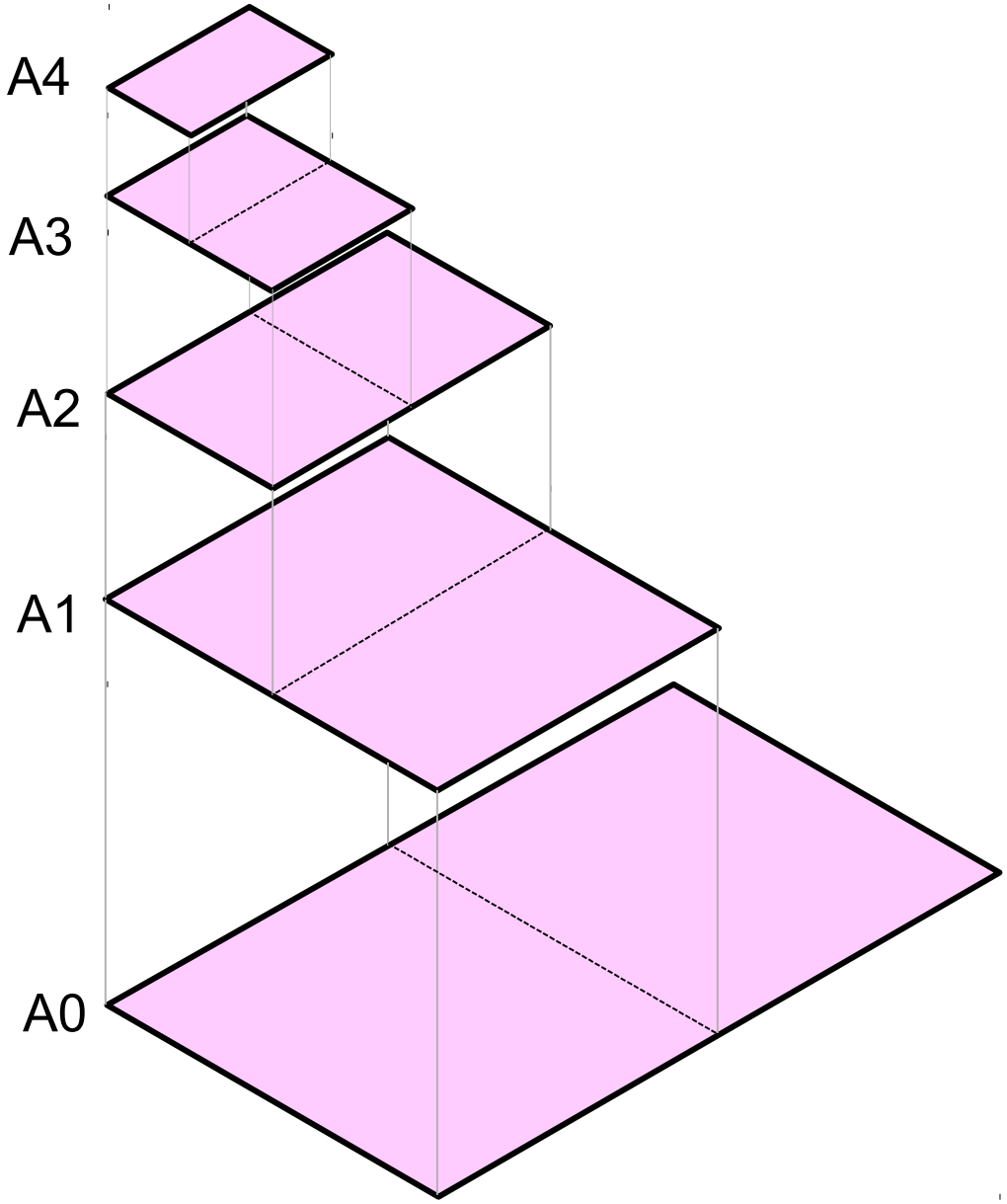
| Code number | Contents |
|---|---|
| JIS Z 8311 | ***Sizes and Format of Drawings*** |
| JIS Z 8312 | ***Line Conventions*** |
| JIS Z 8313 | ***Lettering*** |
| JIS Z 8314 | ***Scales*** |
| JIS Z 8315 | Projection methods |
| JIS Z 8316 | Presentation of Views and Sections |
| JIS Z 8317 | Dimensioning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

# Drawing Sheet

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

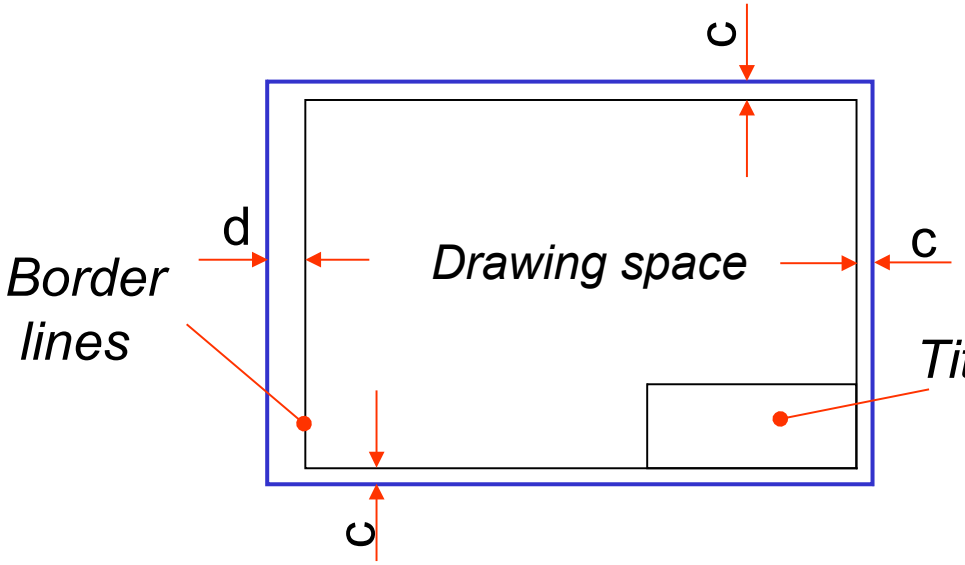
| | |
|---|---|
| A4 | 210 x 297 |
| A3 | 297 x 420 |
| A2 | 420 x 594 |
| A1 | 594 x 841 |
| A0 | 841 x 1189 |

*(Dimensions in millimeters)*

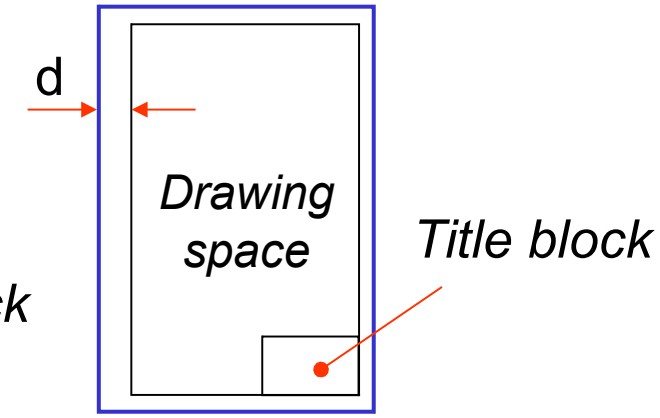


# Orientation of drawing sheet

**1. Type X** (A0~A4)




**2. Type Y** (A4 only)

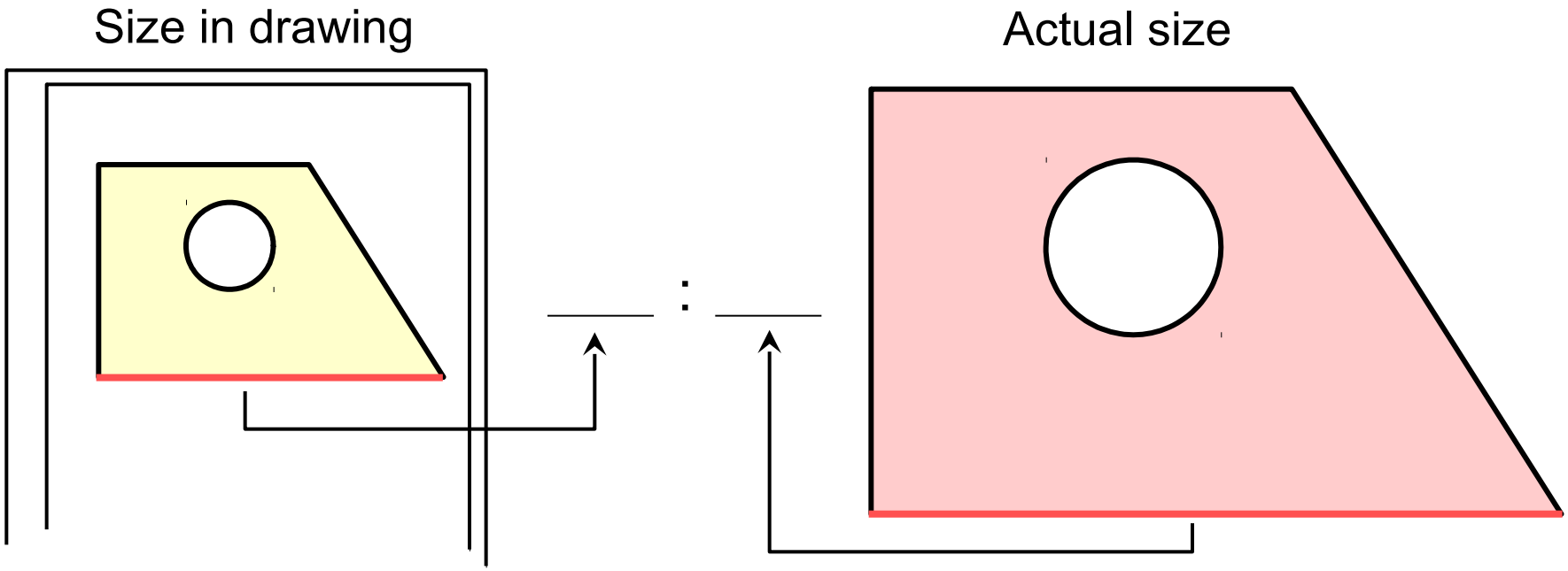



| Sheet size | c (min) | d (min) |
|---|---|---|
| A4 | 10 | 25 |
| A3 | 10 | 25 |
| A2 | 10 | 25 |
| A1 | 20 | 25 |
| A0 | 20 | 25 |

# 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<br>Extension line<br>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

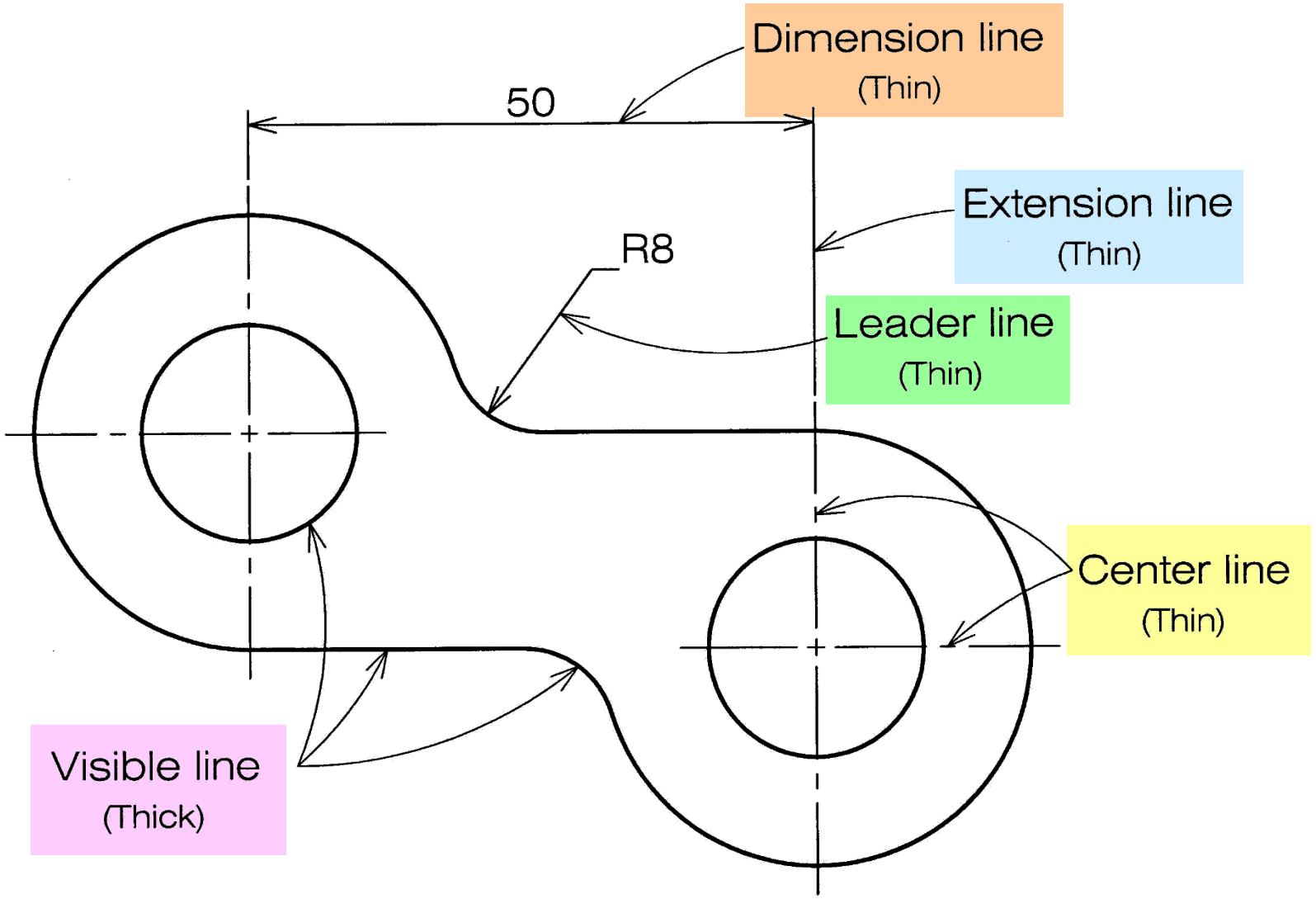
***Visible lines*** represent features that can be seen in the current view

