
Civinnovate
Discover, Learn, and Innovate in Civil Engineering

Chapter 1

Overview of an Engineering Drawing

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TOPICS

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

TOPICS

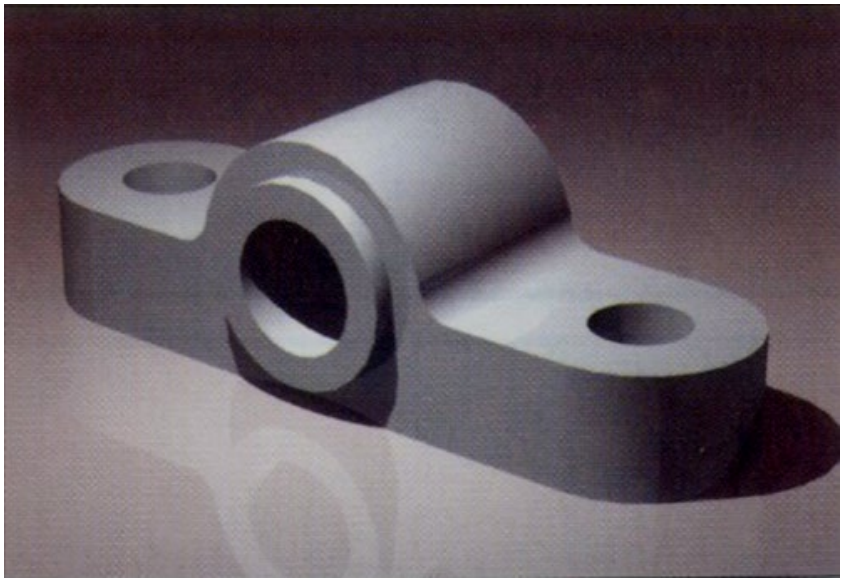
- Traditional Drawing Tools
- Lettering
- Freehand Sketching

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

Composition of Graphic Language

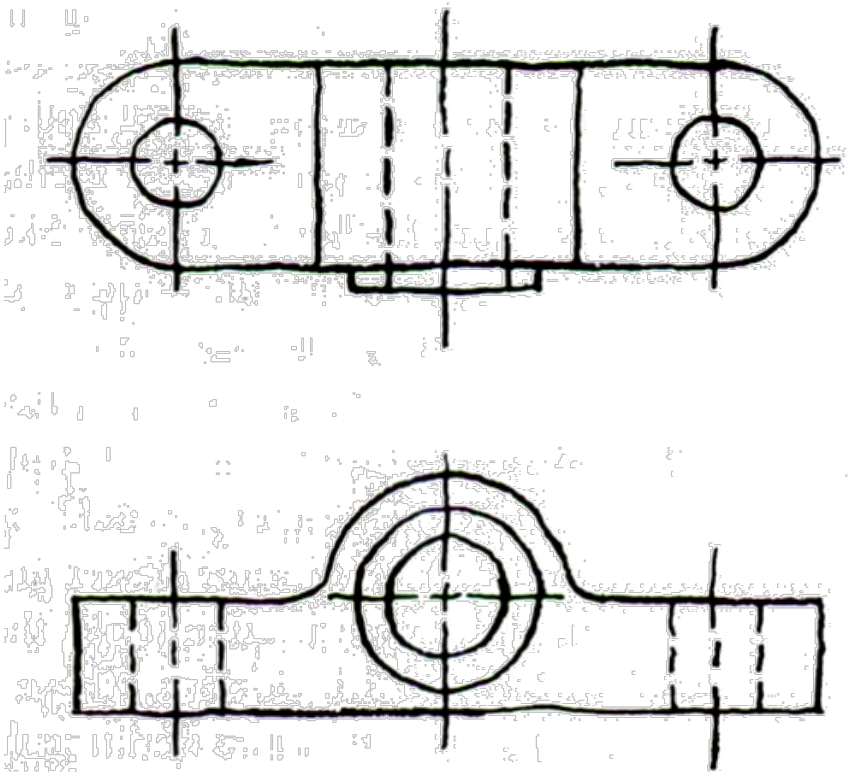
Graphic language in **"engineering application"** use ***lines*** to represent the ***surfaces***, ***edges*** and ***contours*** of objects.

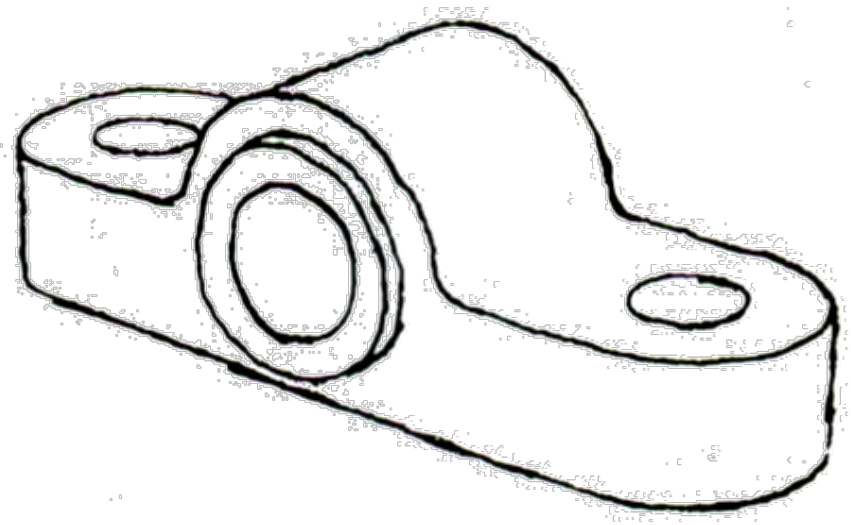
- The language is known as "***drawing***" or "***drafting***".
- A drawing can be done using ***freehand***, ***instruments*** or ***computer*** methods.

Freehand drawing

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

Example

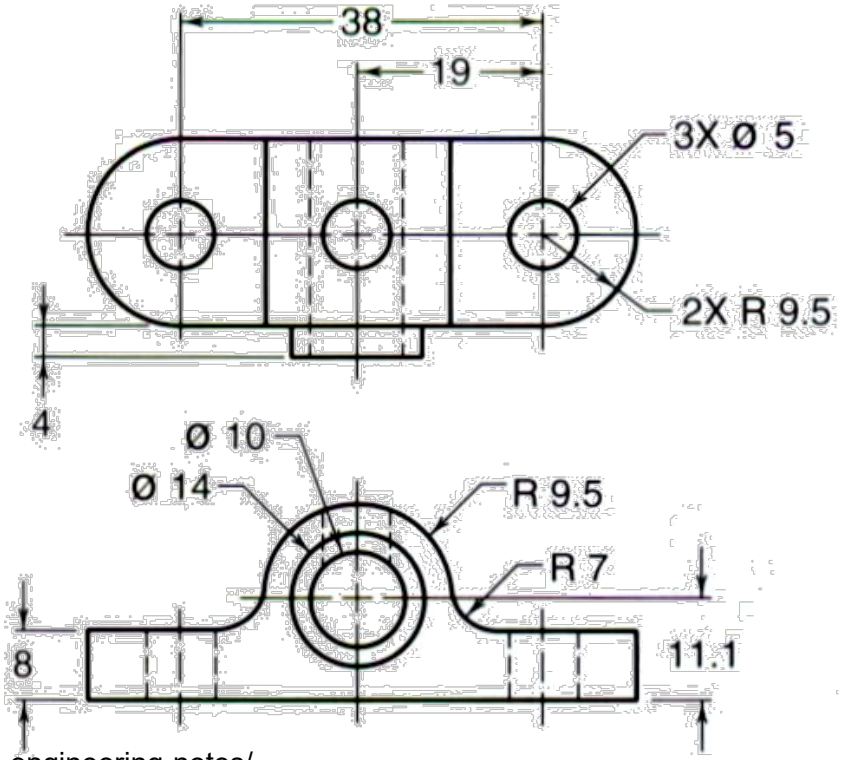




Instrument drawing

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

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Elements of Engineering Drawing

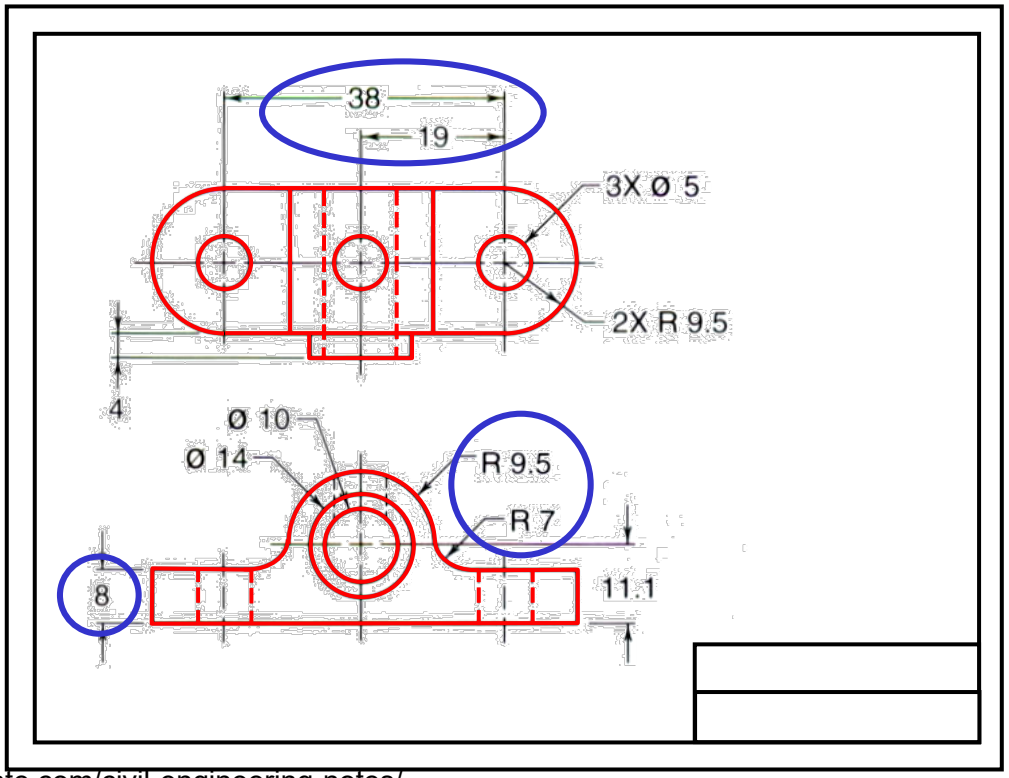
Engineering drawing are made up of ***graphics language*** and ***word language***.

Graphics language

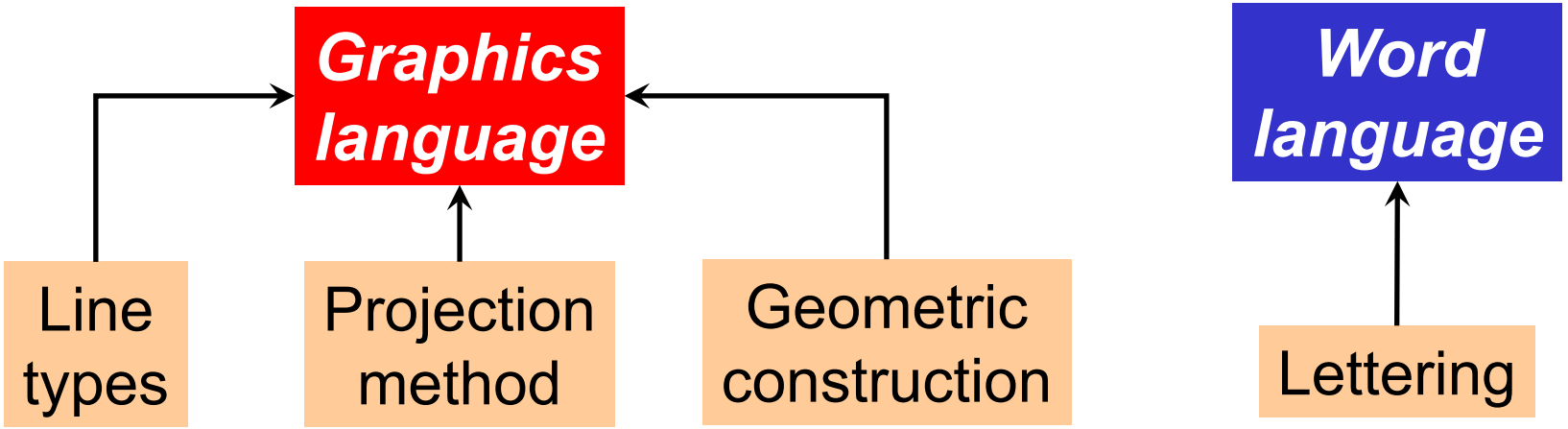
Describe a shape (mainly).

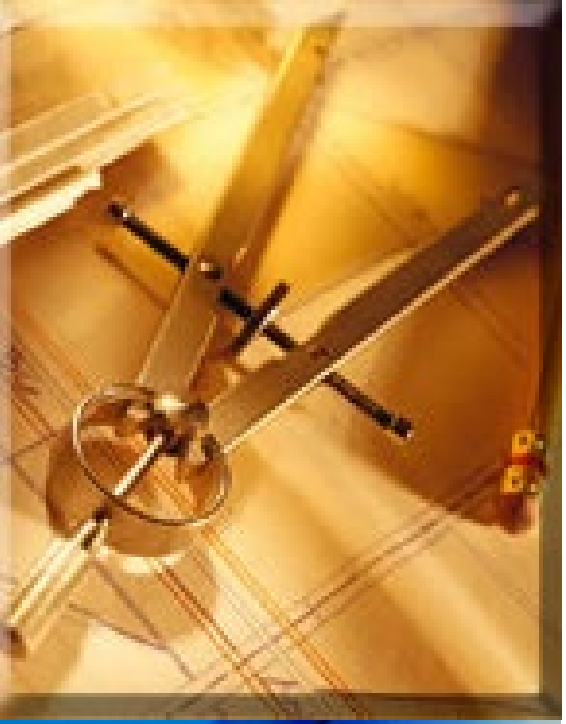
Word language

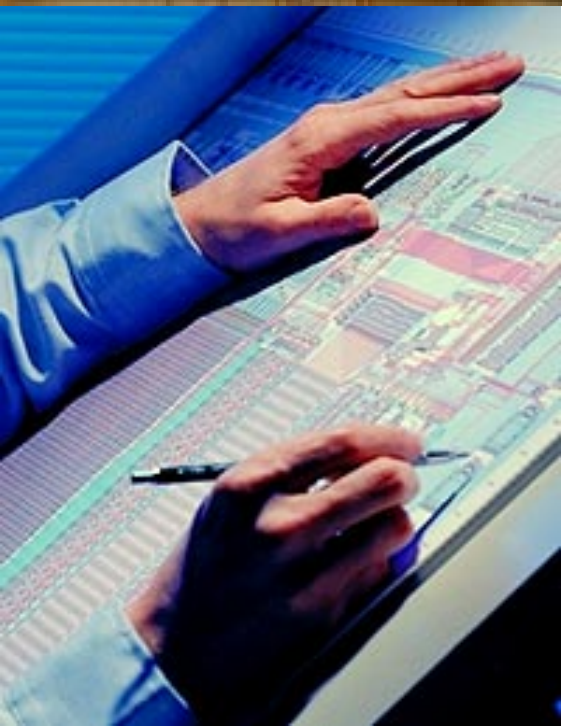
Describe size, location and specification of the object.