***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

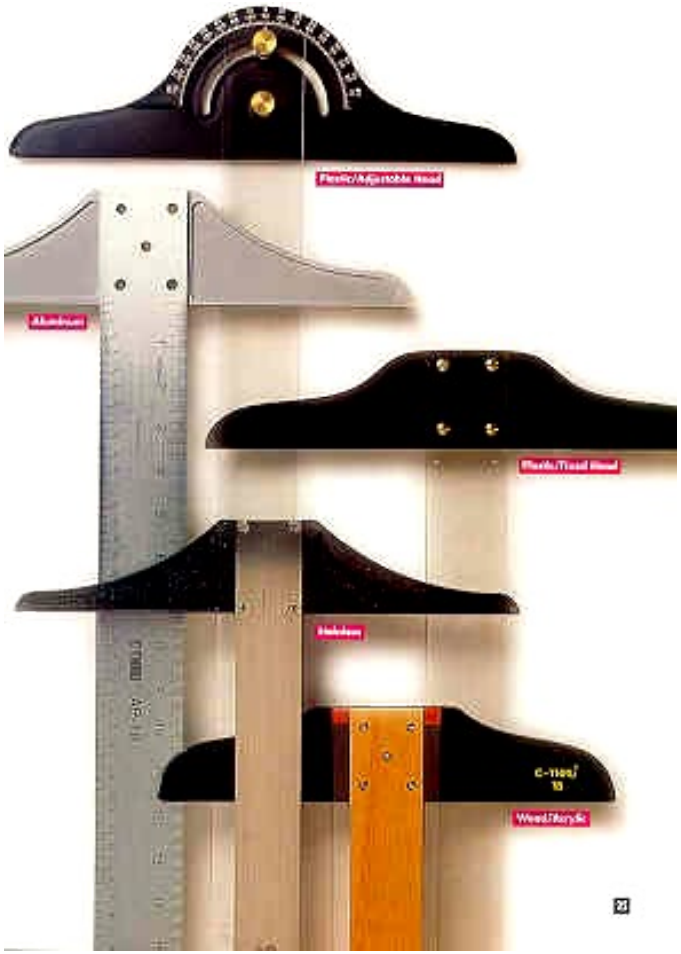
## ***Example*** : *Line conventions in engineering drawing*

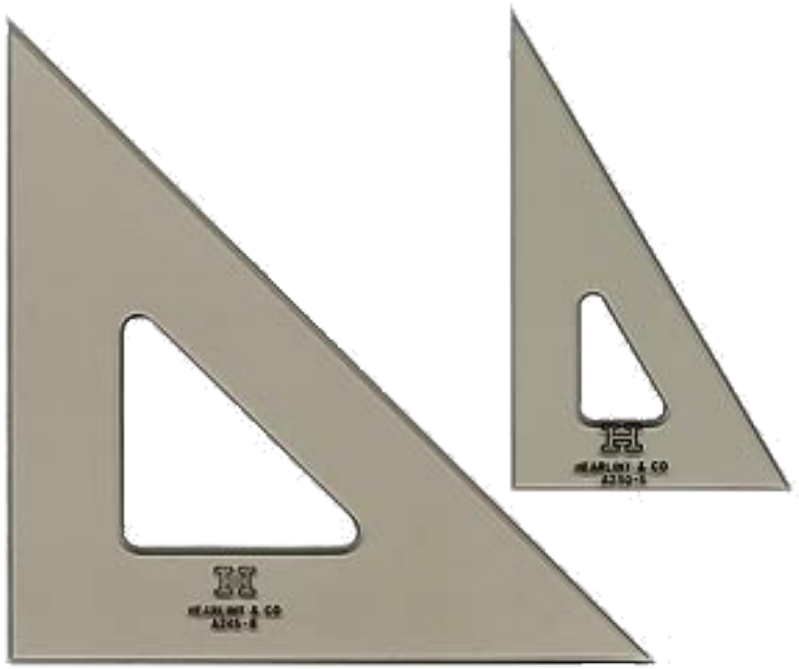


# Traditional Drawing Tools

# DRAWING TOOLS

# DRAWING TOOLS





1. T-Square

2. Triangles

# DRAWING TOOLS


**2H or HB for thick line**

**4H for thin line**


3. Adhesive Tape

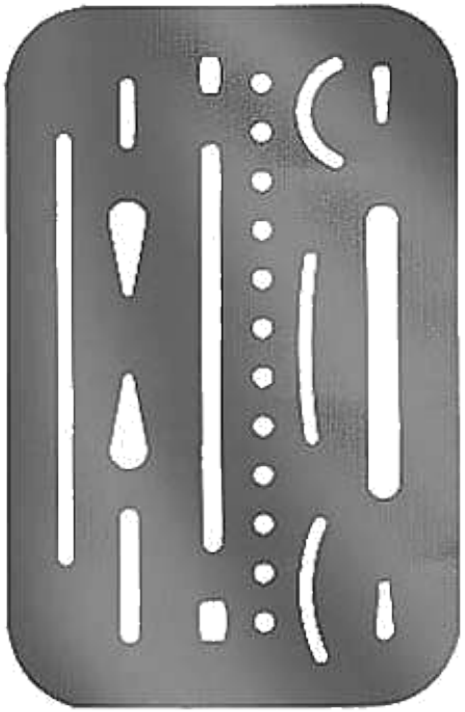
4. Pencils

# DRAWING TOOLS

5. Sandpaper


6. Compass

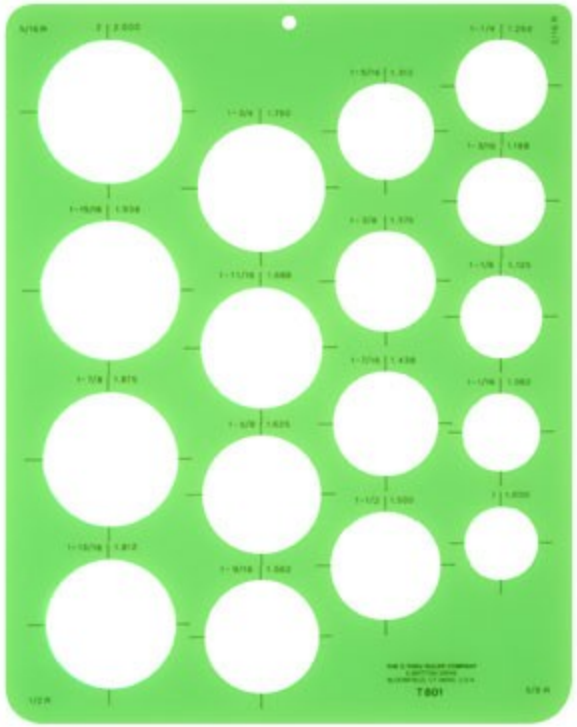
# DRAWING TOOLS

7. Pencil Eraser

8. Erasing Shield

# DRAWING TOOLS



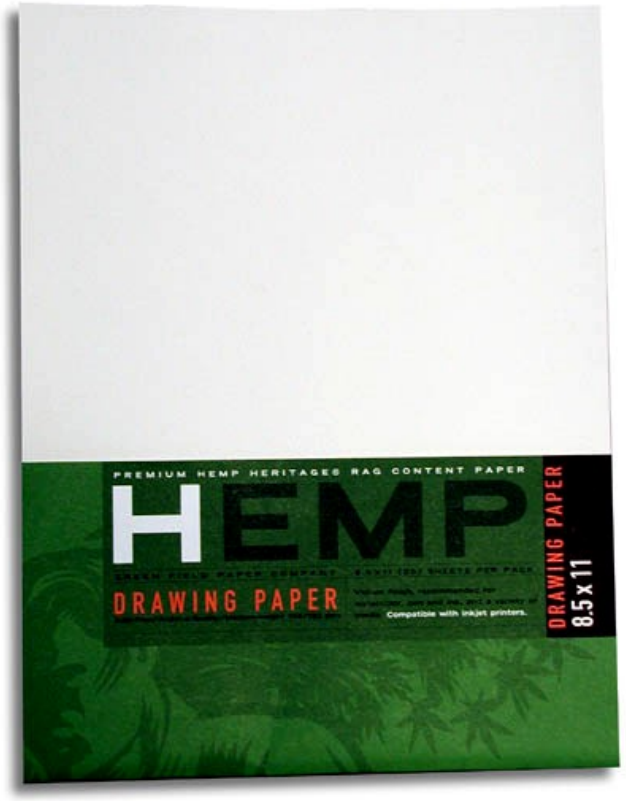

9. Circle Template

10. Tissue paper

# DRAWING TOOLS



11. Sharpener




12. Clean paper

# Lettering

# Text on Drawings

Text on engineering drawing is used :

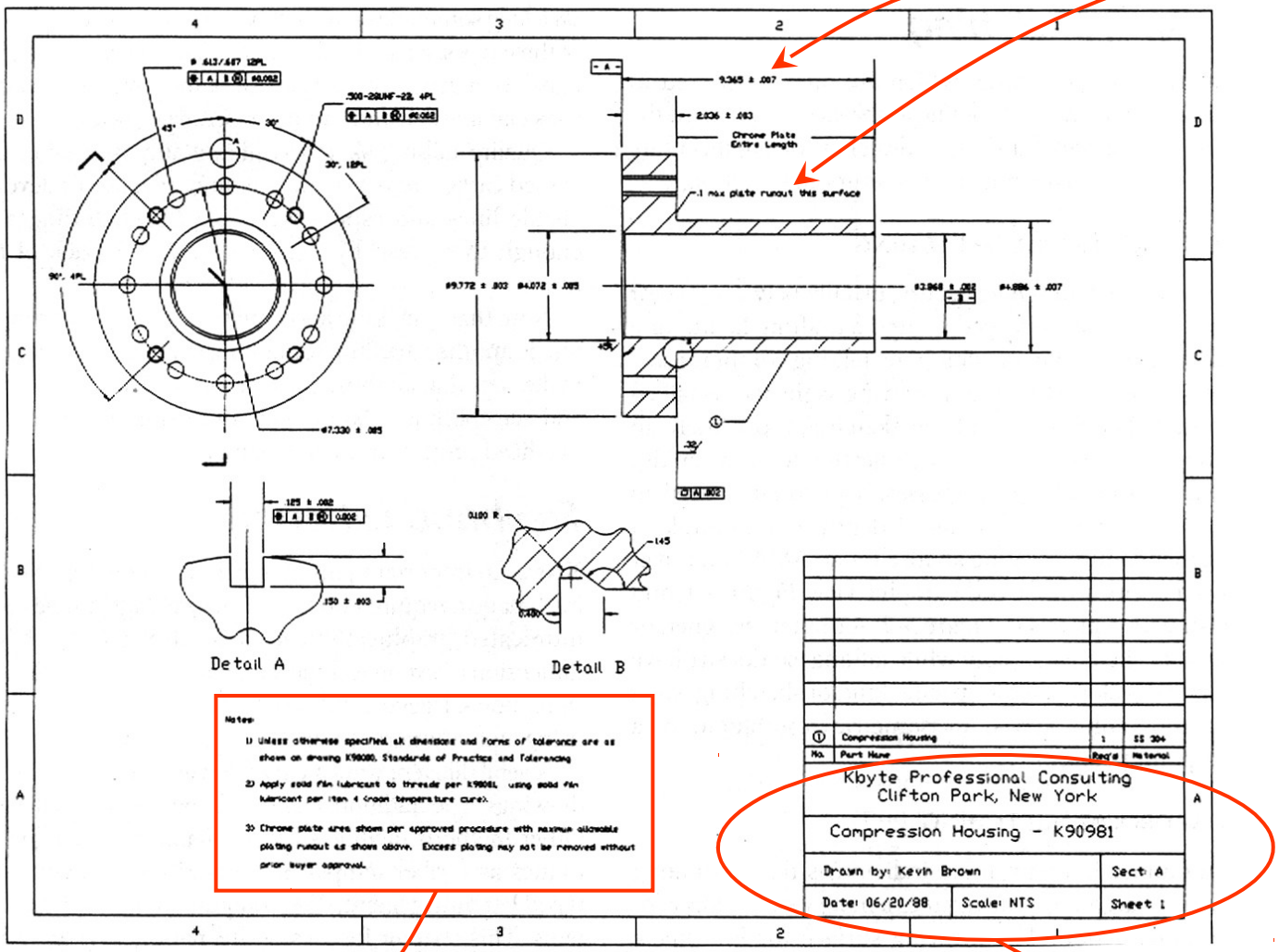
- To communicate nongraphic information.
- As a substitute for graphic information, in those instance where text can communicate the needed information more clearly and quickly.