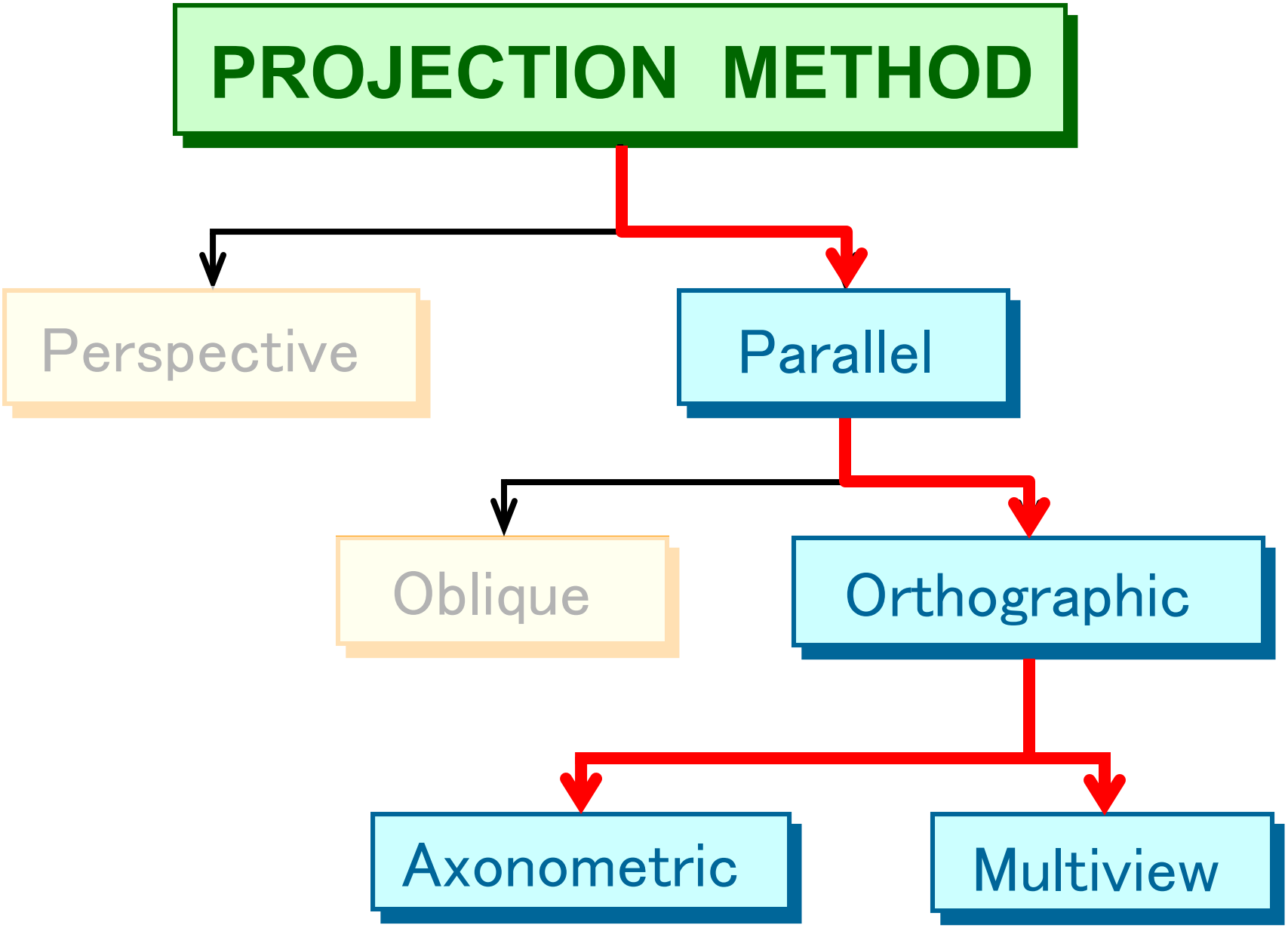
Basic Knowledge for Drafting







PROJECTION METHOD



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PROJECTION THEORY

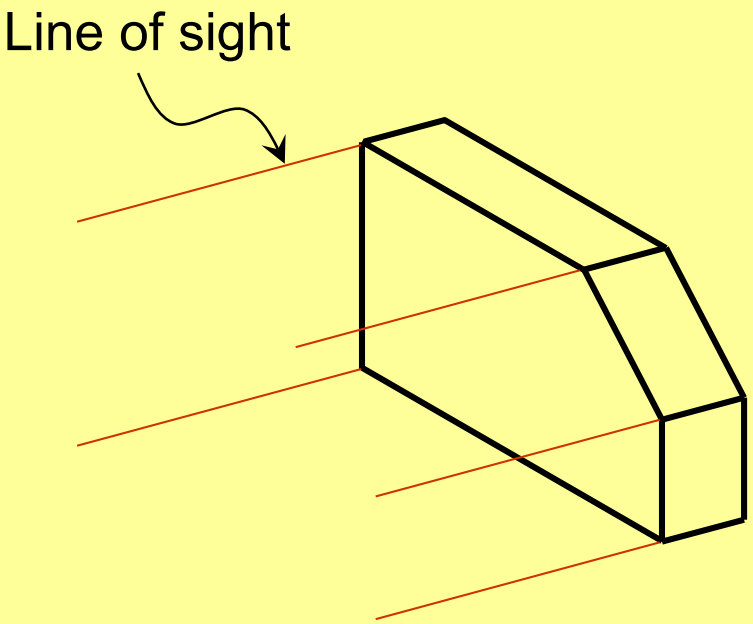
- The projection theory is used to graphically represent 3-D objects on 2-D media (paper, computer screen).

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

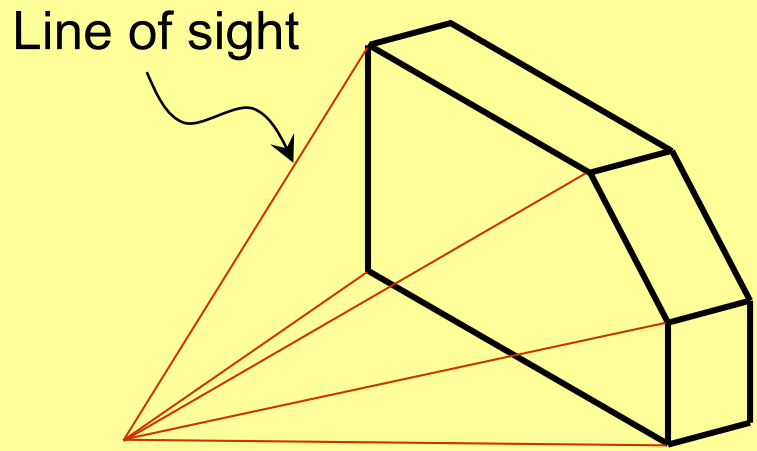
Line of sight is an imaginary ray of light between an observer's eye and an object.

- There are 2 types of LOS : parallel and converge

Parallel projection



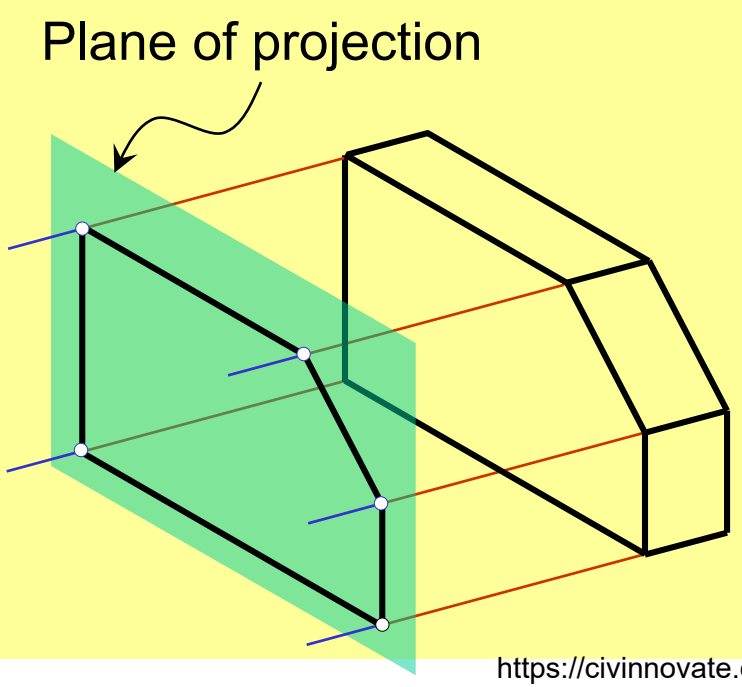
Perspective projection



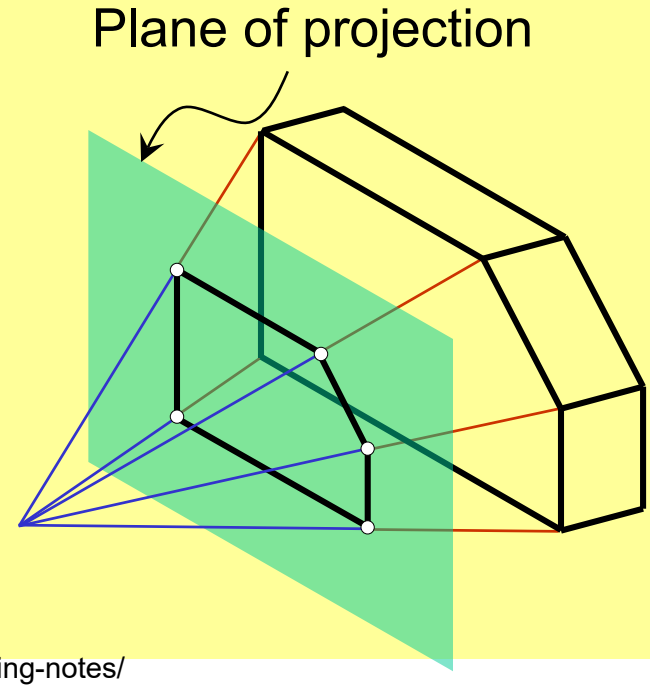
Plane of projection is an imaginary flat plane which the image is created.

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

Parallel projection



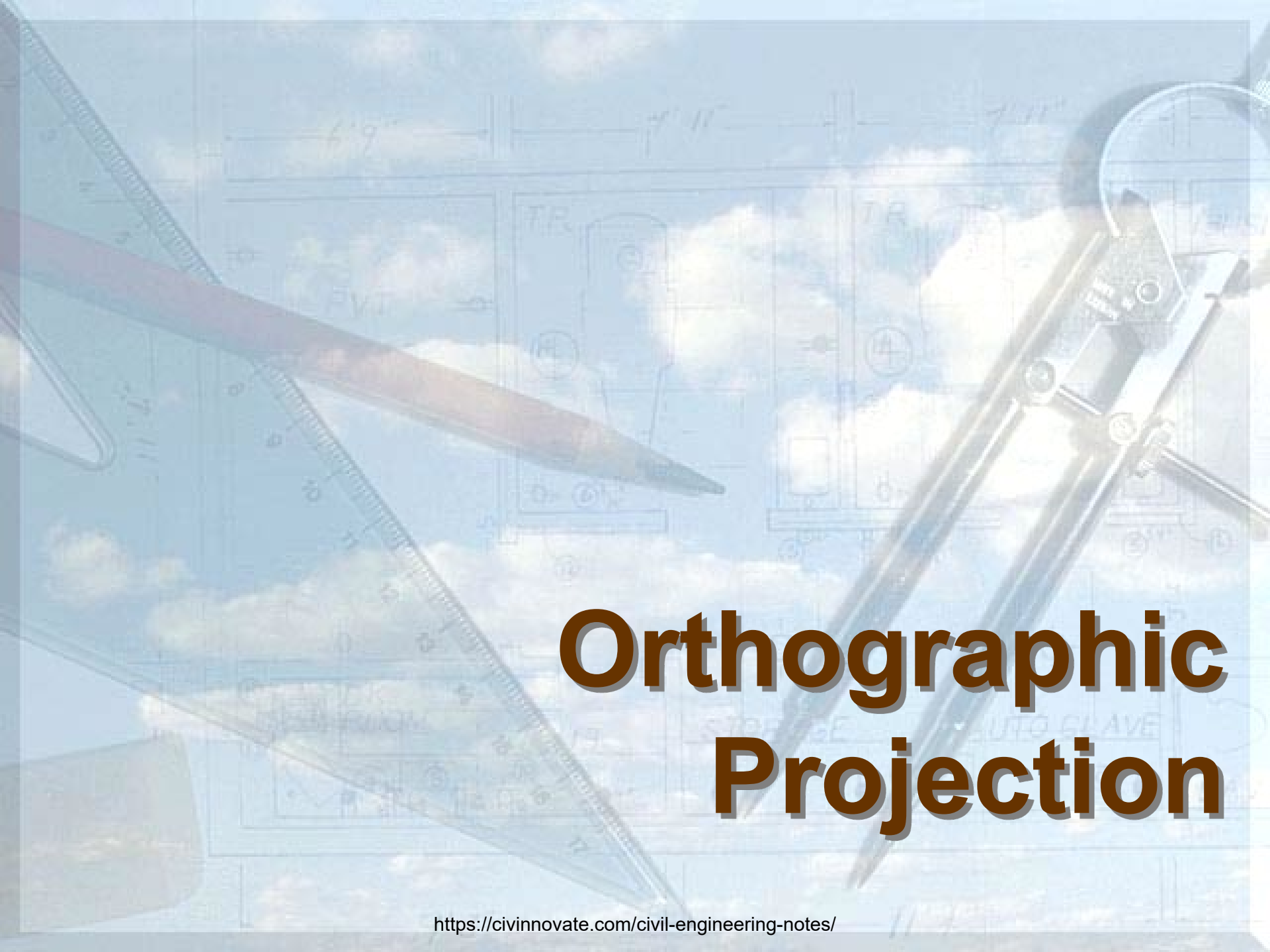
Perspective projection



Disadvantage of Perspective Projection

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

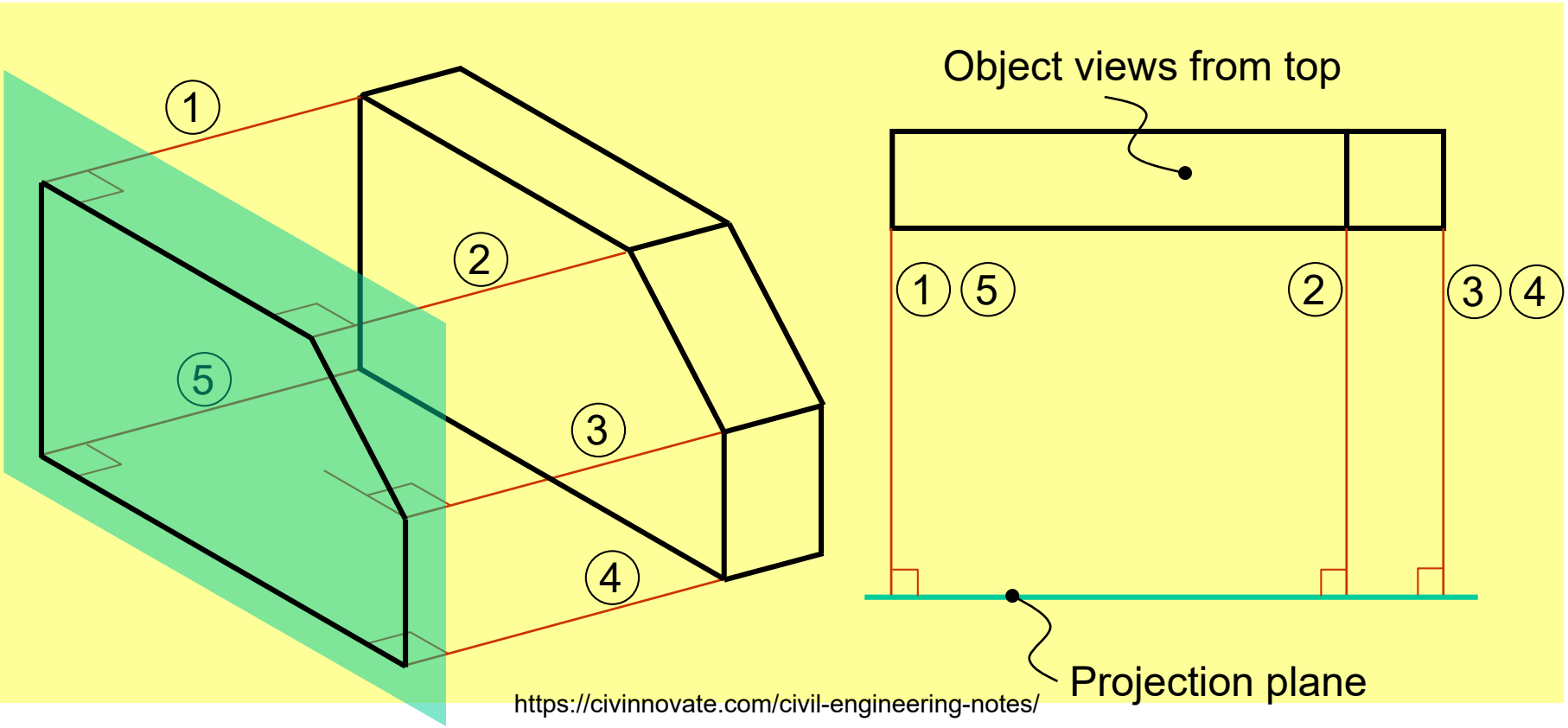
  1) It is difficult to create.
  2) It does not reveal exact shape and size.