Thus, it must be written with

***Legibility*** - shape
- space between letters and words

***Uniformity*** - size
- line thickness

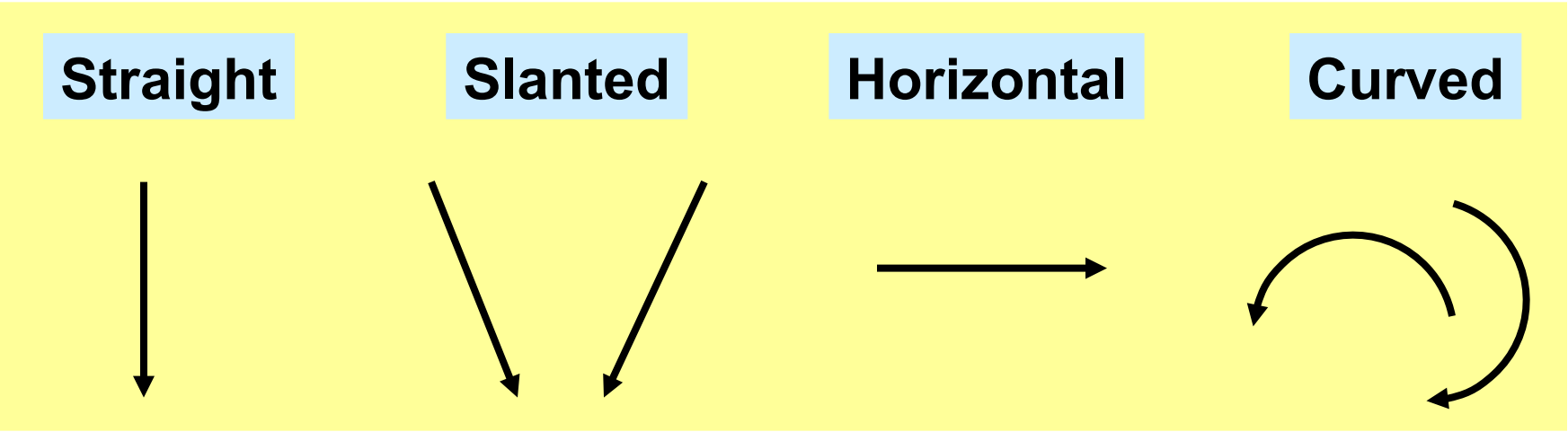
# Example *Placement of the text on drawing*



# 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. |

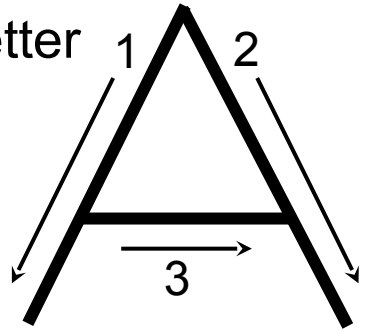
# Basic Strokes



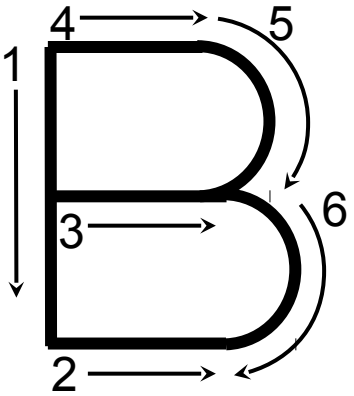

**Examples :** *Application of basic stroke*

"**I**" letter


"**A**" letter




"**B**" letter

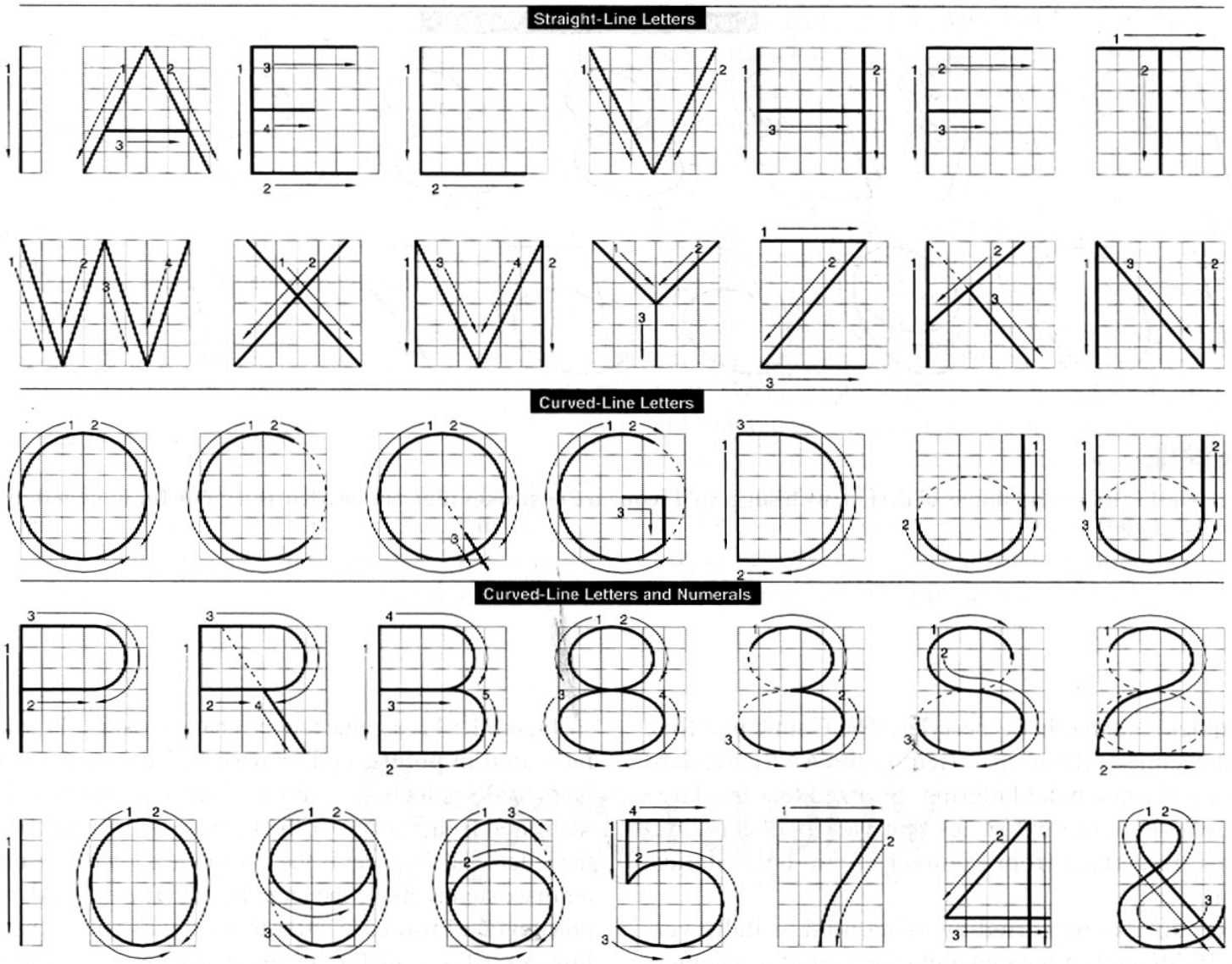


# Upper-case letters & Numerals

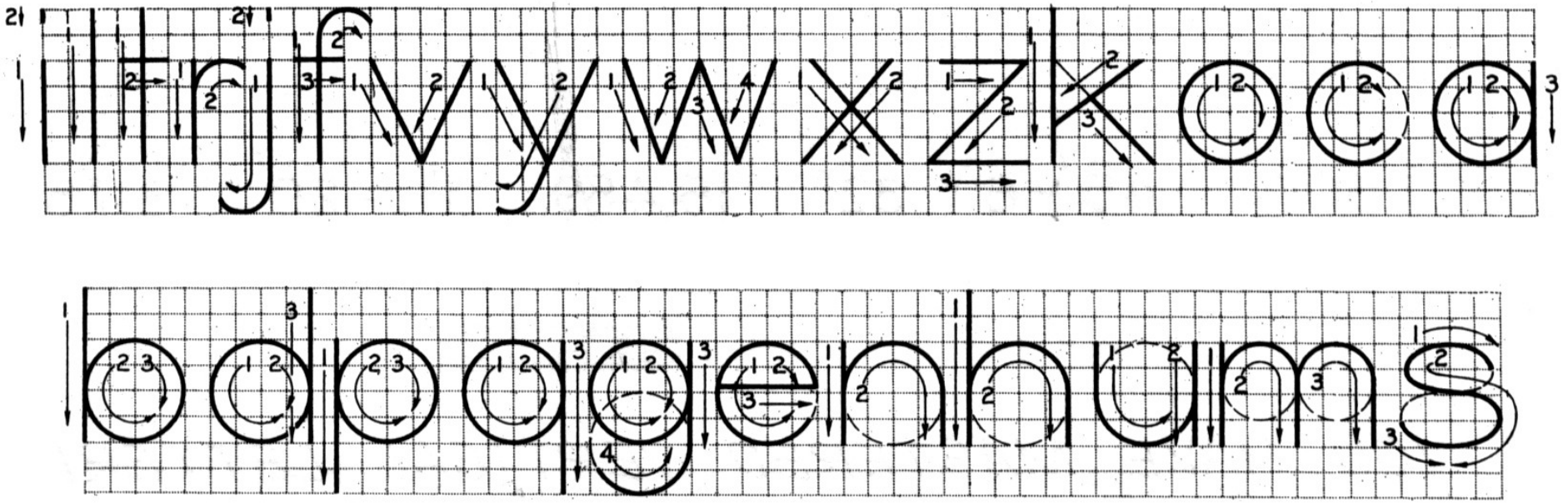
Straight line letters

Curved line letters

Curved line letters & Numerals



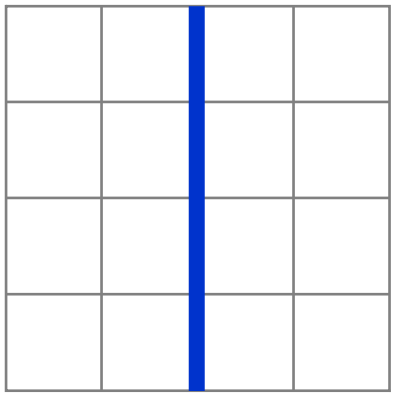
# Lower-case letters



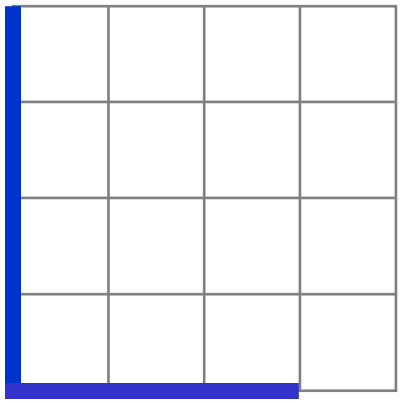
- The text' s body height is about 2/3 the height of a capital letter.

# Stroke Sequence

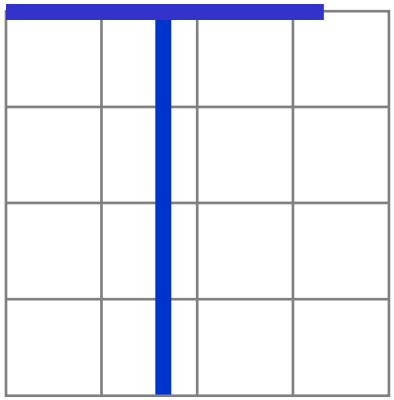
I



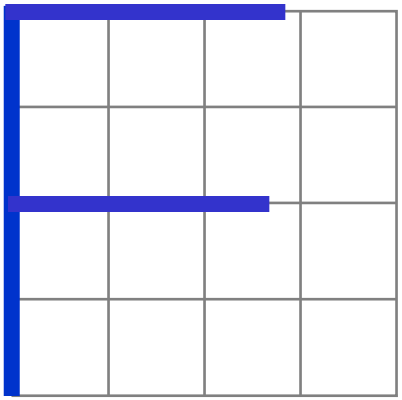
L



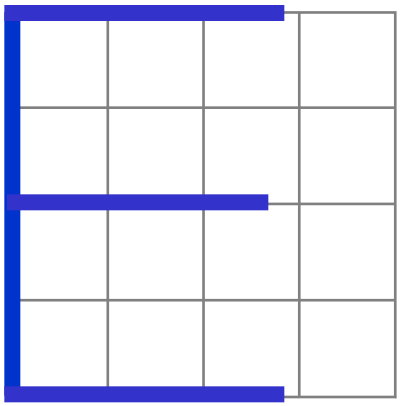
T



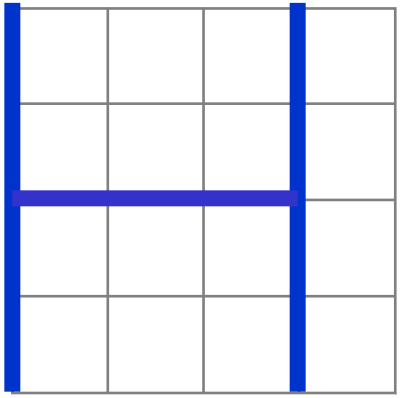
F



E

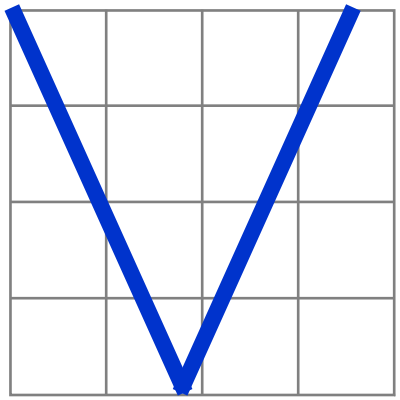


H

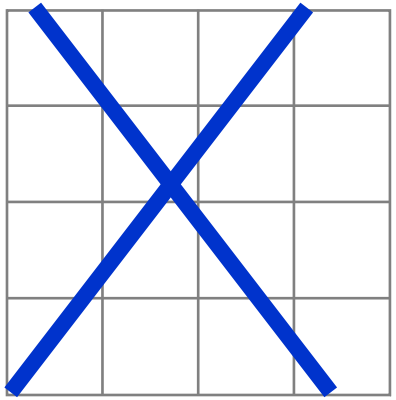


# Stroke Sequence

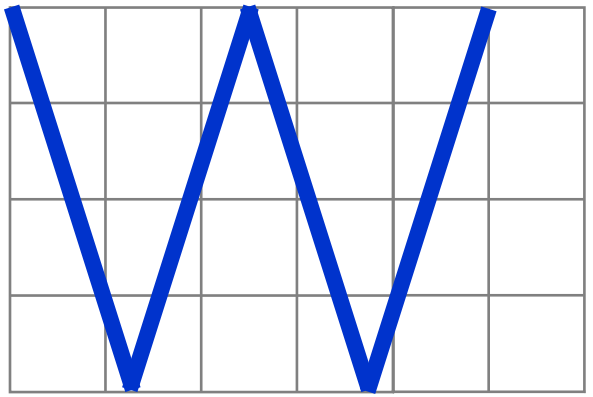
V



X



W



# Stroke Sequence

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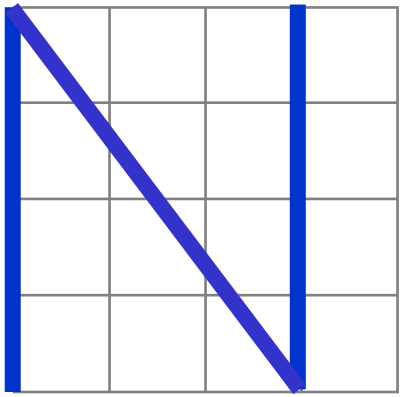

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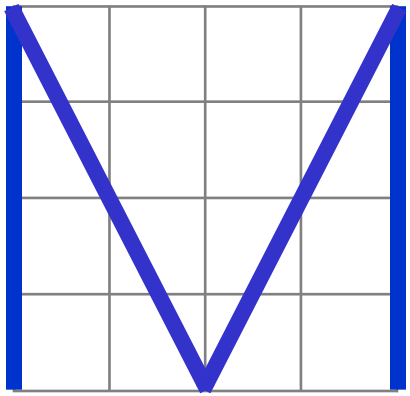

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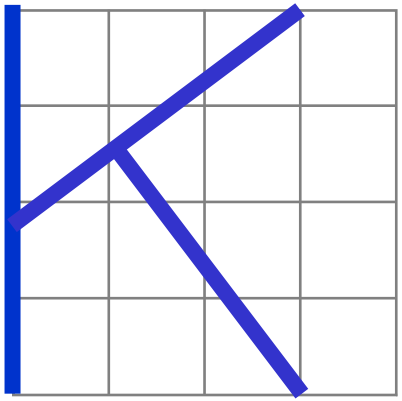

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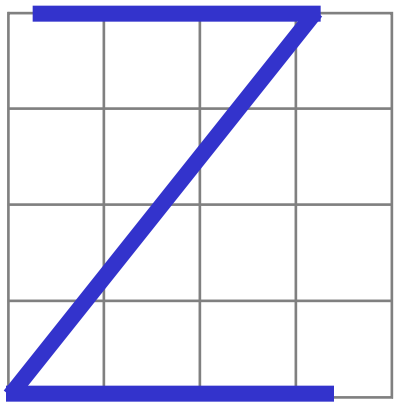

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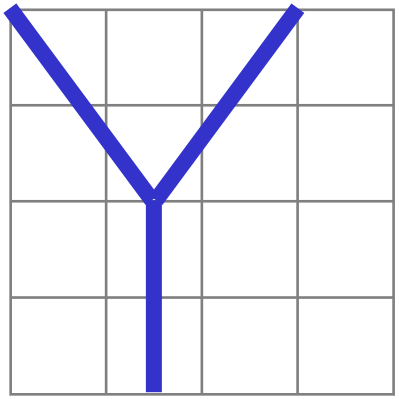

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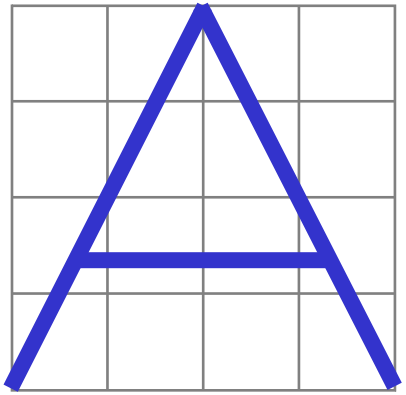

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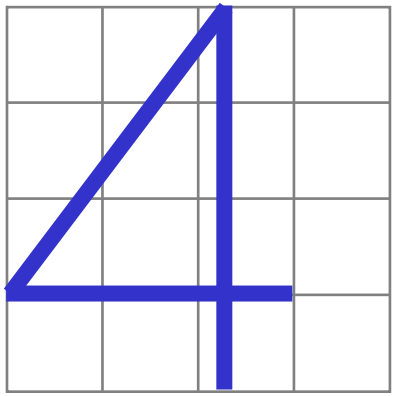

# Stroke Sequence

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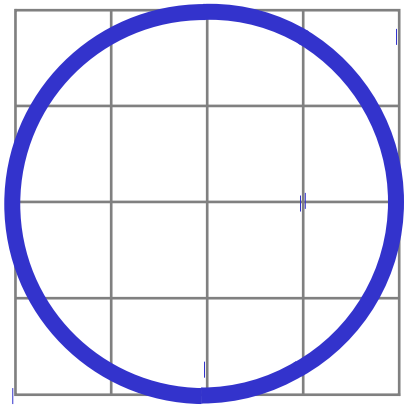

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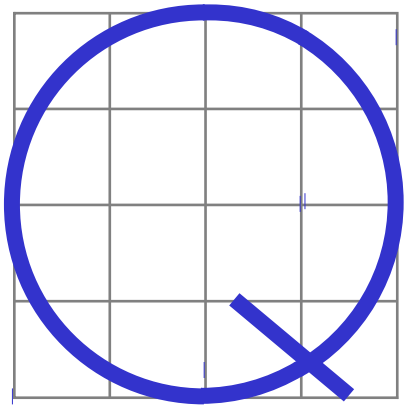

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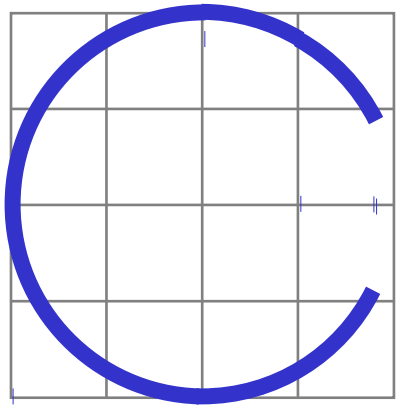

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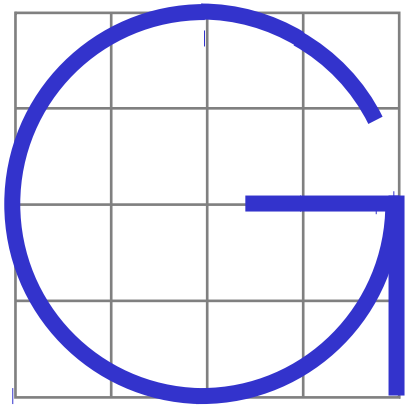

# Stroke Sequence

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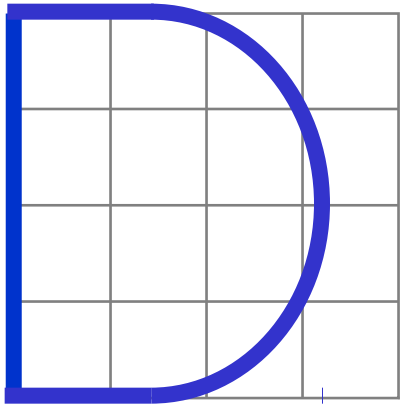

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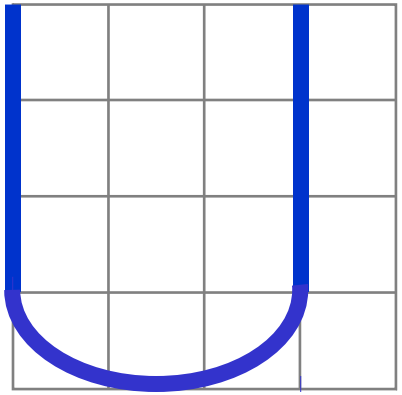

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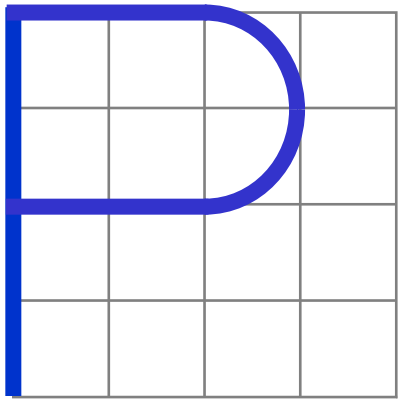

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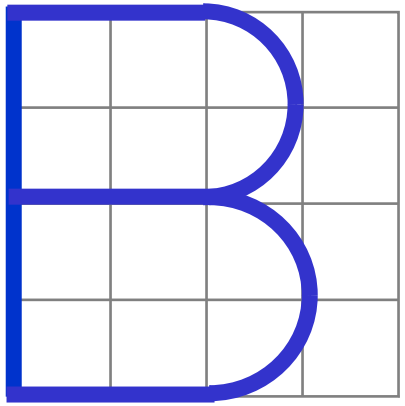

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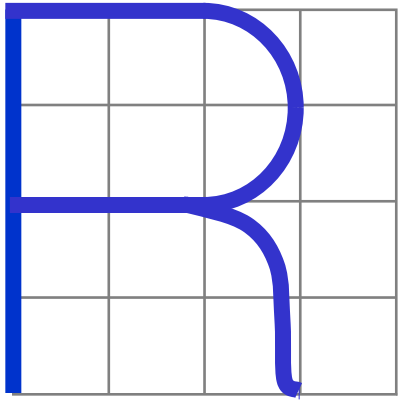

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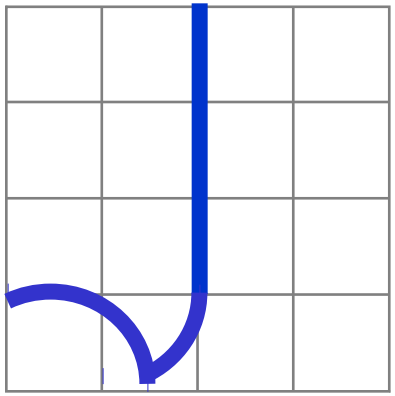

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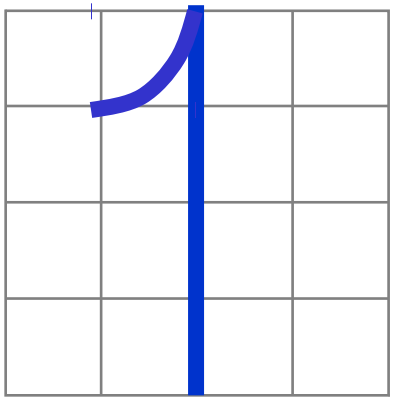

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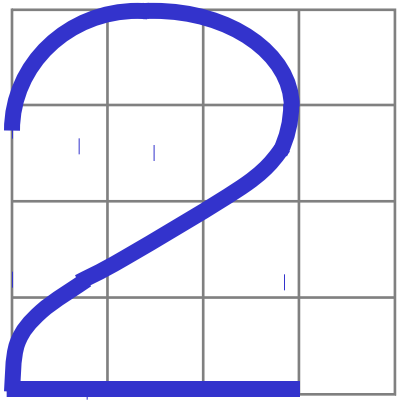