Orthographic Projection

MEANING

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



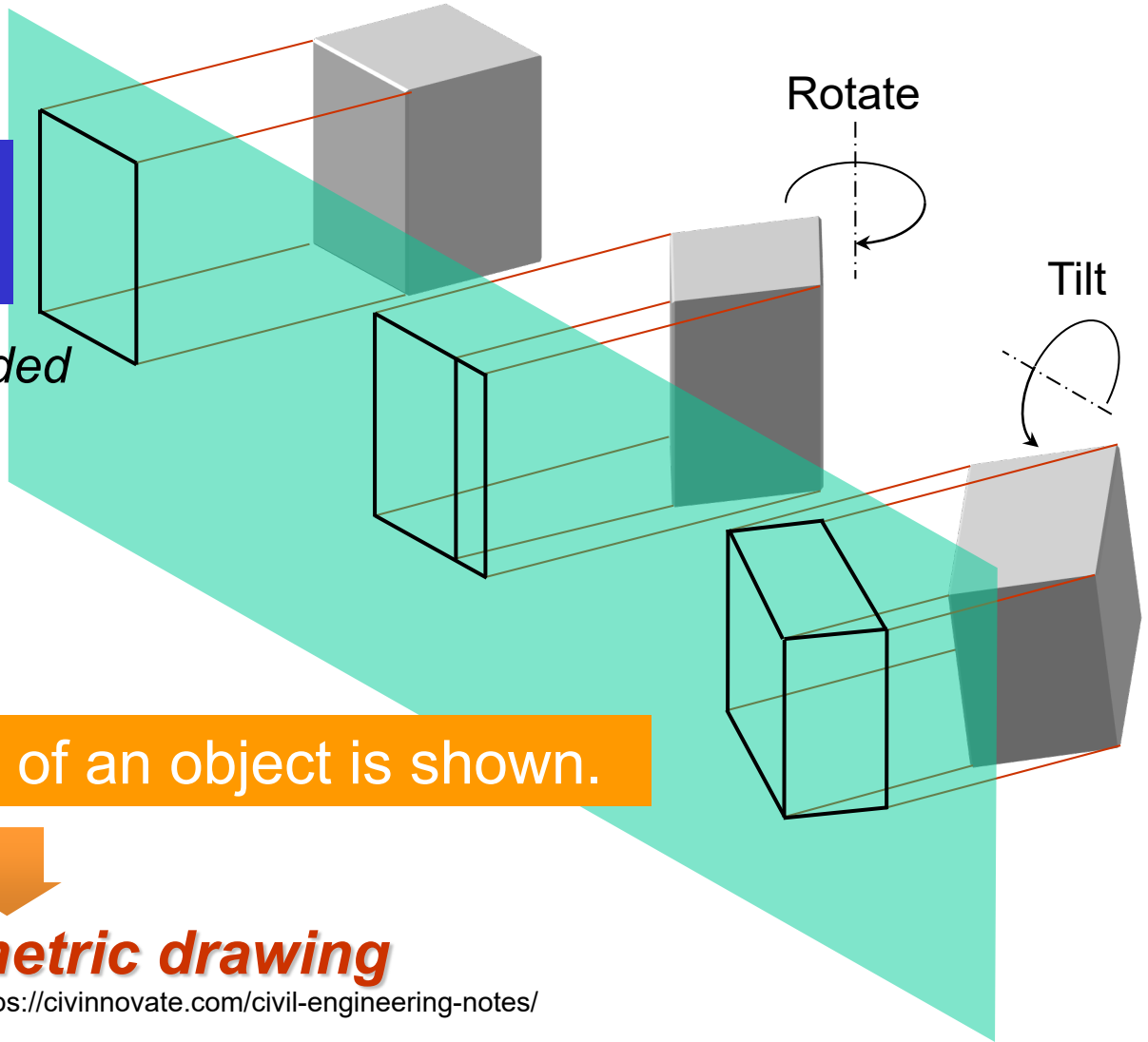
ORTHOGRAPHIC VIEW

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.

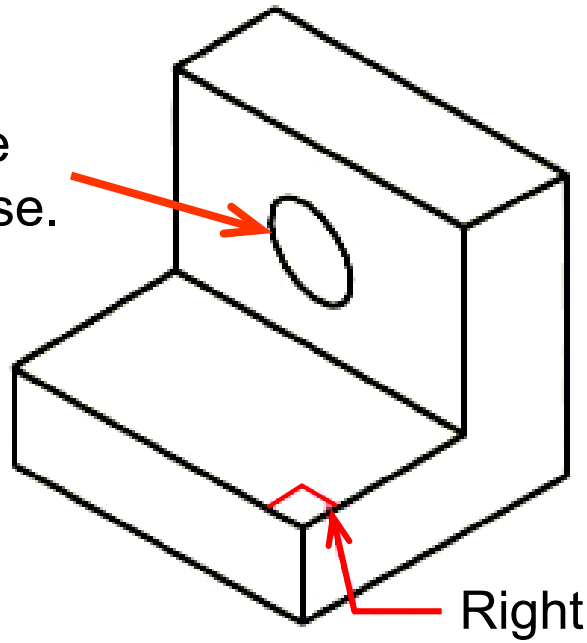
- Both drawing types are used in technical drawing for communication.

Axonometric (Isometric) Drawing

Advantage Easy to understand

Disadvantage Shape and angle distortion

Example Distortions of shape and size in isometric drawing



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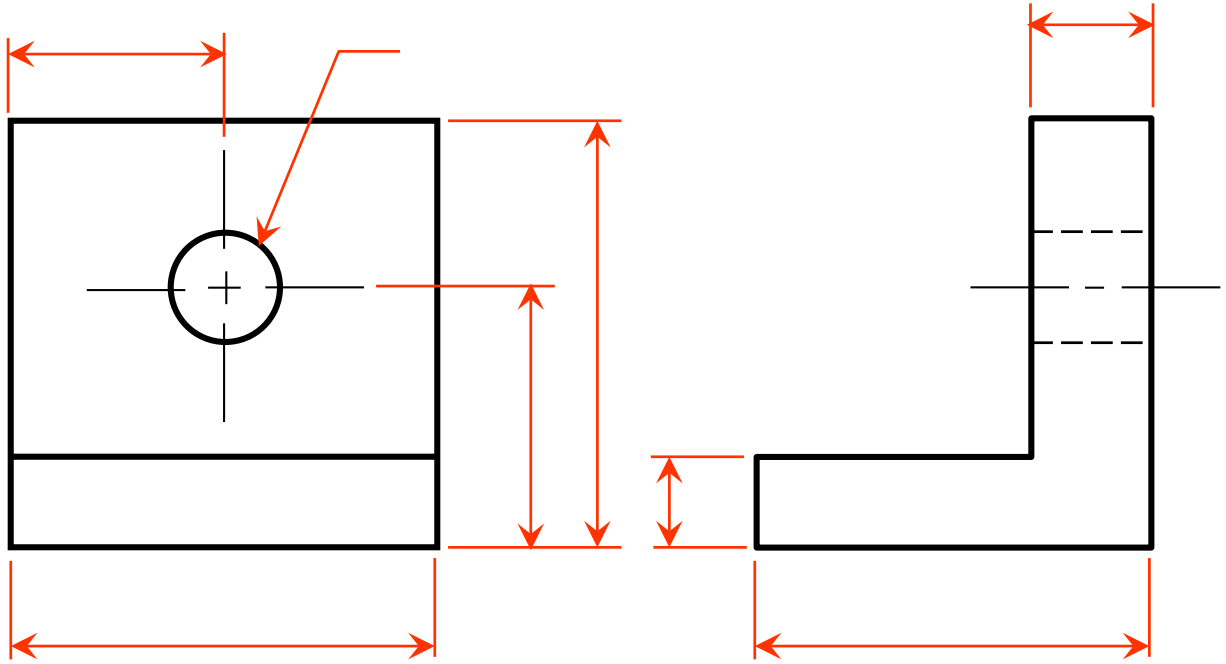
Multiview Drawing

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

Disadvantage Require practice in writing and reading.

Example Multiviews drawing (2-view drawing)



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

Partial List of Drawing Standards

Code number	Contents
มอก. 210 2520	วิธีเขียนแบบทั่วไป : ทางเครื่
มอก. 440 ล.1 2541	การเขียนแบบก่อสร้างเล่ม 1
มอก. 446 ล.4 2532	ข้อแนะนำสำหรับการเขียนแ วงจรไฟฟ้า
มอก. 1473 2540	การเขียนแบบเทคนิค การติ สัญลักษณ์สำหรับระบบท่อของเห ระบบทำความร้อน การระบายอาก 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

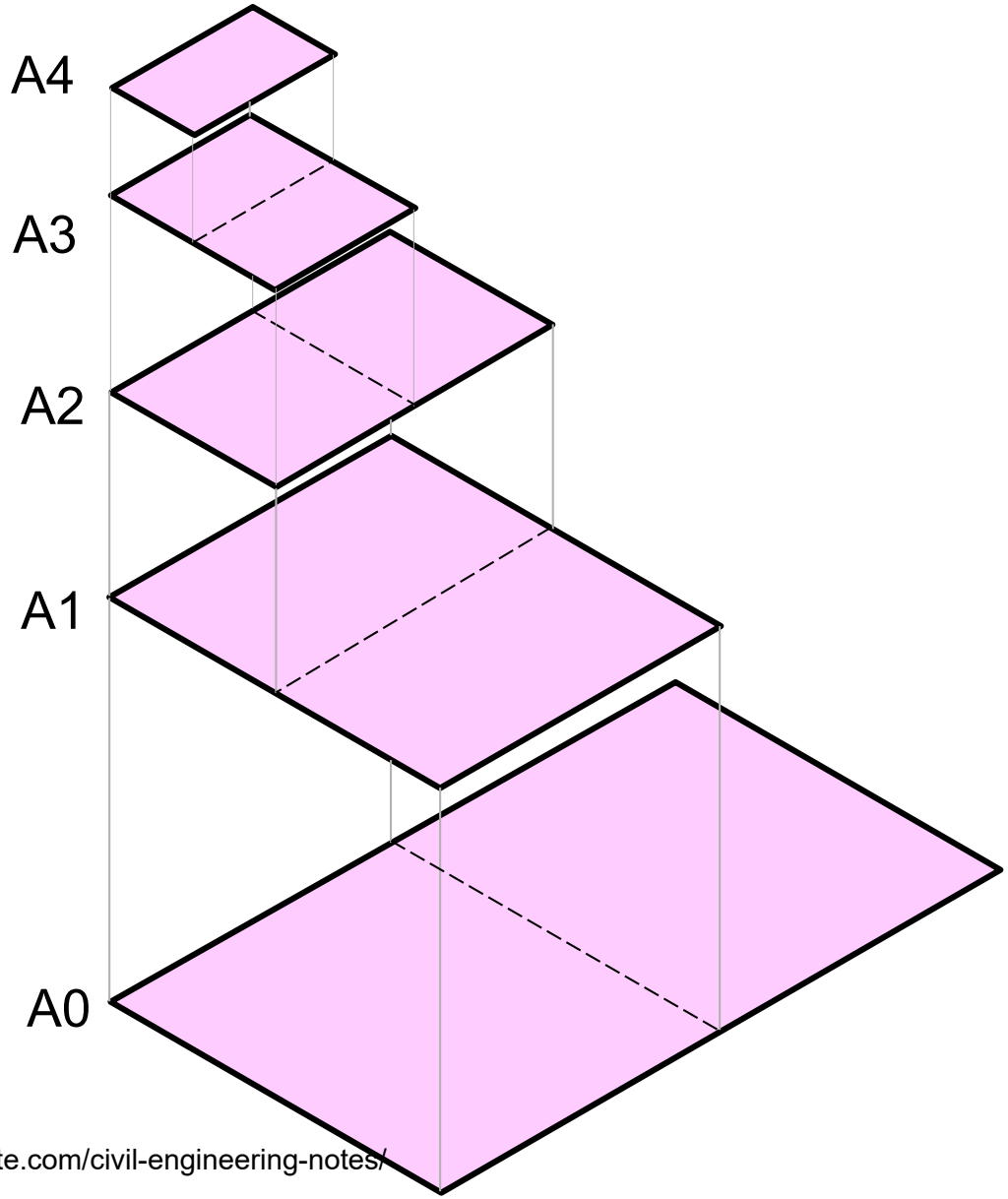
Drawing Sheet

- Trimmed paper of a size A0 ~ A4.

- Standard sheet size (**JIS**)

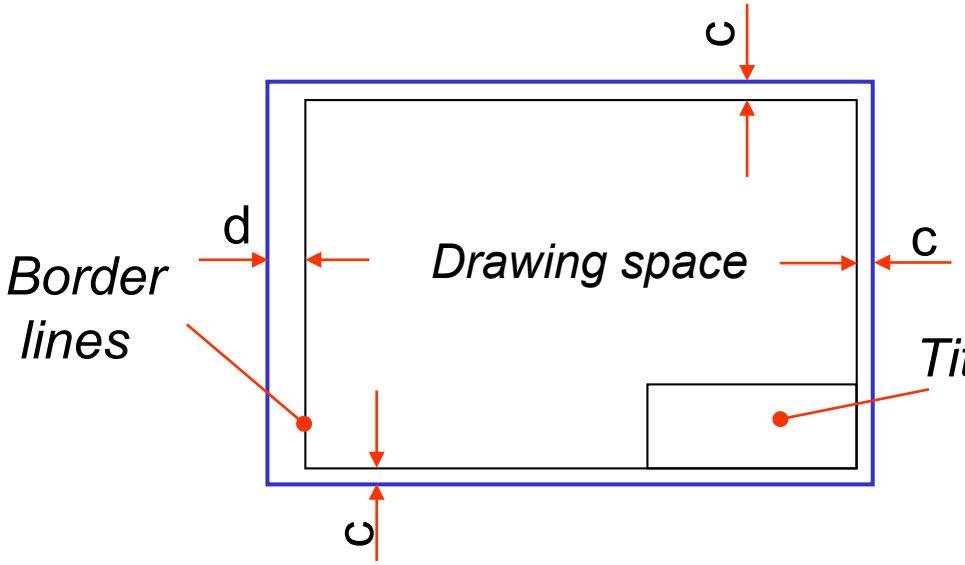
A4	210 x 297
A3	297 x 420
A2	420 x 594
A1	594 x 841
A0	841 x 1189

(Dimensions in millimeters)

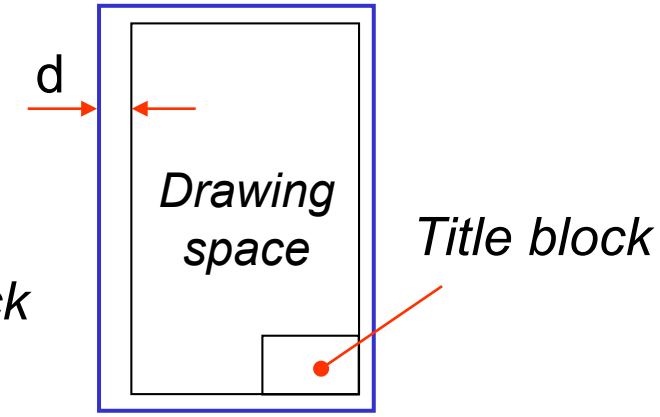


Orientation of drawing sheet

1. Type X (A0~A4)



2. Type Y (A4 only)

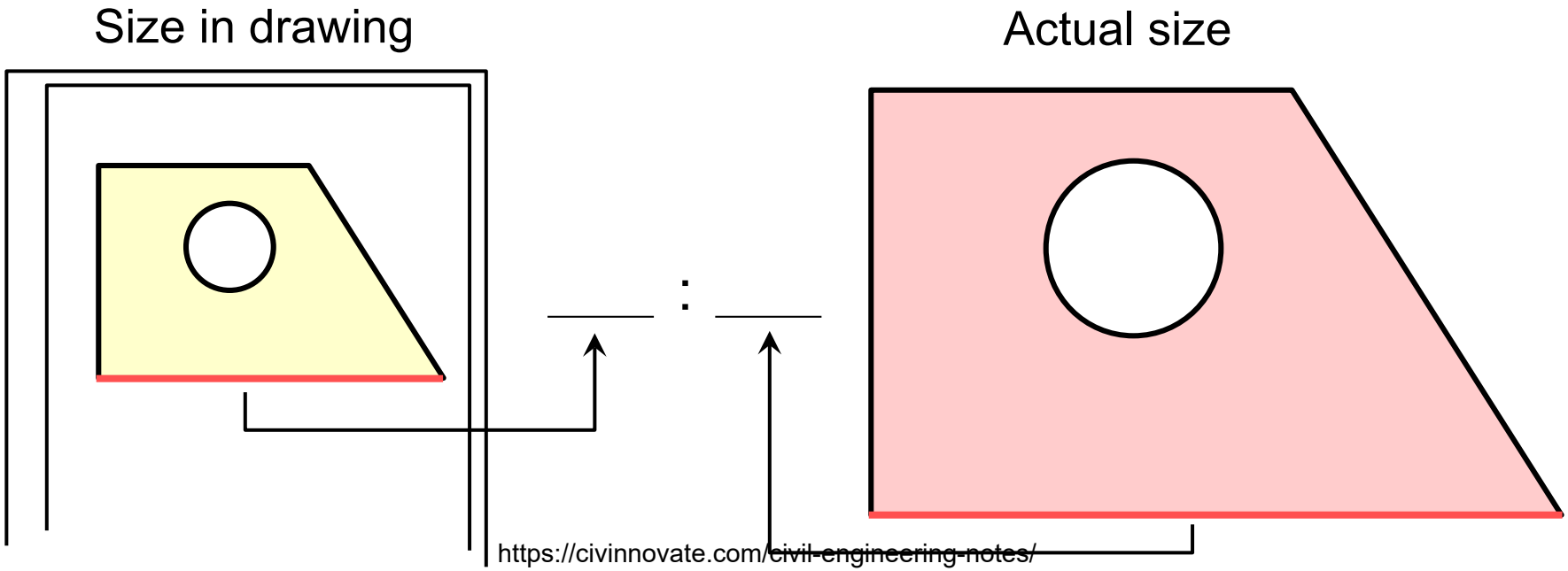


Sheet size	c (min)	d (min)
A4	10	25
A3	10	25
A2	10	25
A1	20	25
A0	20	25

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 Extension line Leader line
Dash thick line		Hidden line
Chain thin line		Center line

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

Meaning of Lines

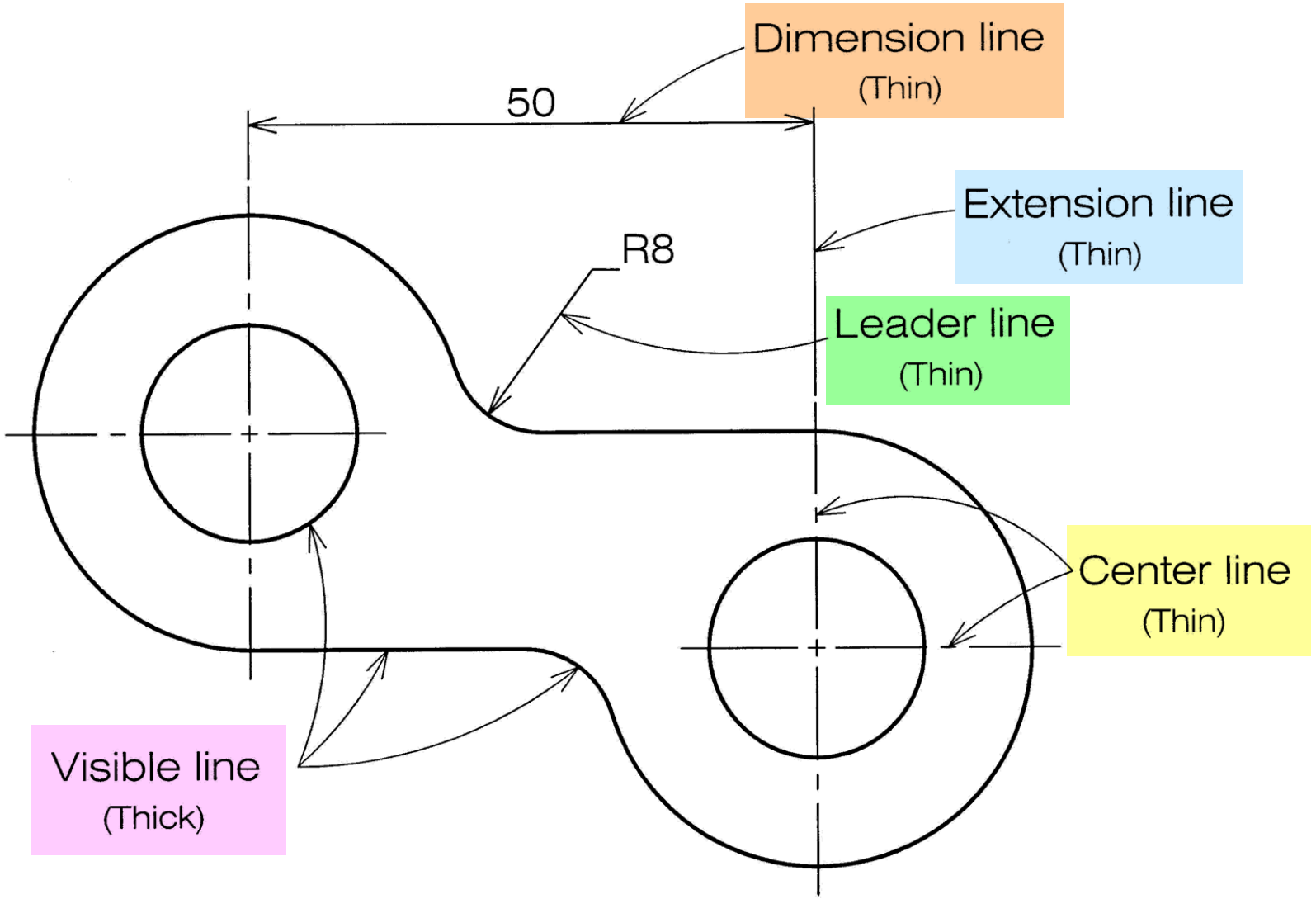
Visible lines represent features that can be seen in the current view

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

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

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

Example : *Line conventions in engineering drawing*



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Traditional Drawing Tools

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DRAWING TOOLS

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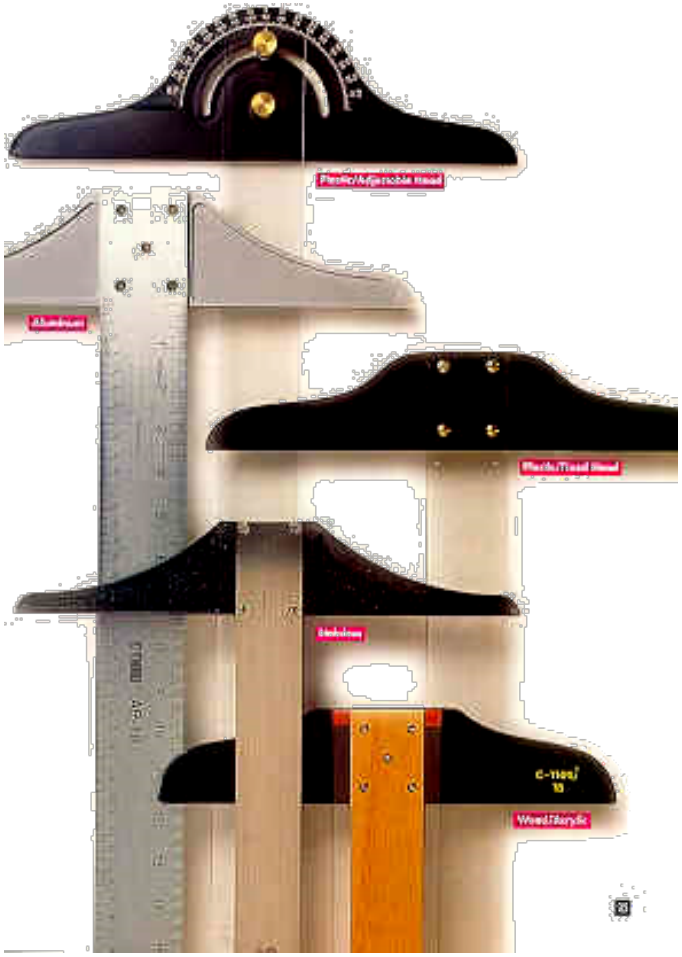
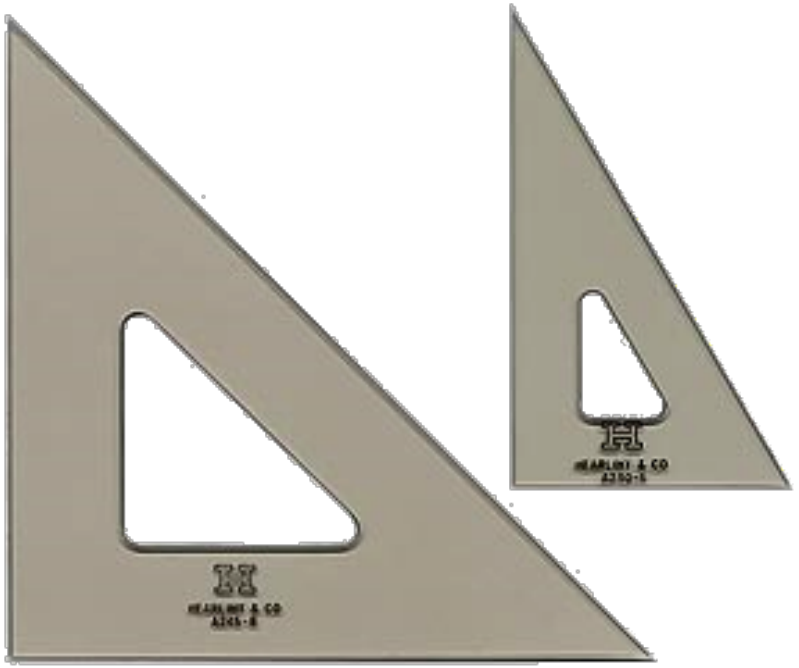
DRAWING TOOLS





1. T-Square

2. Triangles

DRAWING TOOLS

2H or HB for thick line

4H for thin line

3. Adhesive Tape

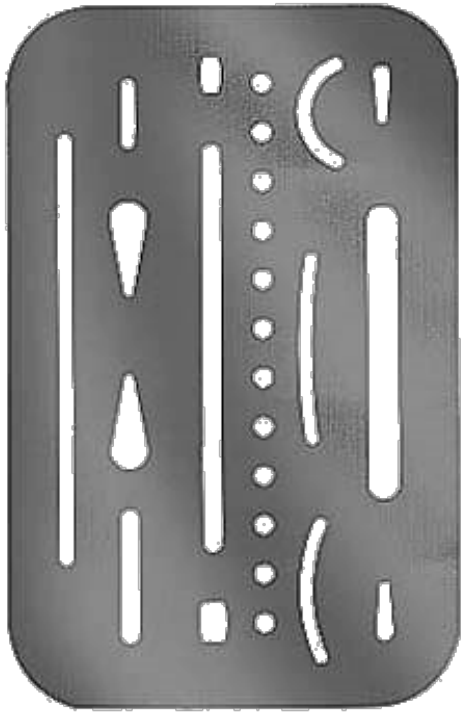
4. Pencils

DRAWING TOOLS

5. Sandpaper

6. Compass

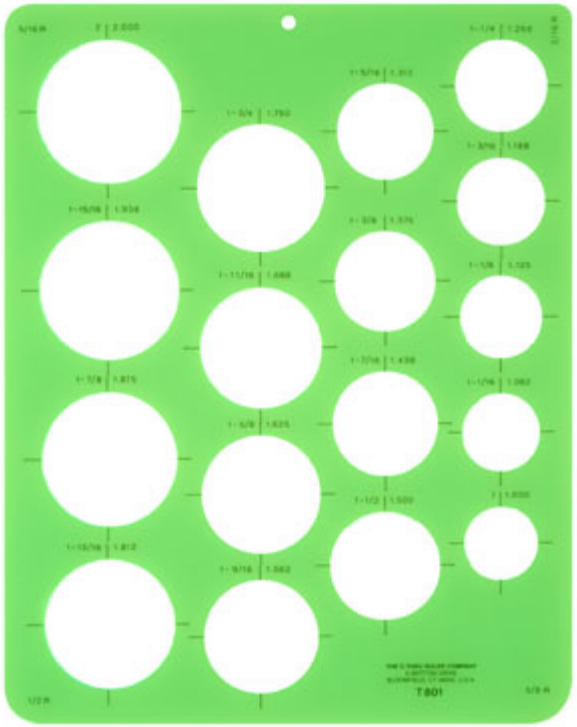
DRAWING TOOLS



7. Pencil Eraser

8. Erasing Shield

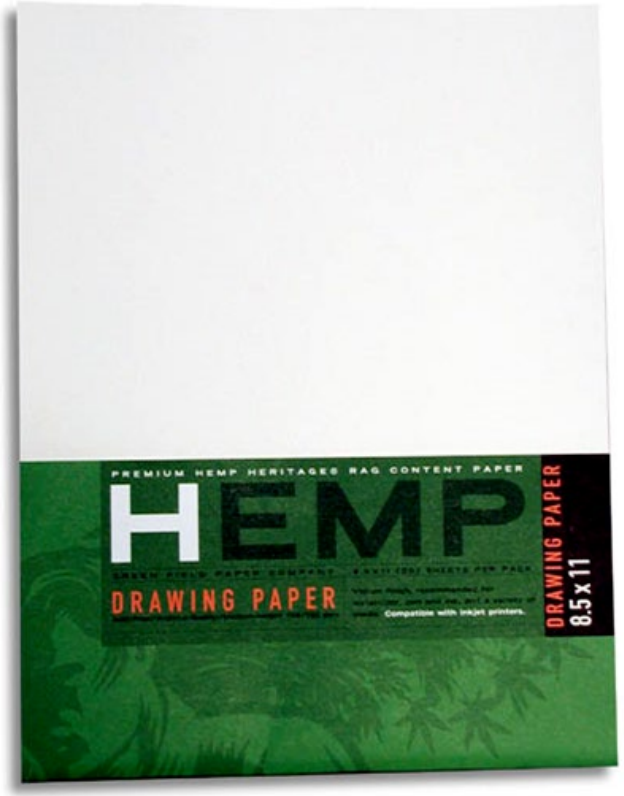
DRAWING TOOLS



9. Circle Template

10. Tissue paper

DRAWING TOOLS



11. Sharpener

12. Clean paper

Lettering

Text on Drawings

Text on engineering drawing is used :