# Stroke Sequence

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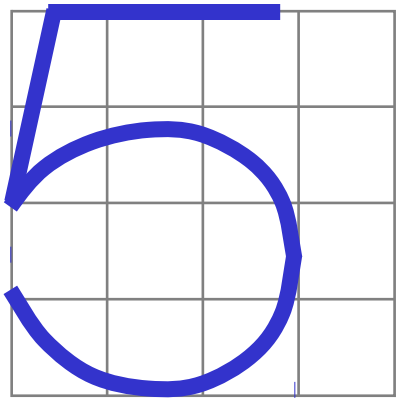

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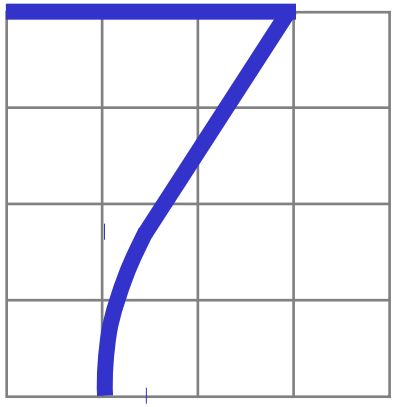

# Stroke Sequence

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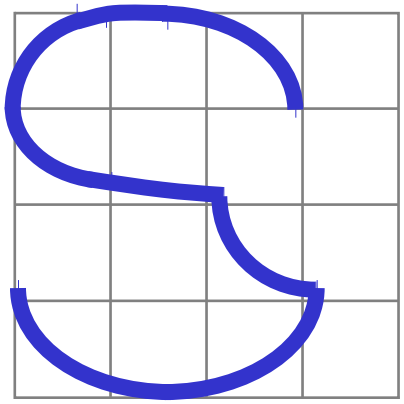

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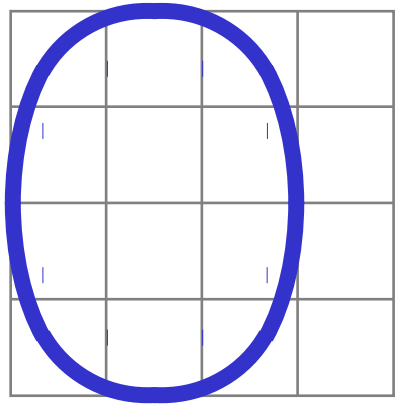

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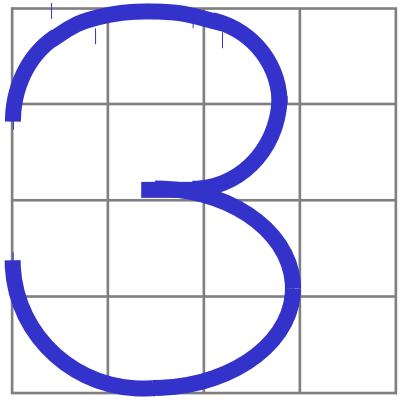

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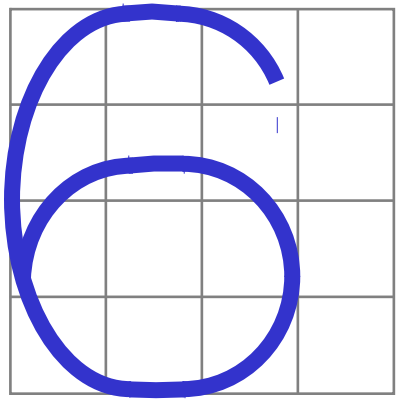

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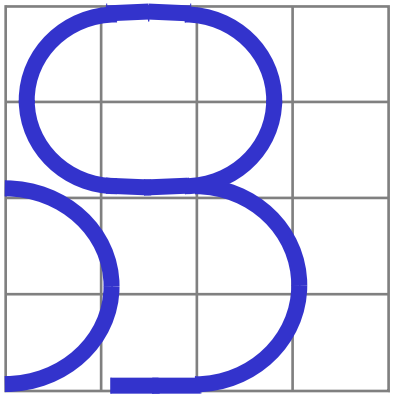

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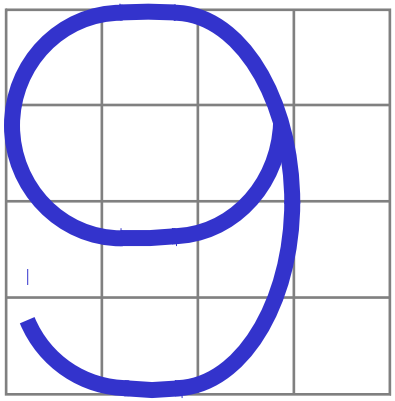

# Stroke Sequence

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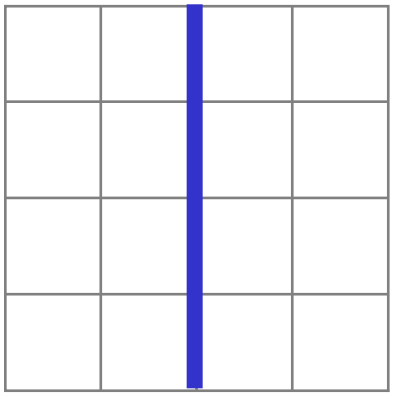

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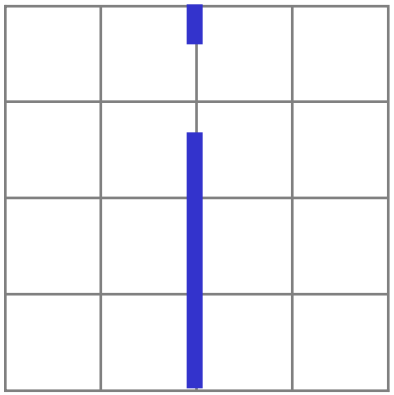

# Stroke Sequence

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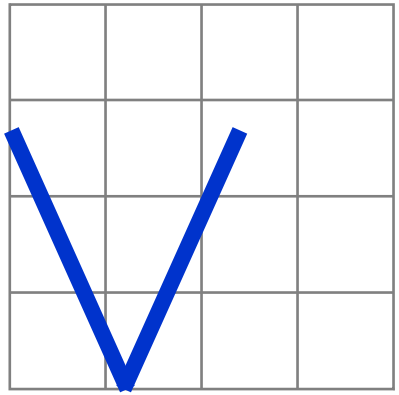

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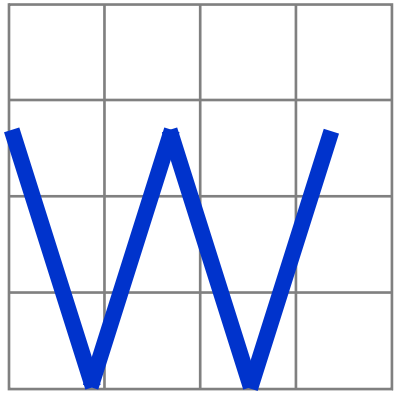

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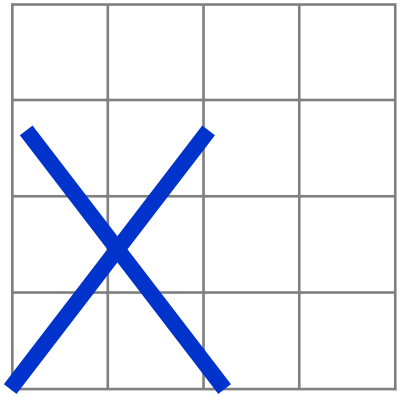

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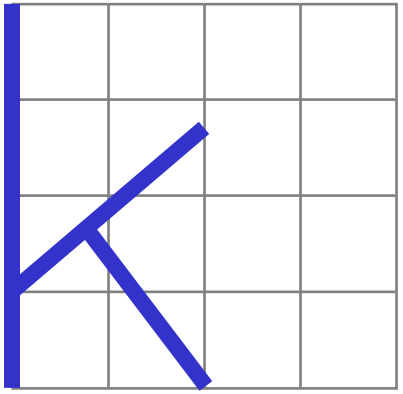

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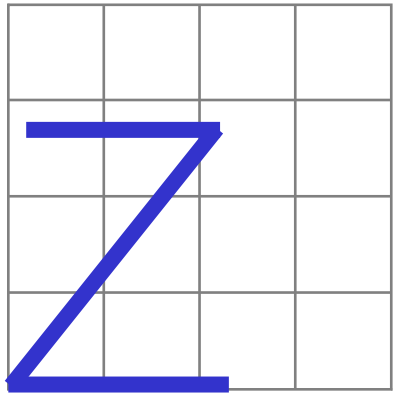
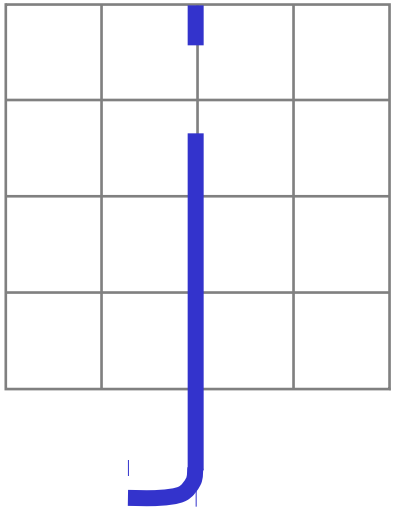


# Stroke Sequence

j



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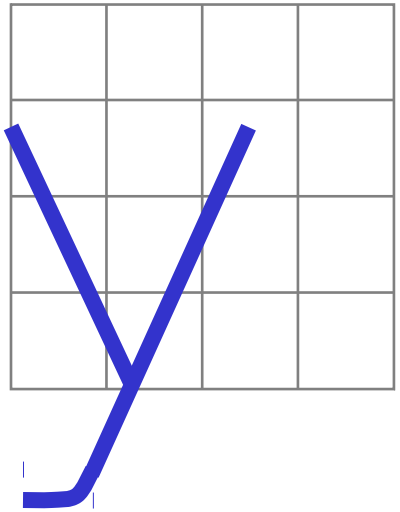

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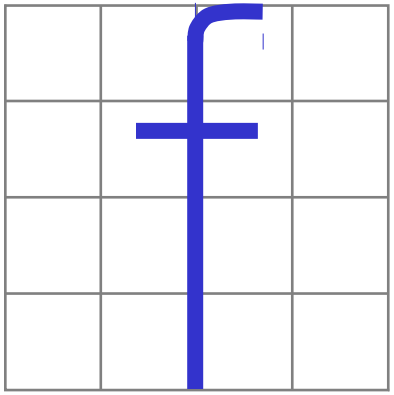

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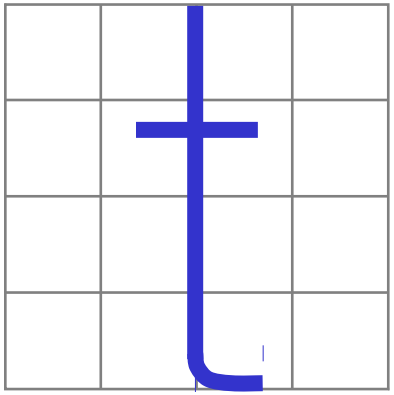

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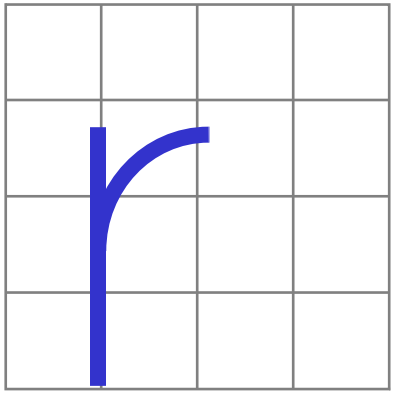

# Stroke Sequence

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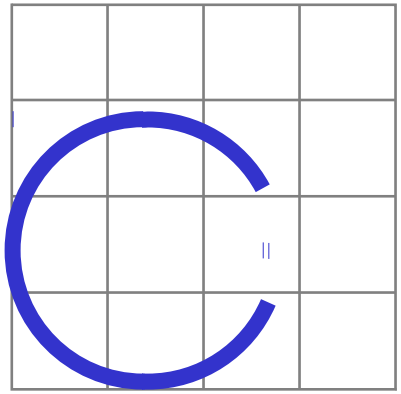

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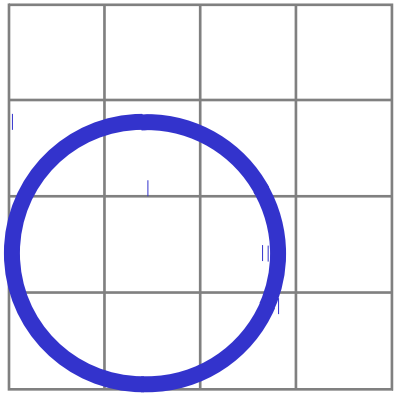