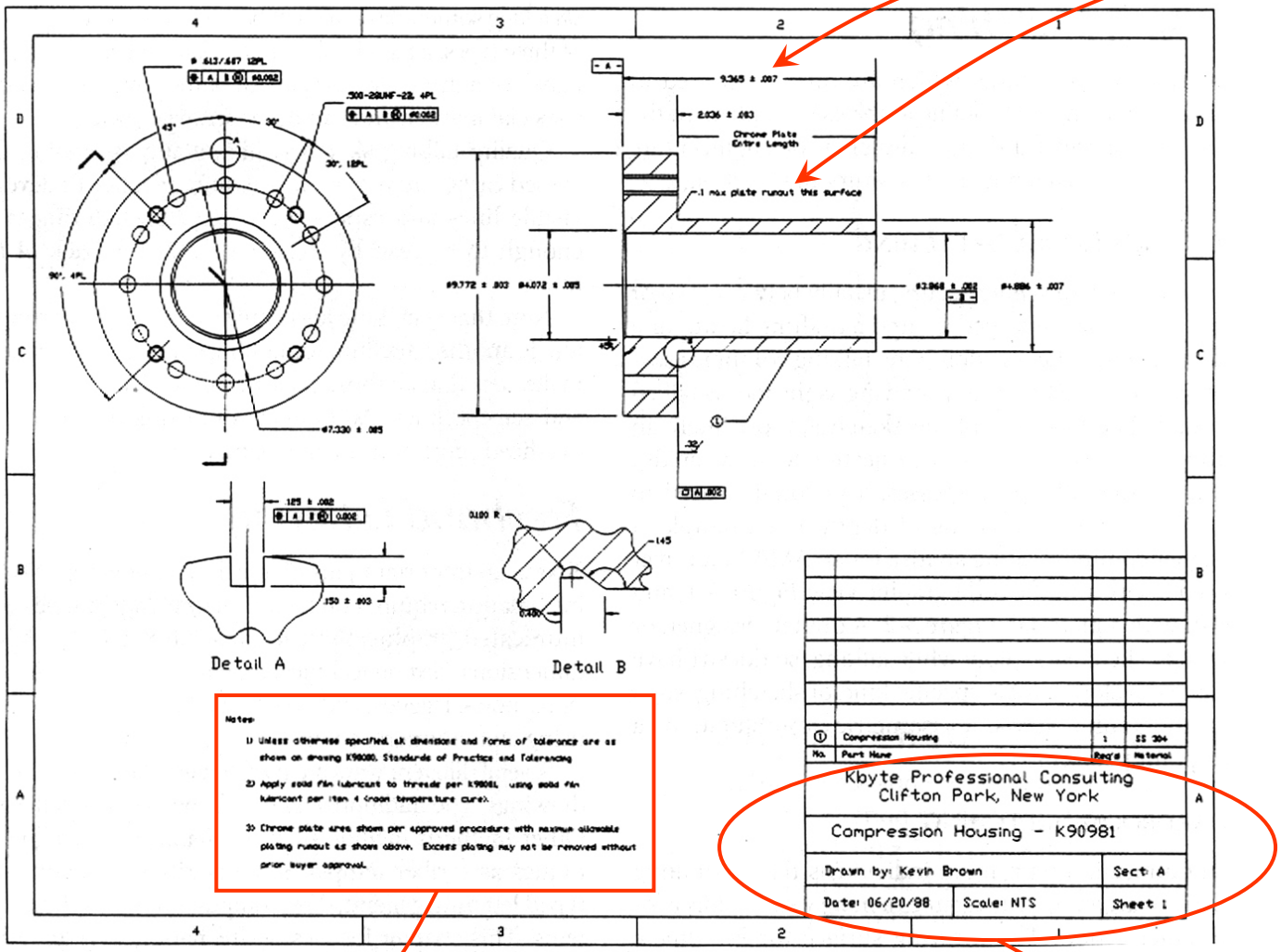
- To communicate nongraphic information.
- As a substitute for graphic information, in those instance where text can communicate the needed information more clearly and quickly.

Thus, it must be written with

Legibility - shape
- space between letters and words

Uniformity - size
- line thickness

Example *Placement of the text on drawing*



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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.

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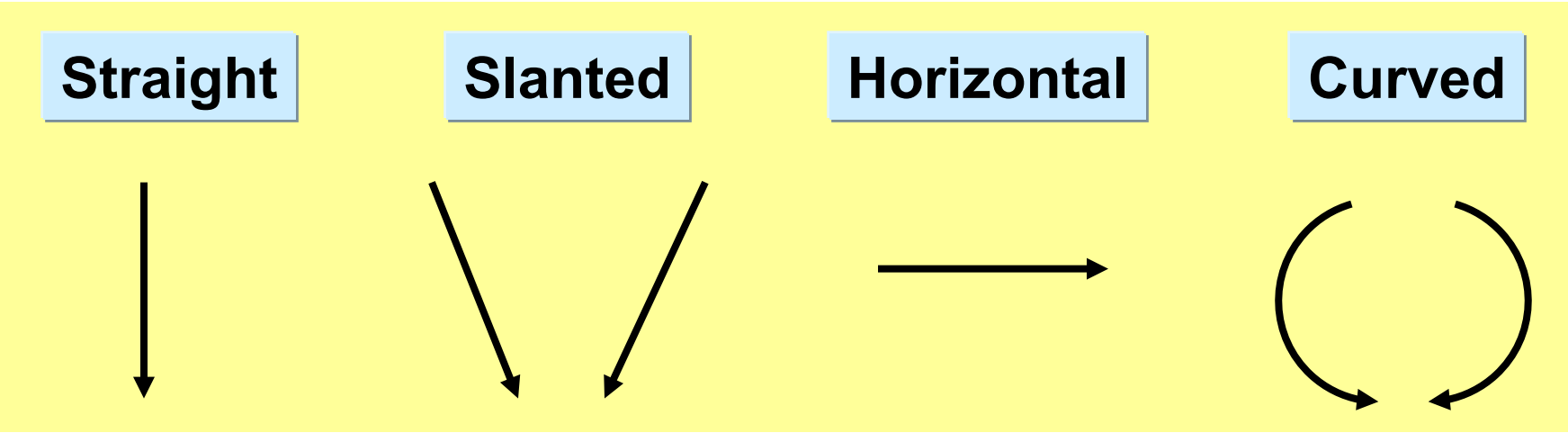
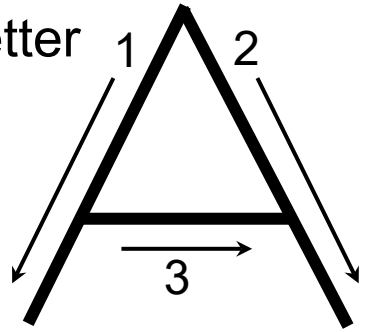
Basic Strokes



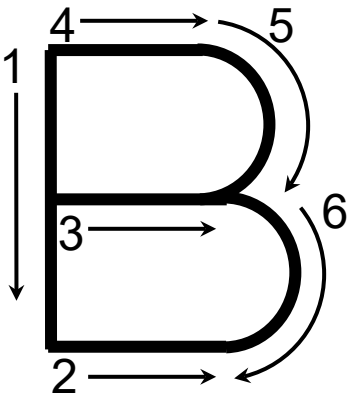
Examples : *Application of basic stroke*

"**I**" letter

"**A**" letter



"**B**" letter

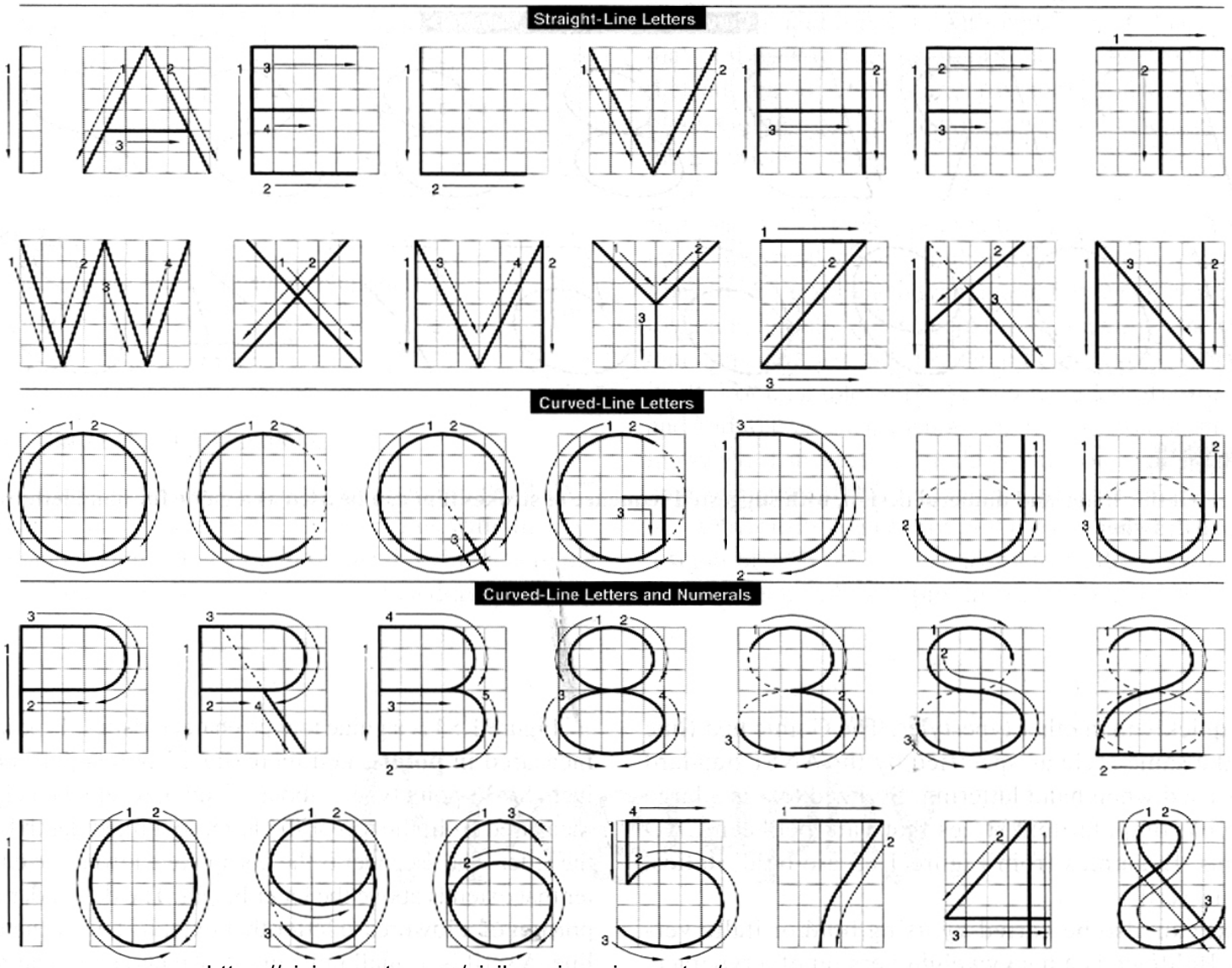


Upper-case letters & Numerals

Straight line letters

Curved line letters

Curved line letters & Numerals



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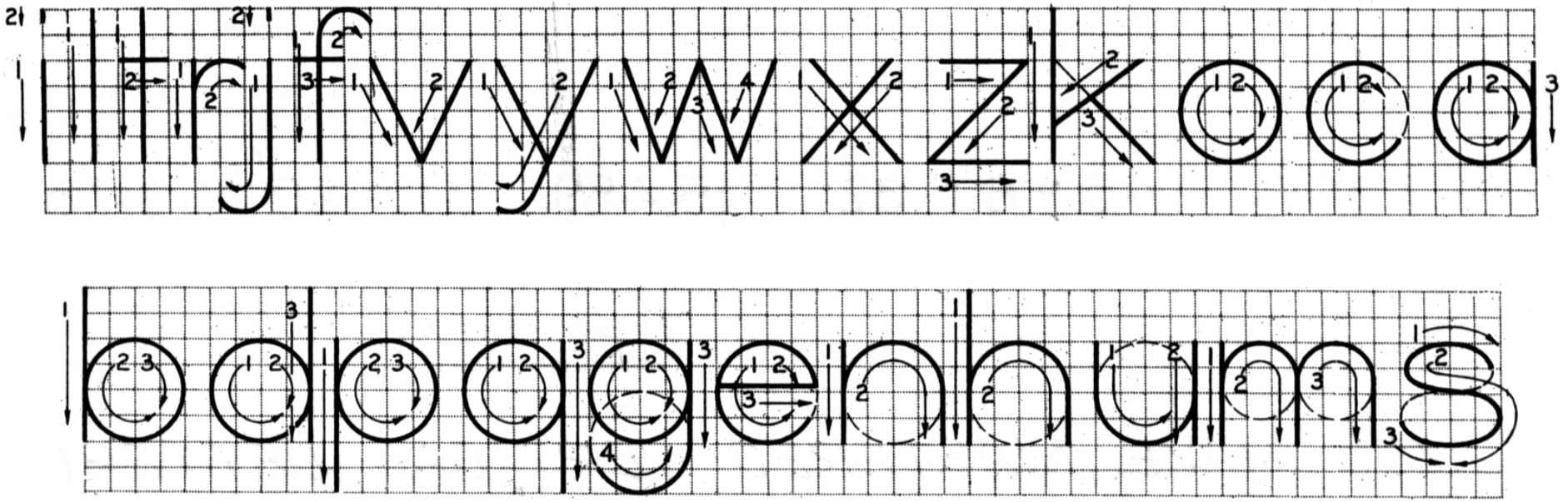
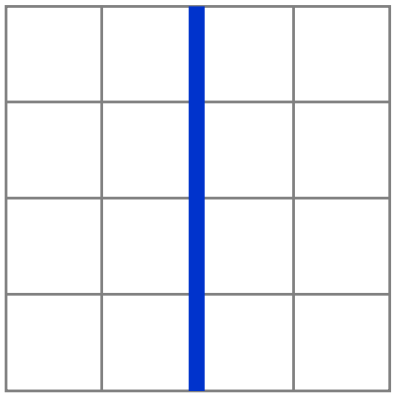
Lower-case letters



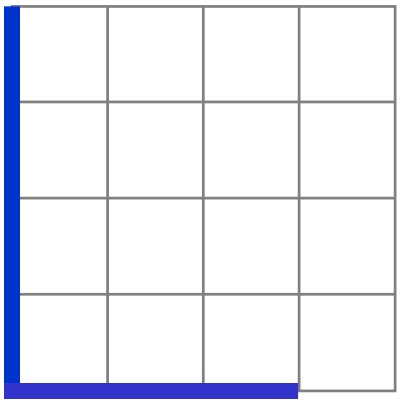
- The text’ s body height is about 2/3 the height of a capital letter.

Stroke Sequence

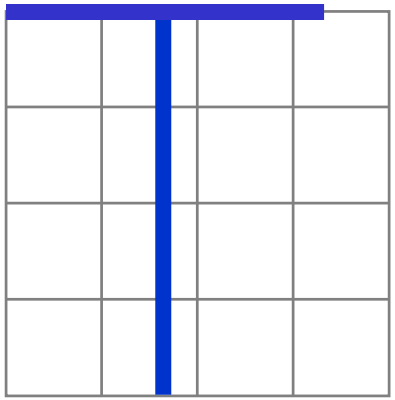
I



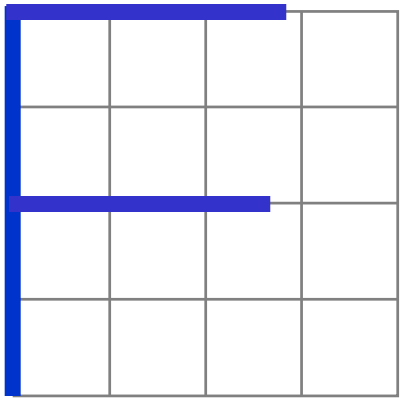
L



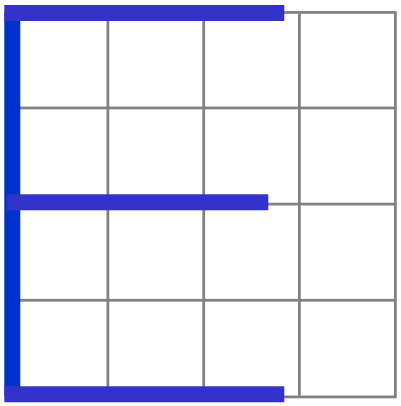
T



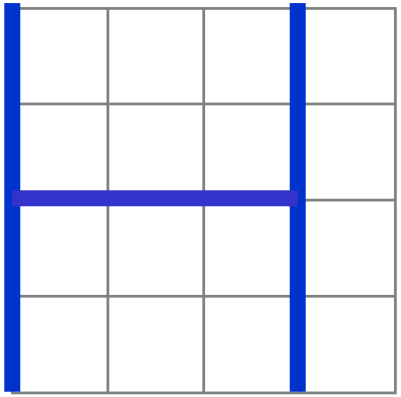
F



E

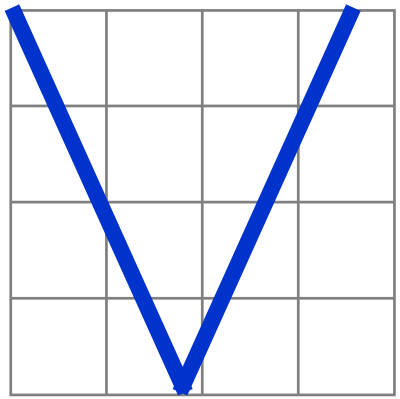


H

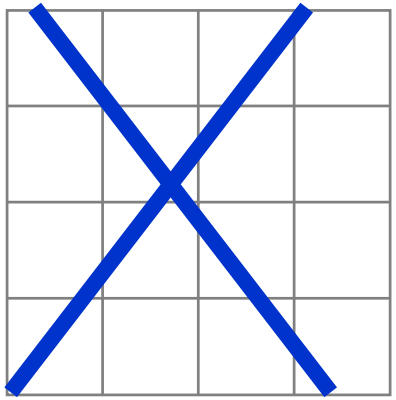


Stroke Sequence

V



X



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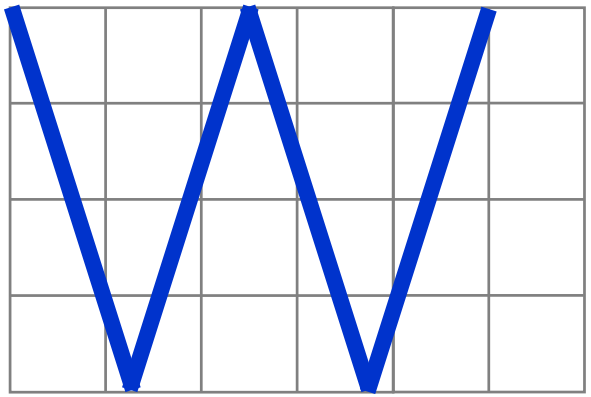
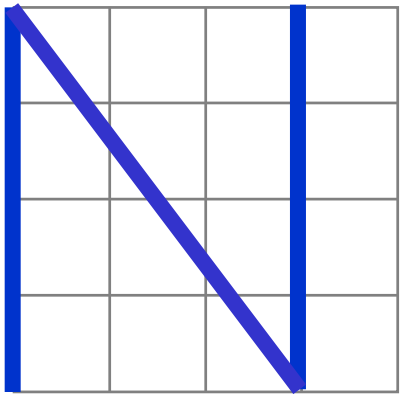


Stroke Sequence

N



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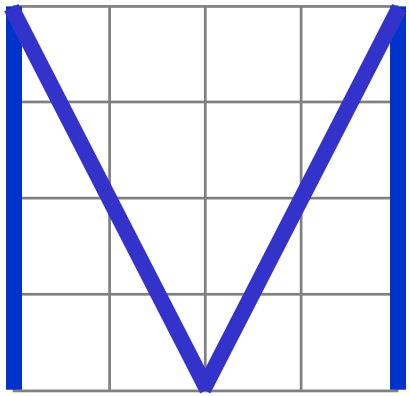

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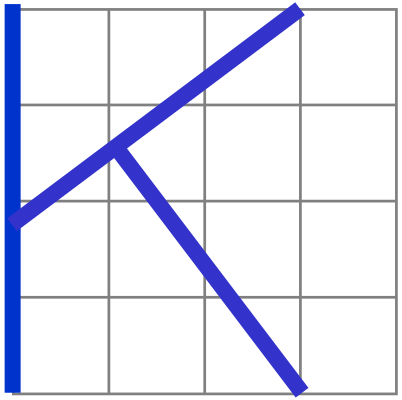

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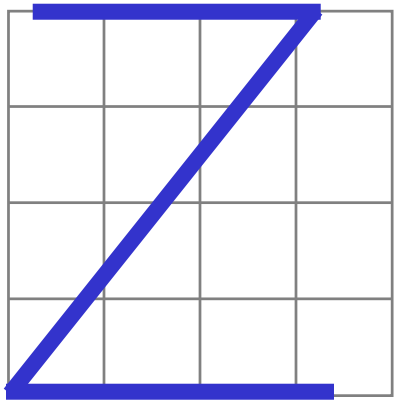

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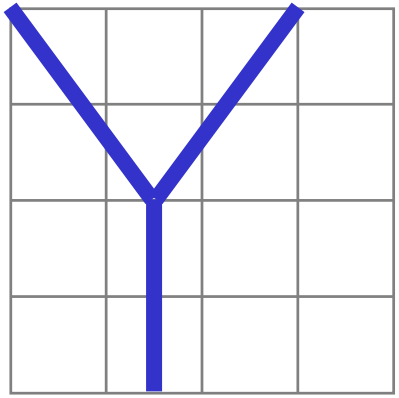

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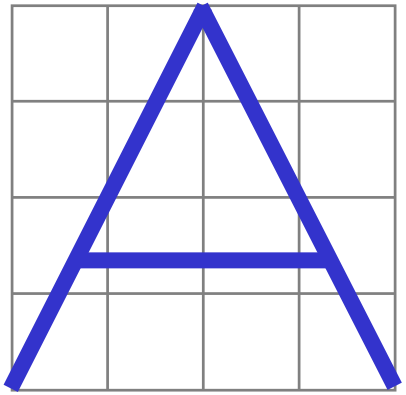

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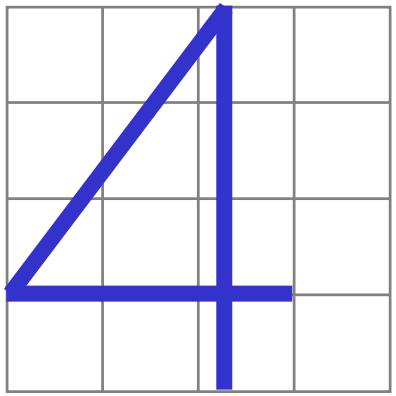

Stroke Sequence

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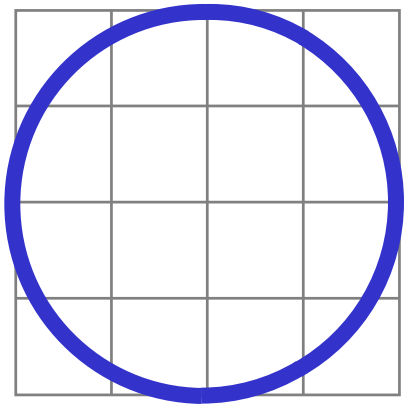

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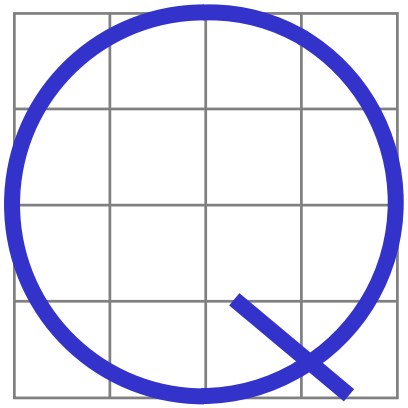

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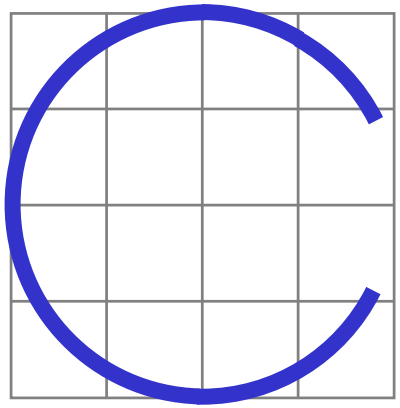

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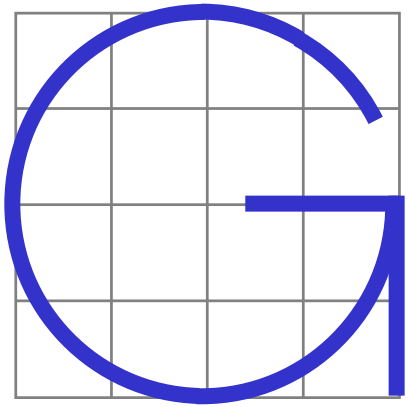

Stroke Sequence

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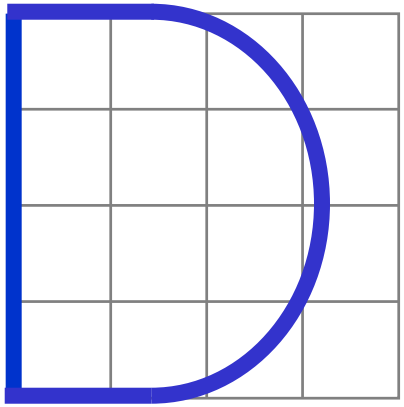

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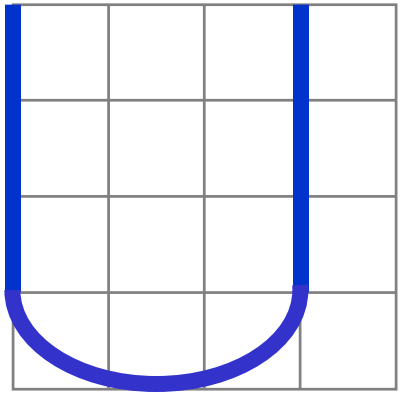

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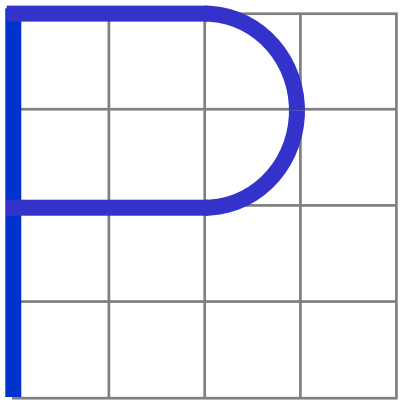

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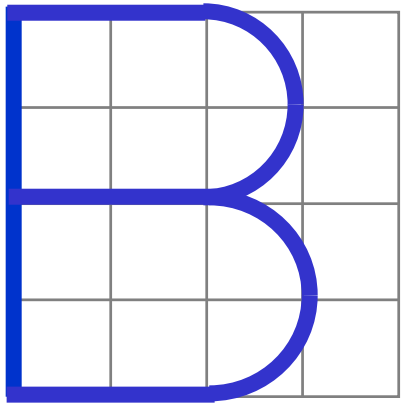

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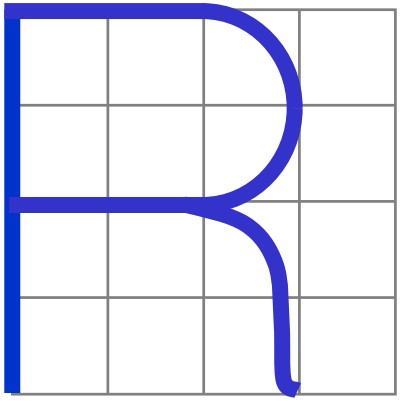

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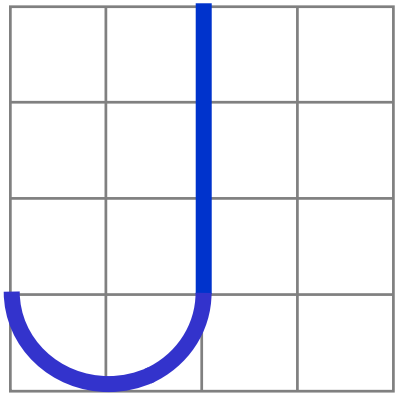

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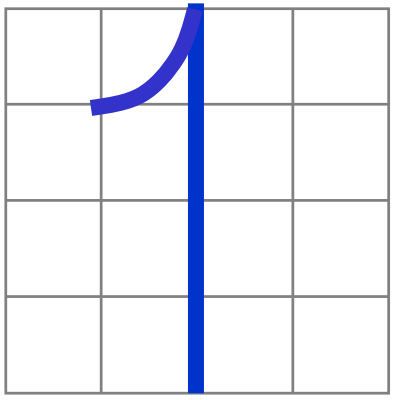

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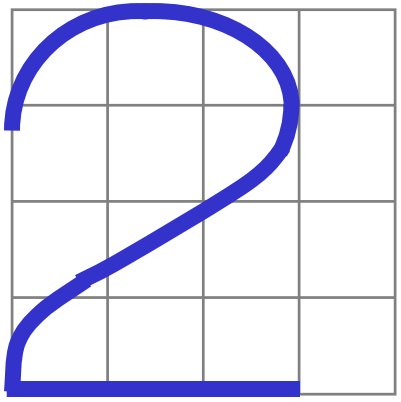

Stroke Sequence

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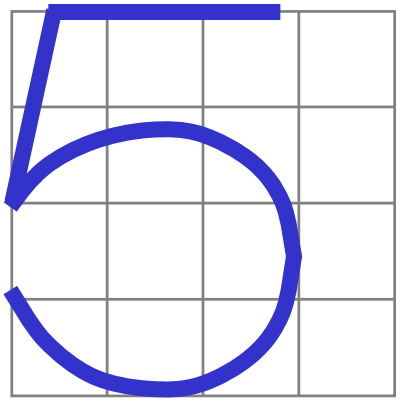

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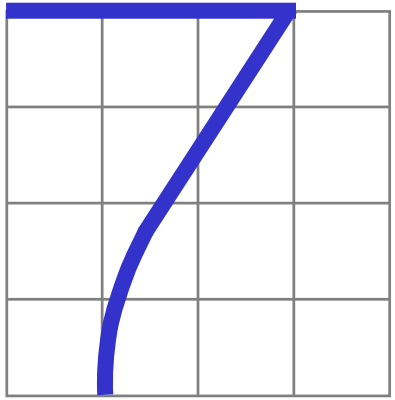

Stroke Sequence

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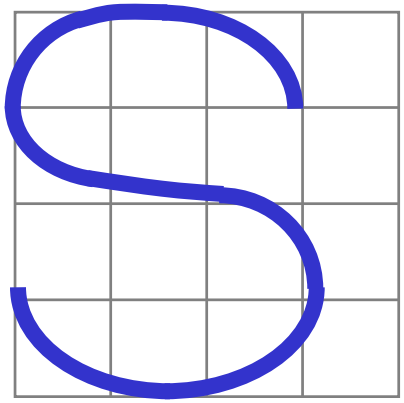

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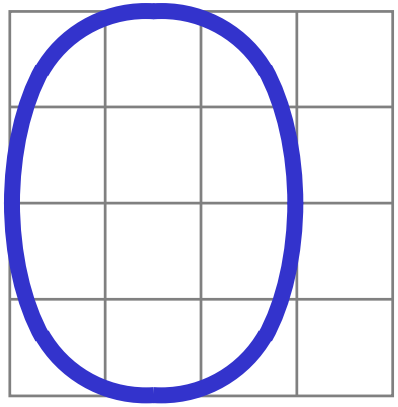