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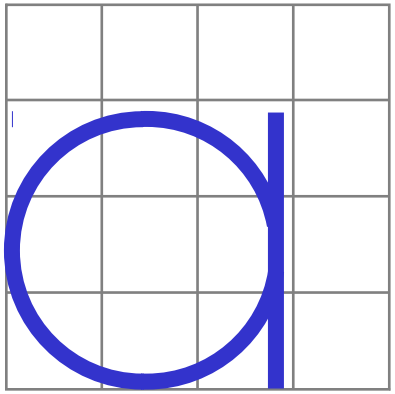

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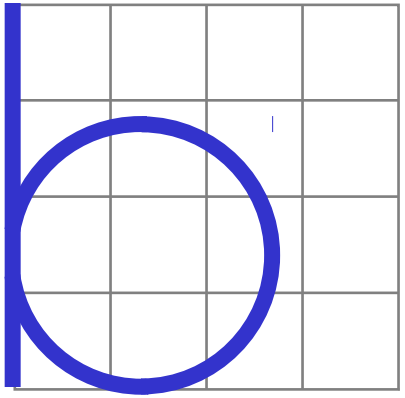

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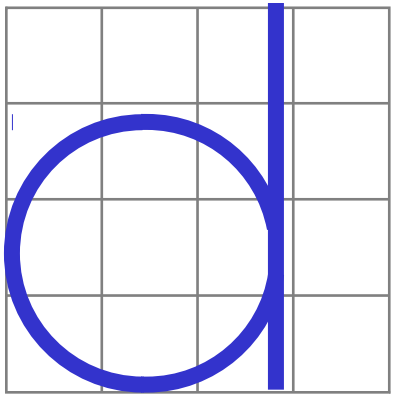

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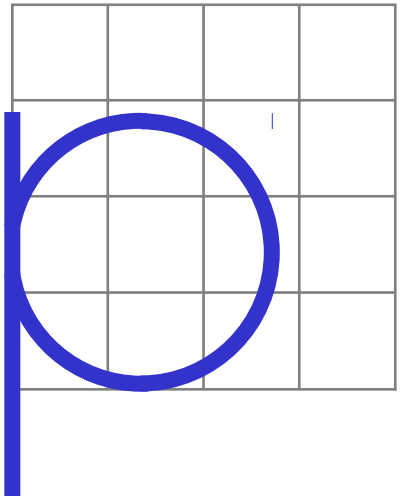

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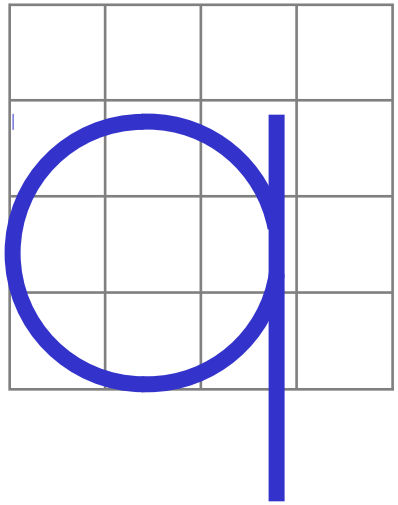

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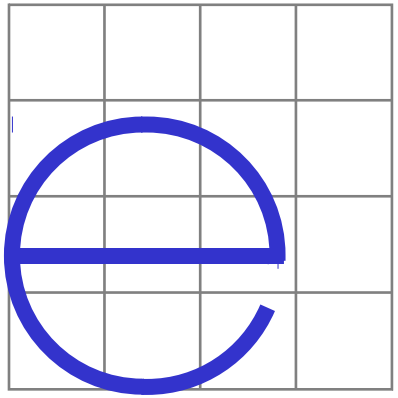
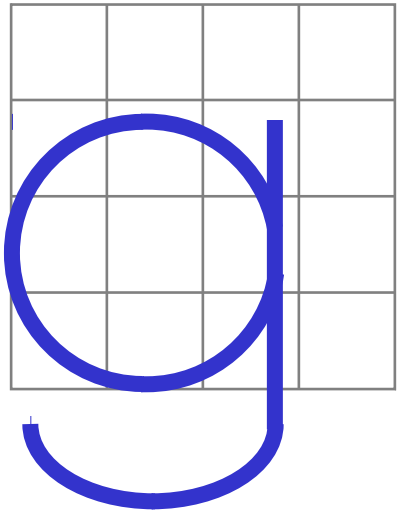


# Stroke Sequence

g



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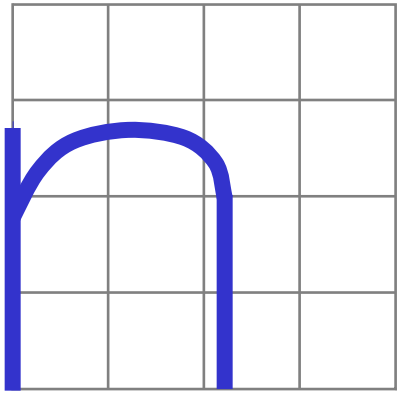

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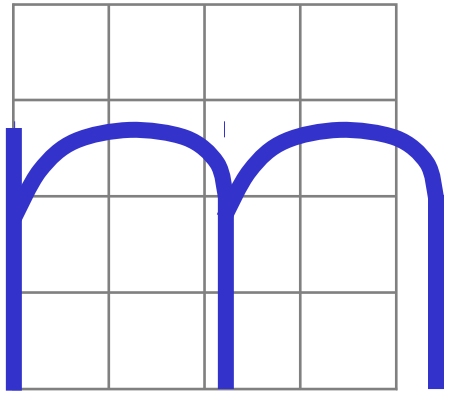

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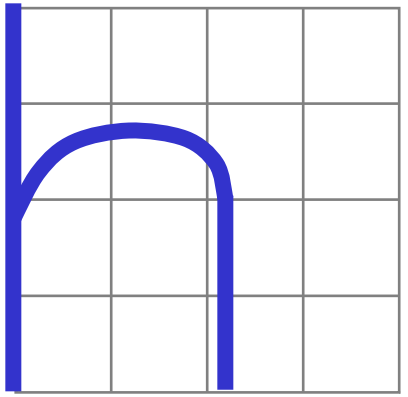

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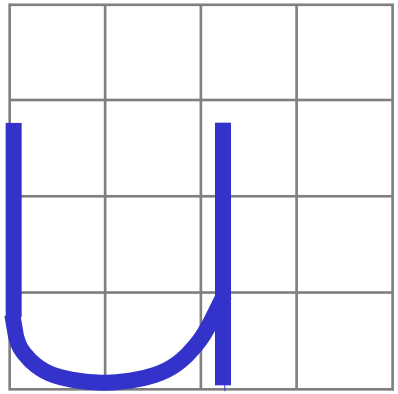

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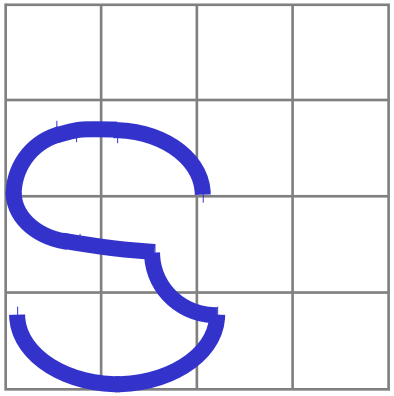
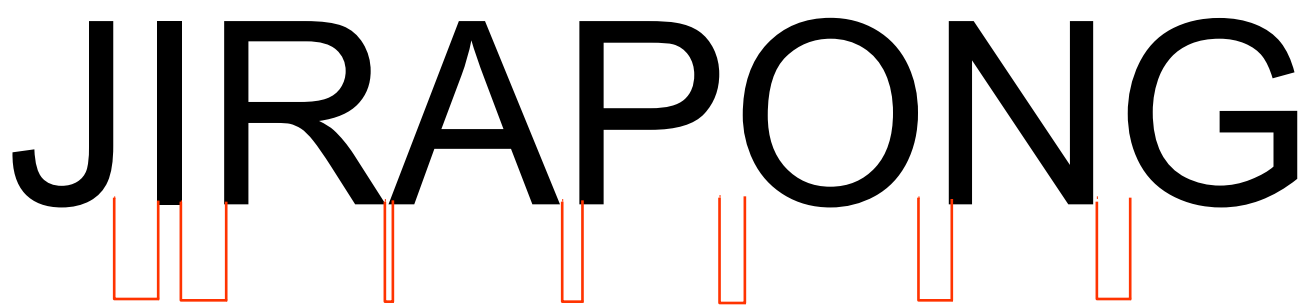


# Word Composition

Look at the same word having different spacing between letters.

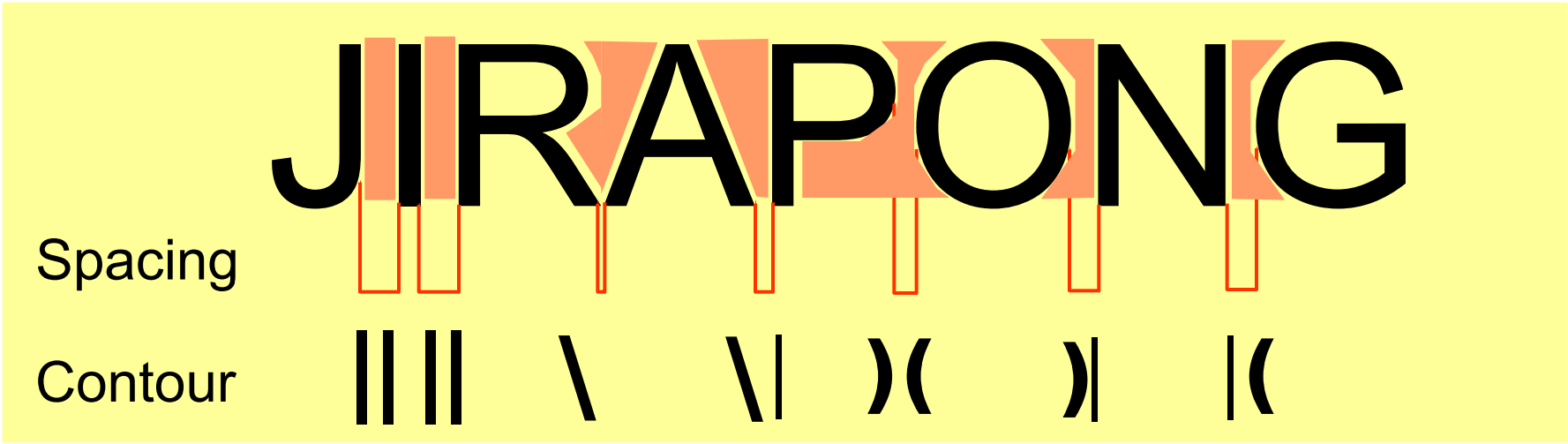
A) Non-uniform spacing




B) Uniform spacing


Which one is easier to read ?

# Word Composition

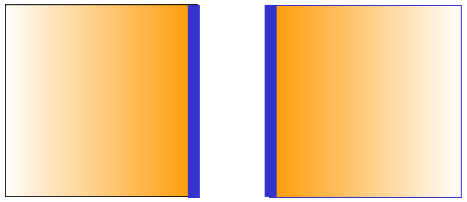



General conclusions are:

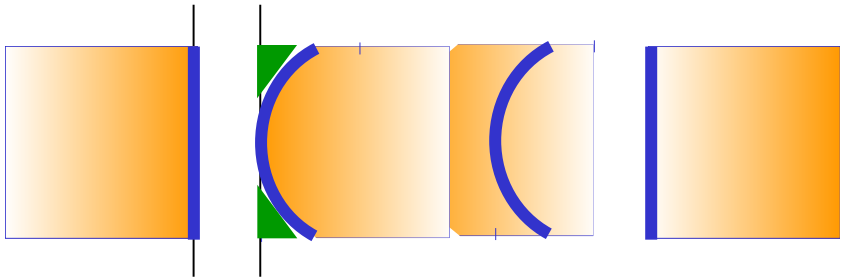
- Space between the letters depends on the contour of the letters at an adjacent side.
- Good spacing creates approximately equal ***background area*** between letters.