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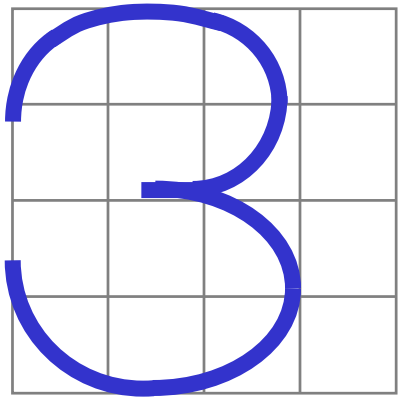

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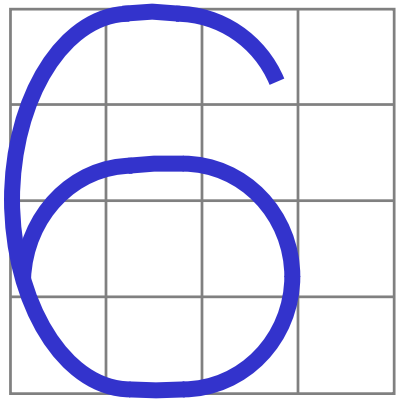

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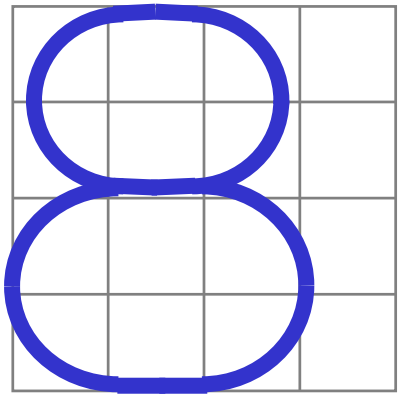

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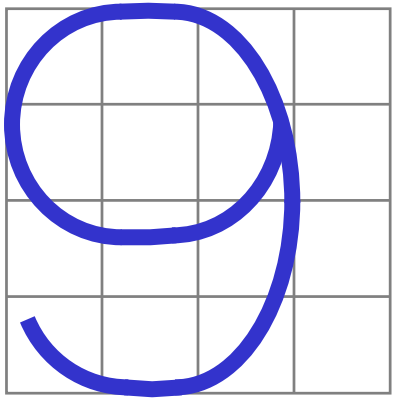

Stroke Sequence

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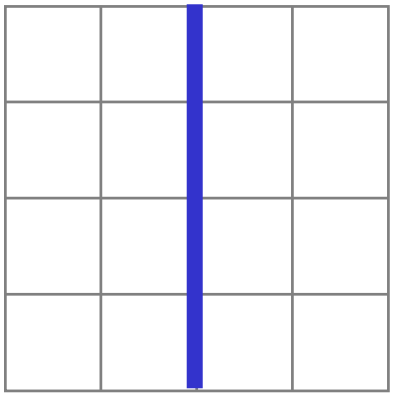

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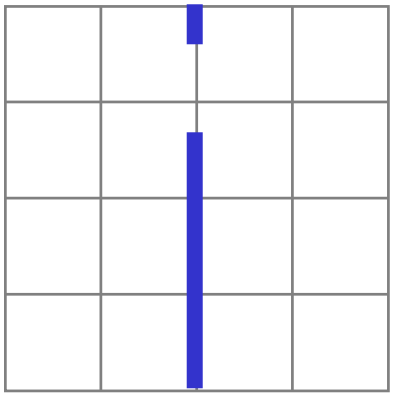

Stroke Sequence

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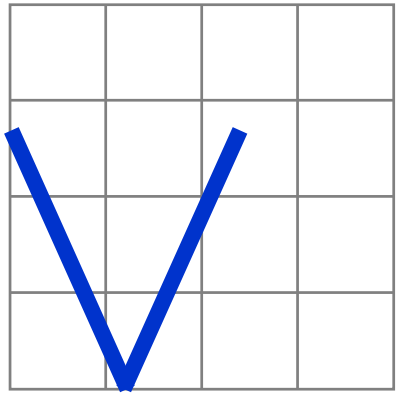

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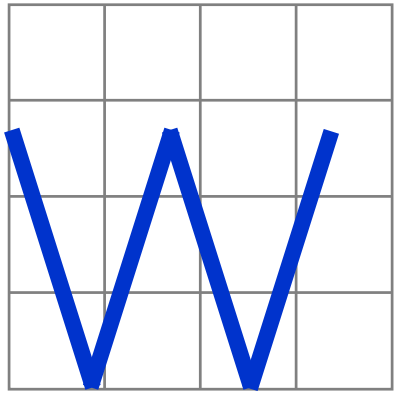

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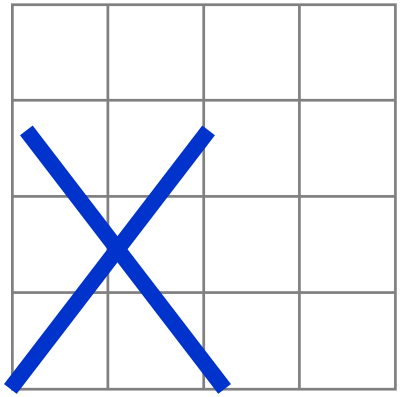

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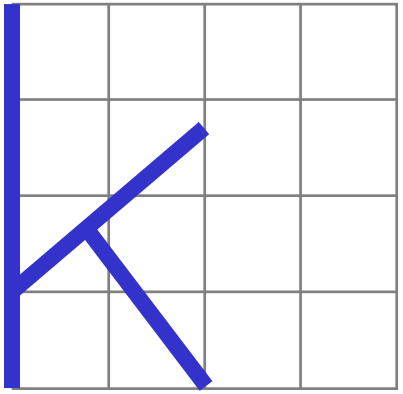

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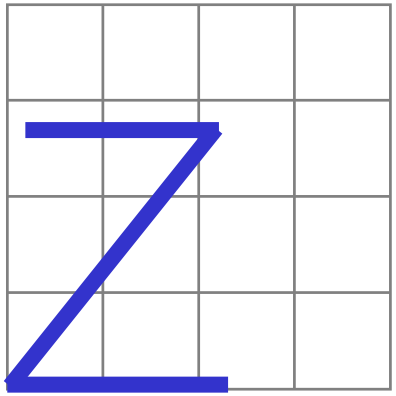

Stroke Sequence

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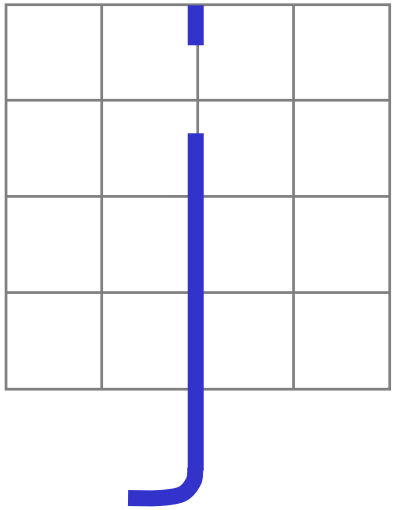

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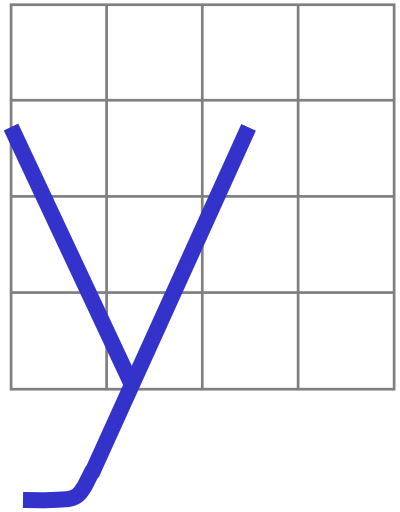

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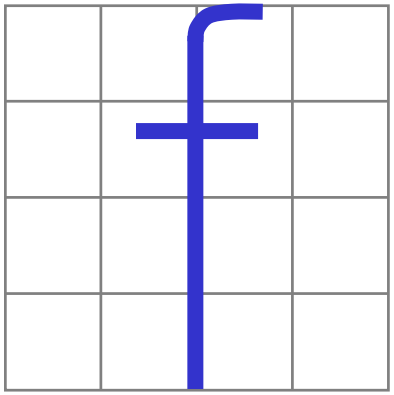

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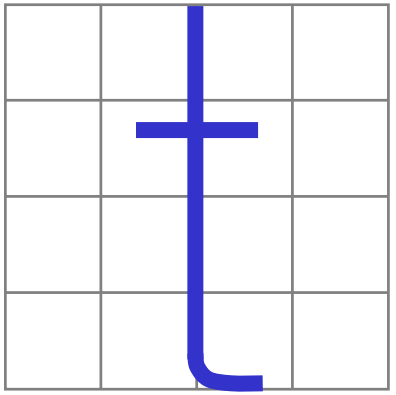

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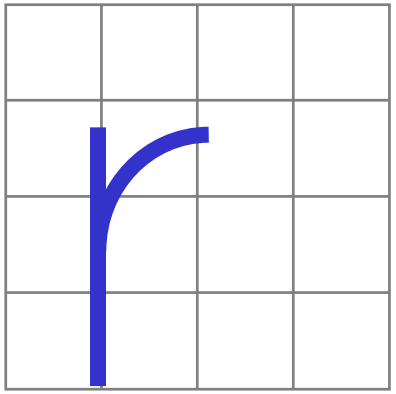

Stroke Sequence

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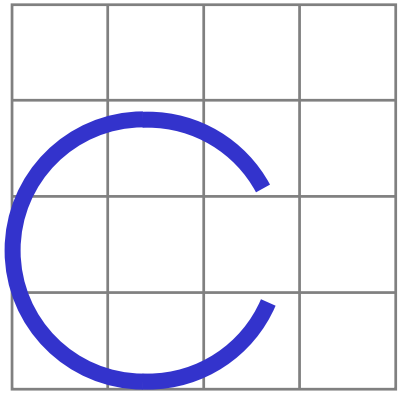

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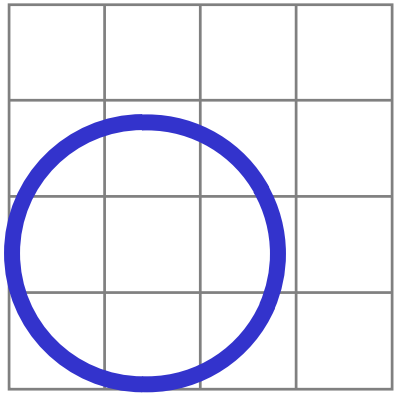

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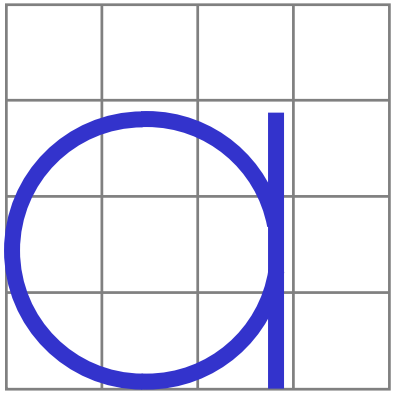

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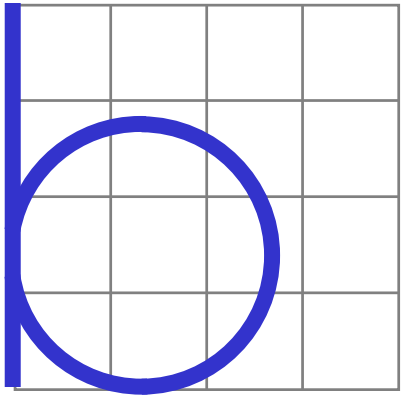

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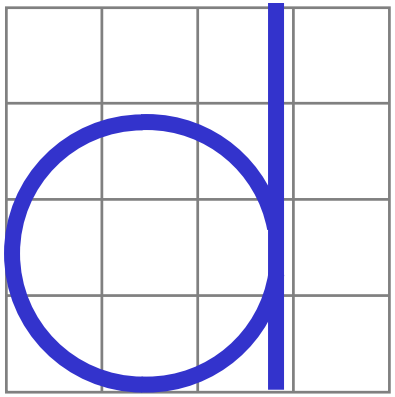

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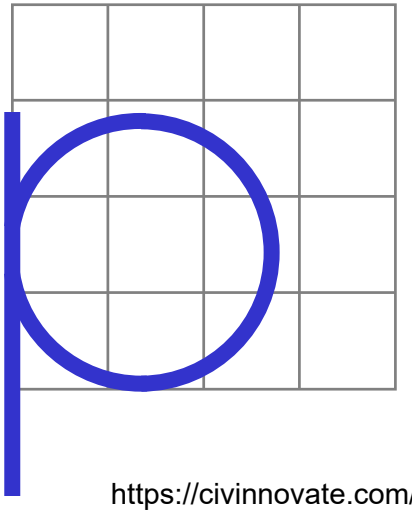

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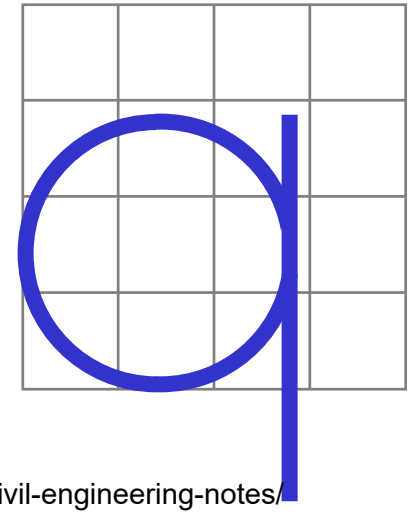

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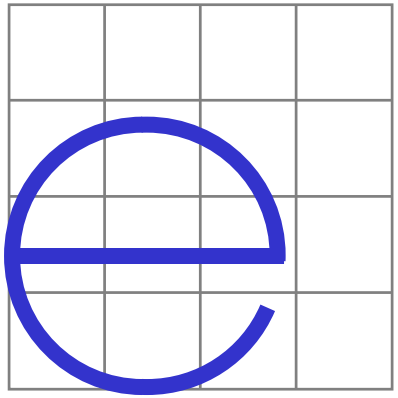
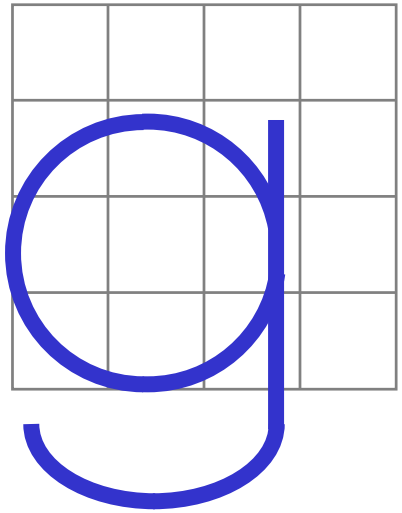


Stroke Sequence

g



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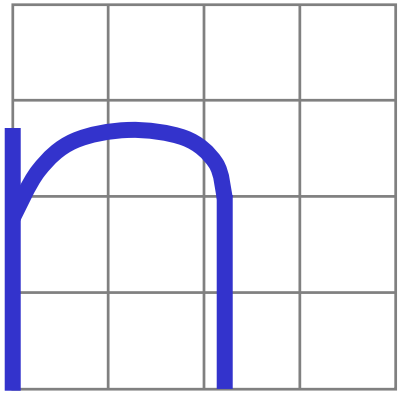

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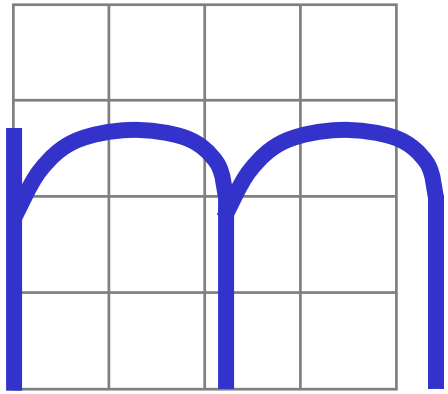