# Space between Letters

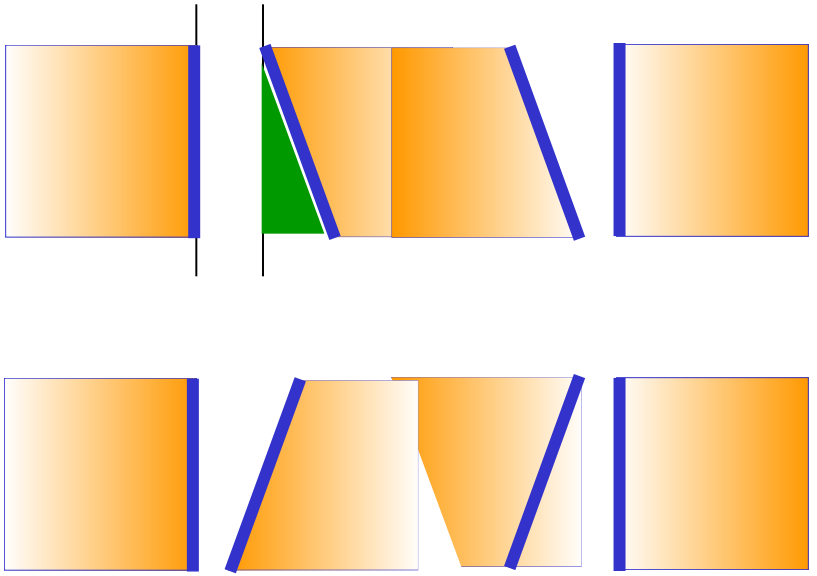
1. Straight - Straight



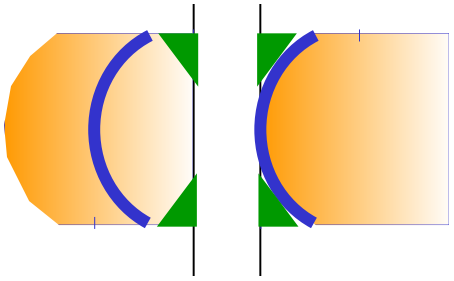
2. Straight - Curve



3. Straight - Slant

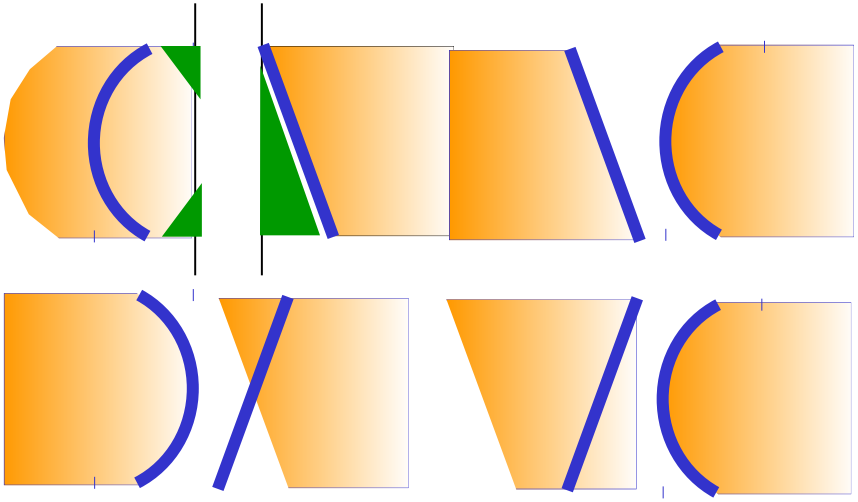


4. Curve - Curve

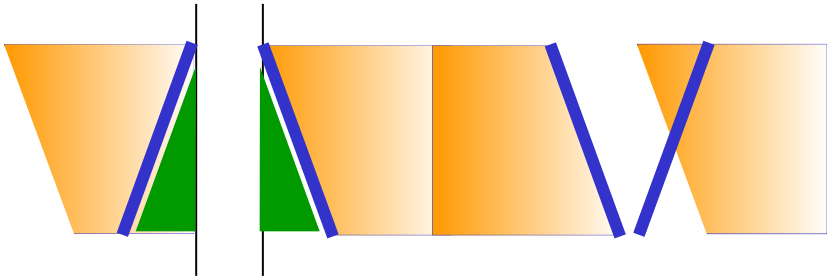


# Space between Letters

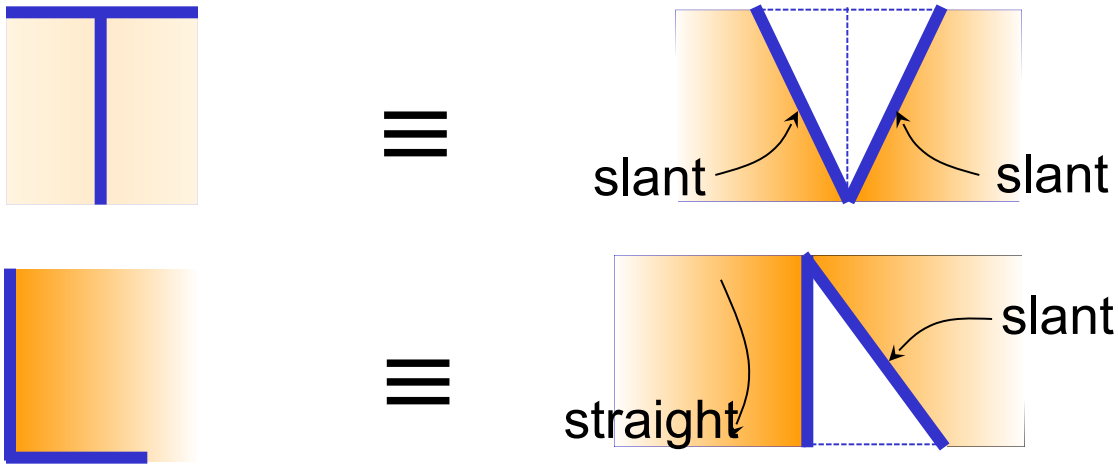
5. Curve - Slant



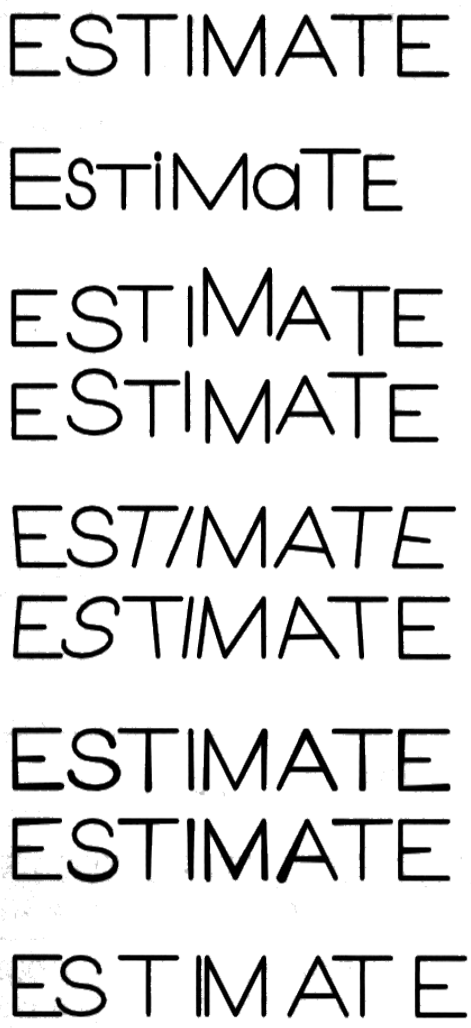
6. Slant - Slant



7. The letter “L” and “T”



# **Example** : *Good and Poor Lettering*




**GOOD**

Not uniform in style.

Not uniform in height.

Not uniformly vertical or inclined.

Not uniform in thickness of stroke.

Area between letters not uniform.

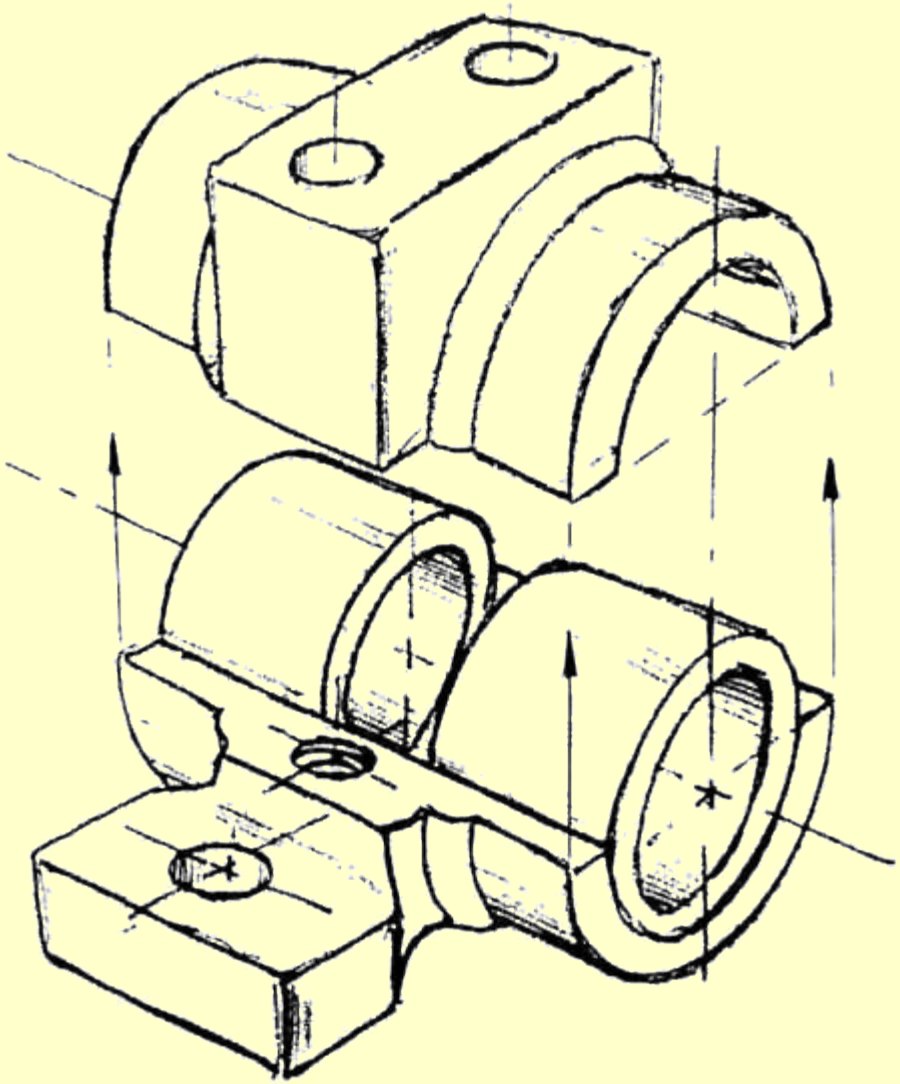
Area between words not uniform.

# 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.



# Freehand Sketching

# Straight Line

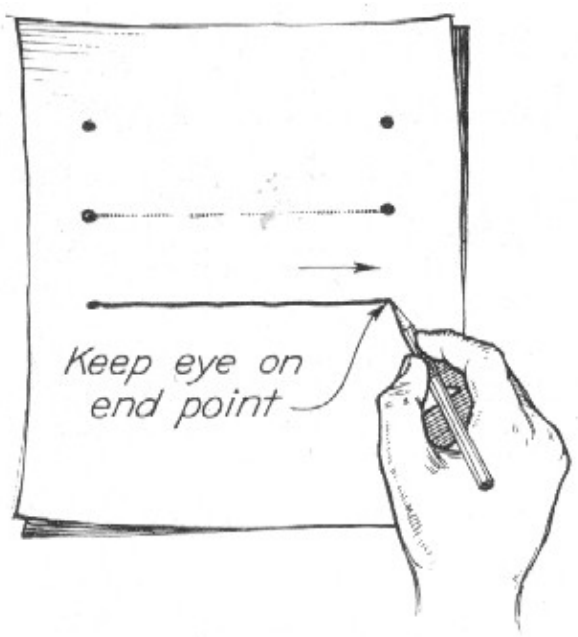
1. Hold the pencil naturally.

2. Spot the beginning and end points.

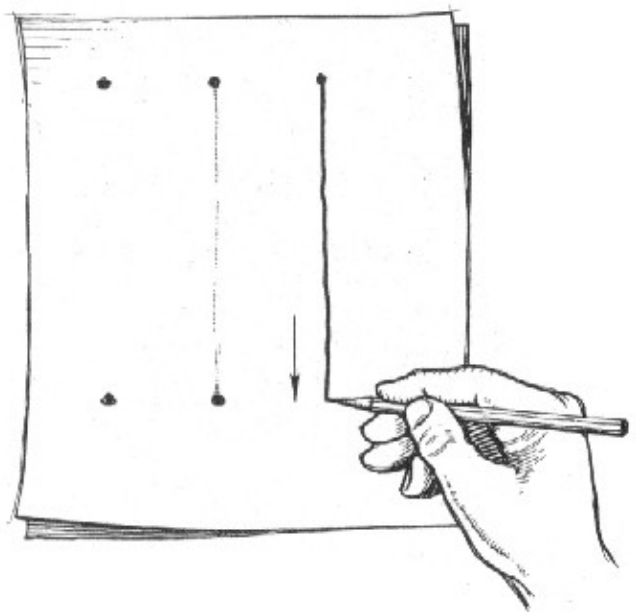
3. Swing the pencil back and forth between the points, barely touching the paper until the direction is clearly established.

4. Draw the line firmly with a free and easy wrist-and-arm motion

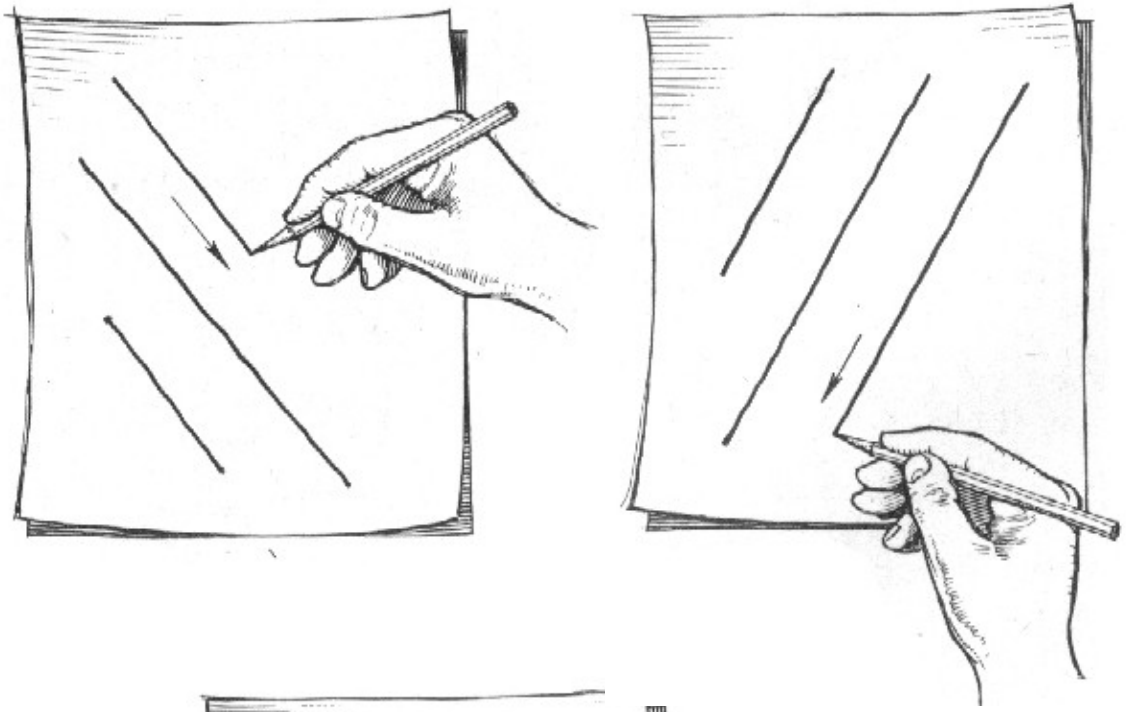
## Horizontal line




## Vertical line



***Nearly vertical inclined line***



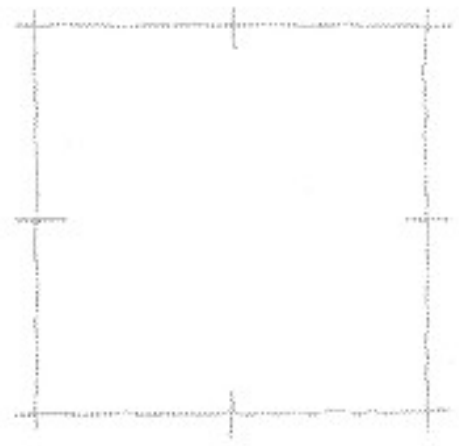
***Nearly horizontal inclined line***

# Small Circle

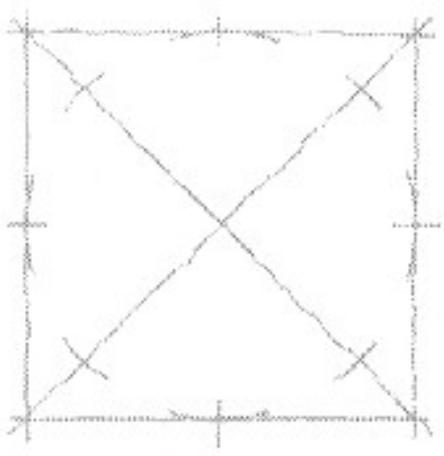
## Method 1 : Starting with a square

1. Lightly sketching the square and marking the mid-points.
2. Draw light diagonals and mark the estimated radius.
3. Draw the circle through the eight points.

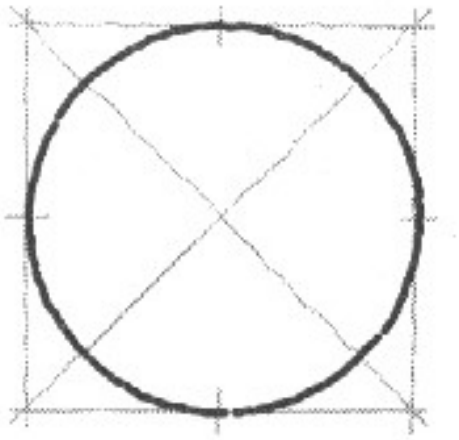
**Step 1**



**Step 2**



**Step 3**



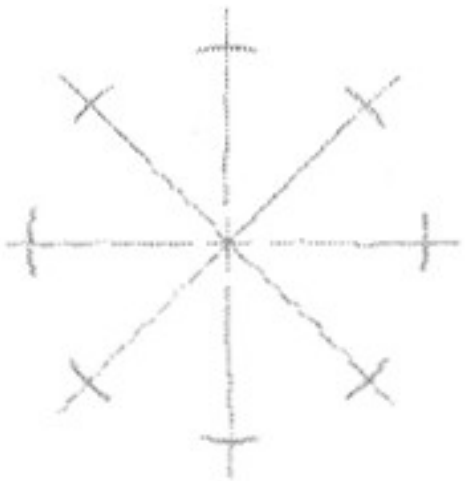
# Small Circle

## Method 2 : Starting with center line

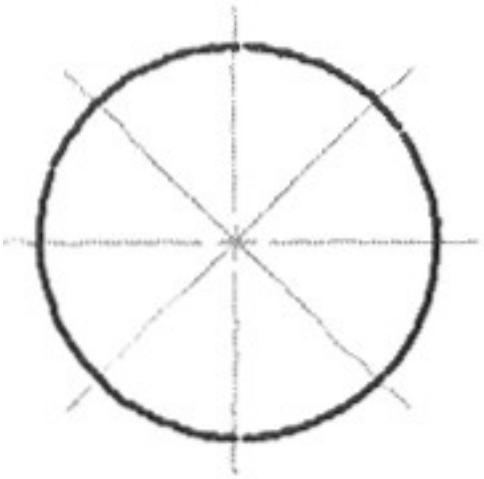
1. Lightly draw a center line.
2. Add light radial lines and mark the estimated radius.
3. Sketch the full circle.

**Step 1**

**Step 2**

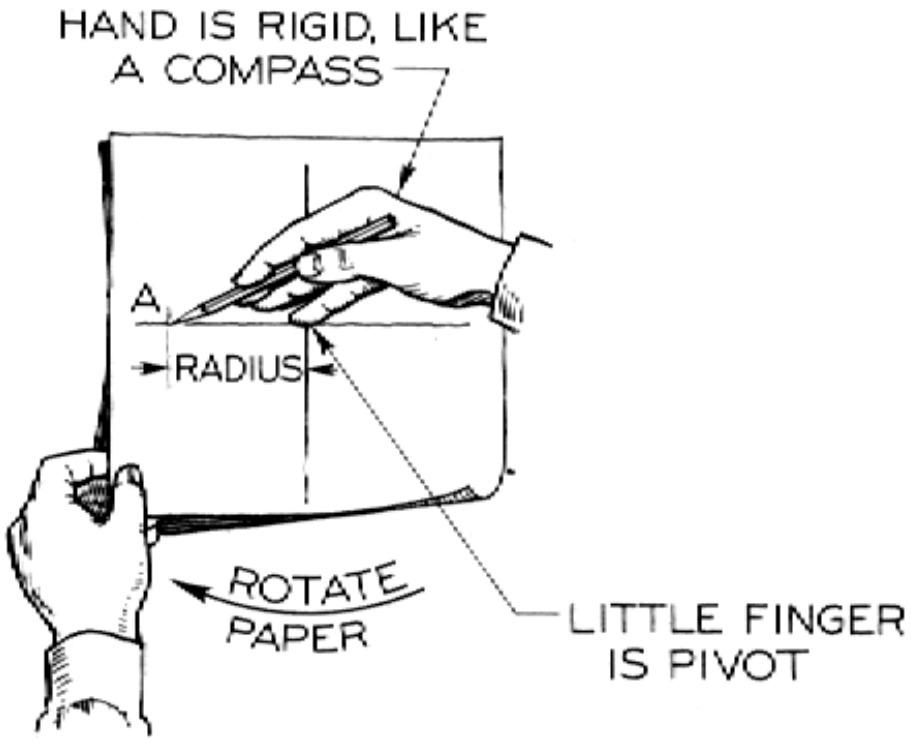


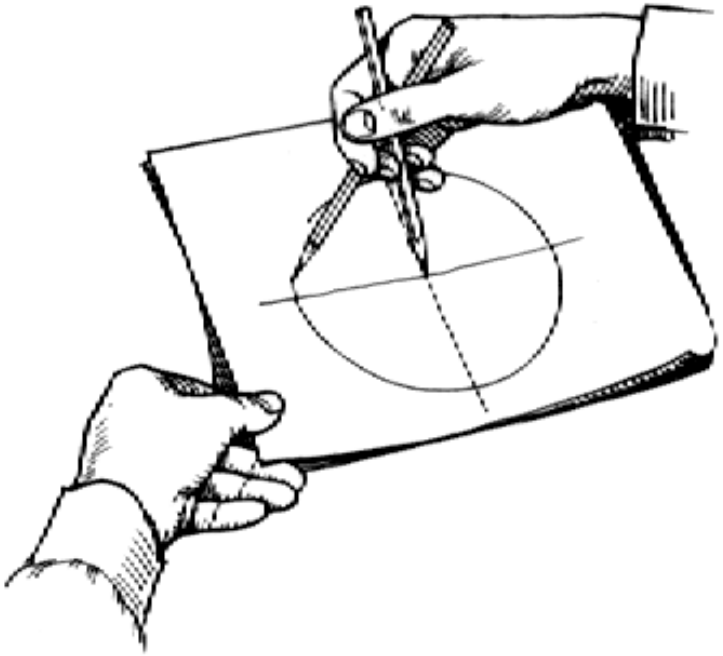
**Step 3**



# Large Circle

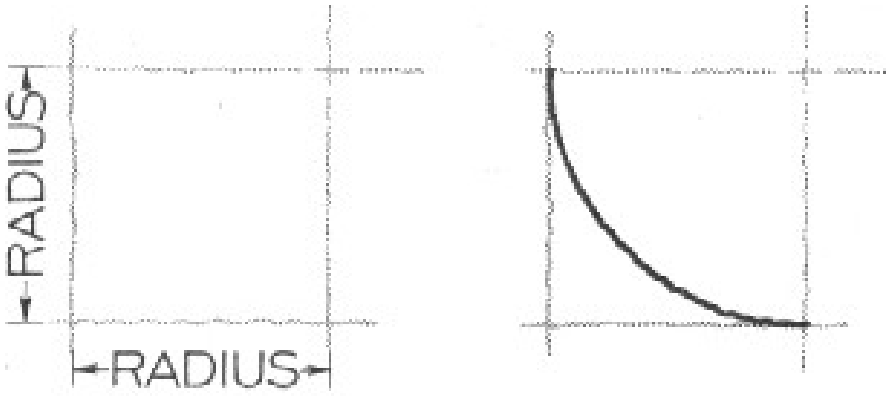
1. Place the little finger (or pencil' s tip) at the center as a pivot, and set the pencil point at the radius-distance from the center.
2. Hold the hand in this position and rotate the paper.



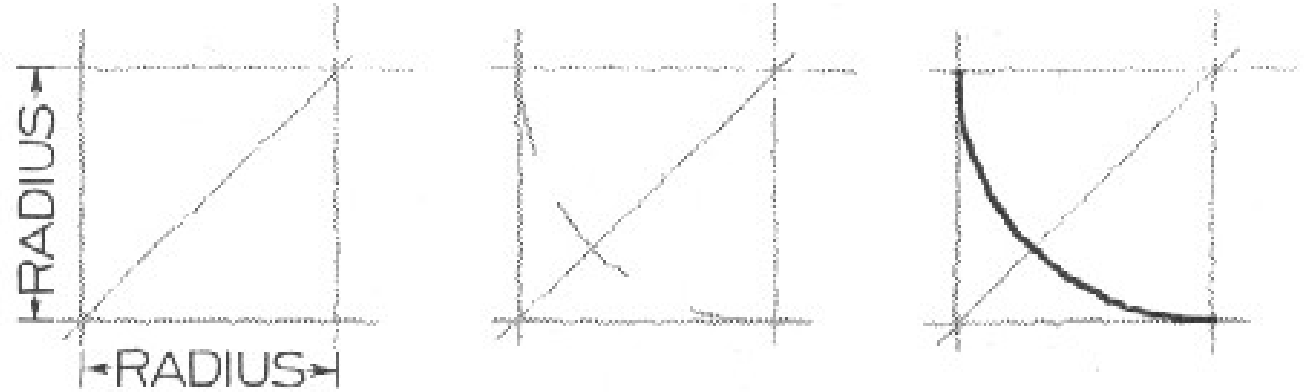



# Arc

## Method 1 : Starting with a square




## Method 2 : Starting with a center line



# Steps in Sketching

1. Block in main shape.
2. Locate the features.
3. Sketch arcs and circles.
4. Sketch lines.

# Example