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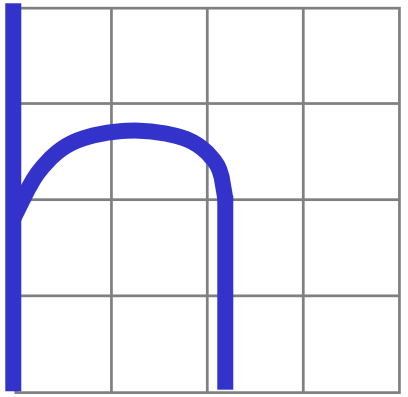

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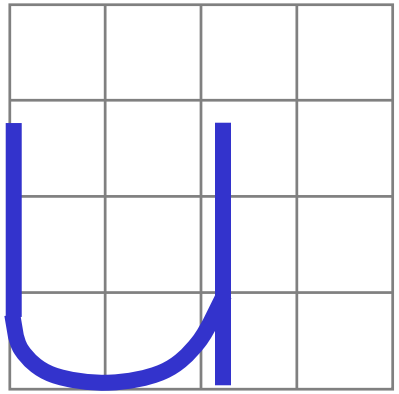

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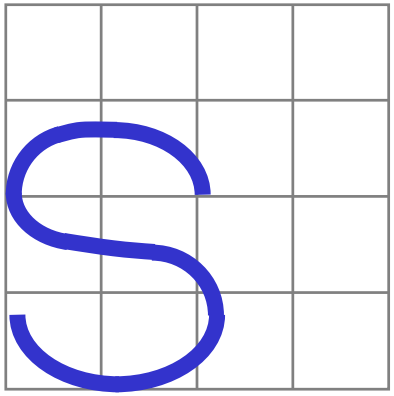
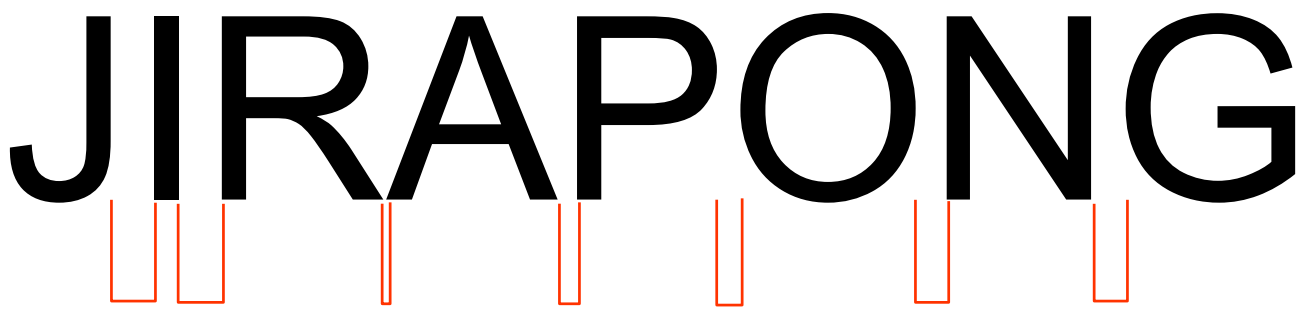


Word Composition

Look at the same word having different spacing between letters.

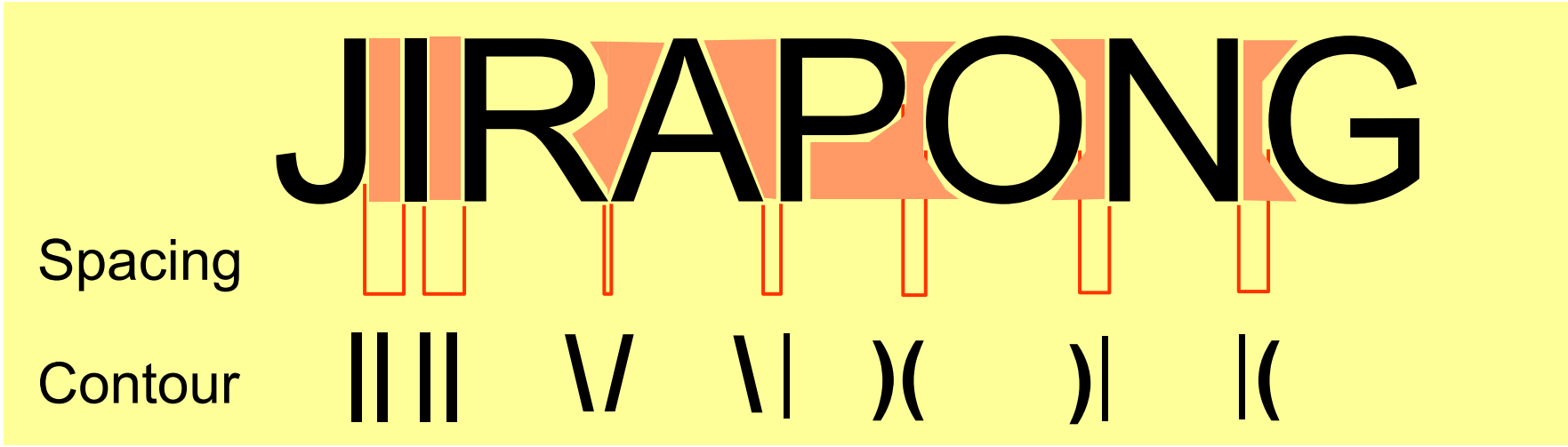
A) Non-uniform spacing



B) Uniform spacing

Which one is easier to read ?

Word Composition

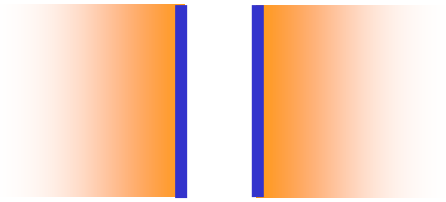


General conclusions are:

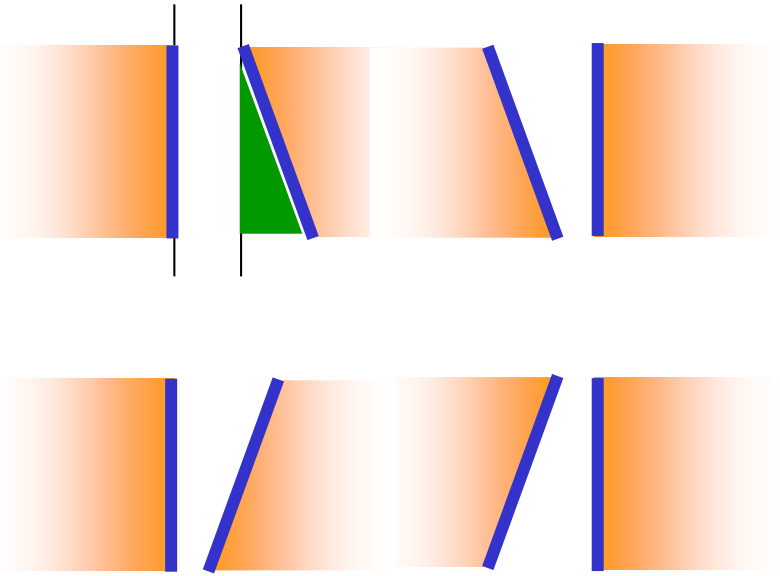
- Space between the letters depends on the contour of the letters at an adjacent side.
- Good spacing creates approximately equal ***background area*** between letters.

Space between Letters

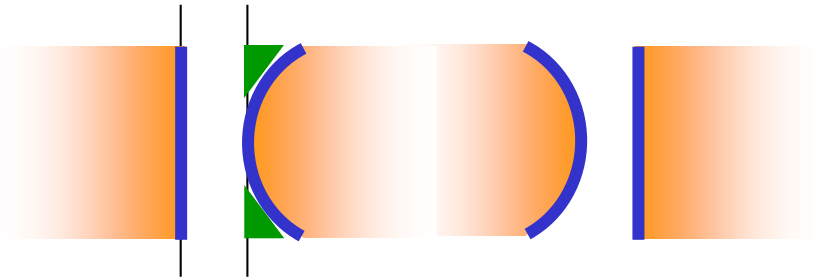
1. Straight - Straight



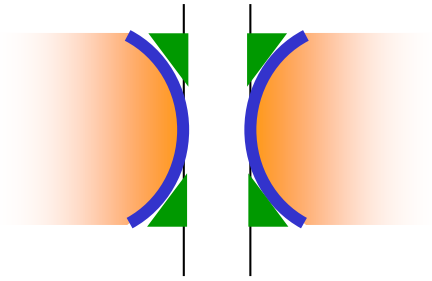
3. Straight - Slant



2. Straight - Curve

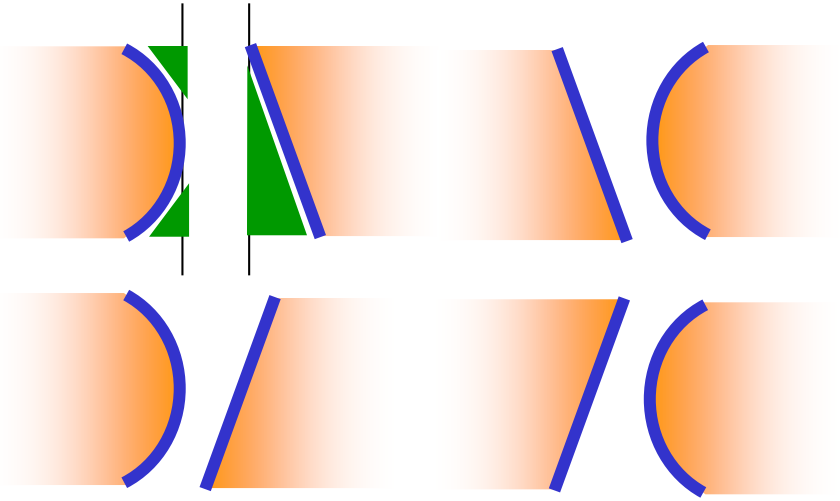


4. Curve - Curve

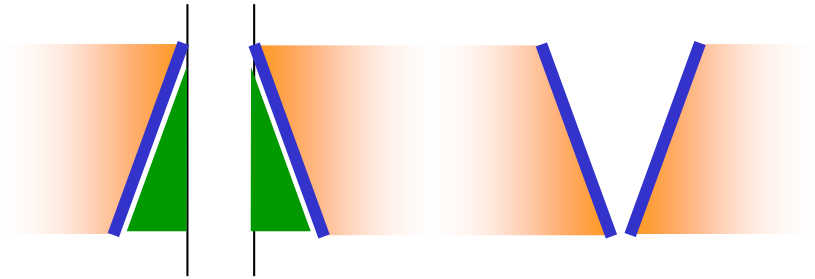


Space between Letters

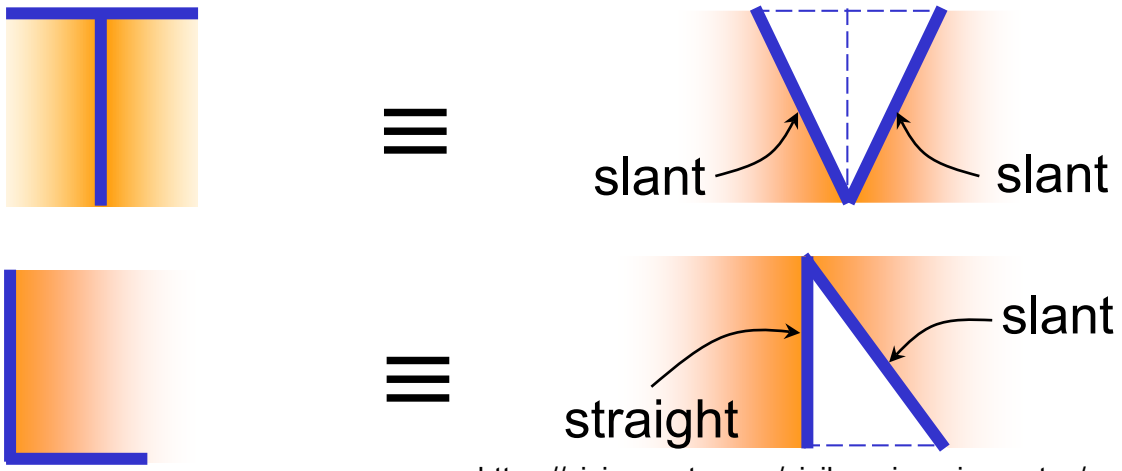
5. Curve - Slant



6. Slant - Slant



7. The letter “L” and “T”



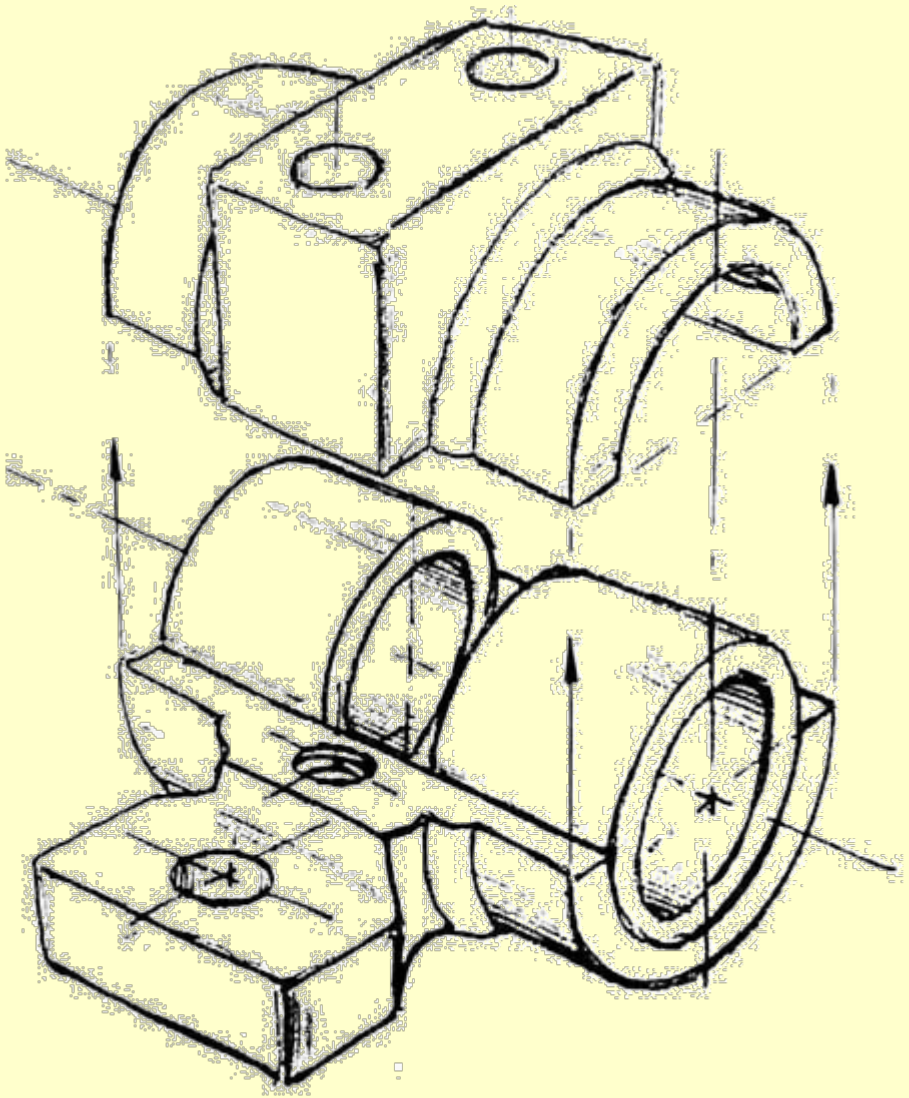
Example : *Good and Poor Lettering*

Sentence Composition

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

Example

ALL ODIMENSIONS OARE OIN
MILLIMETERS OUNLESS
OTHERWISE OSPECIFIED.



Freehand Sketching

Straight Line

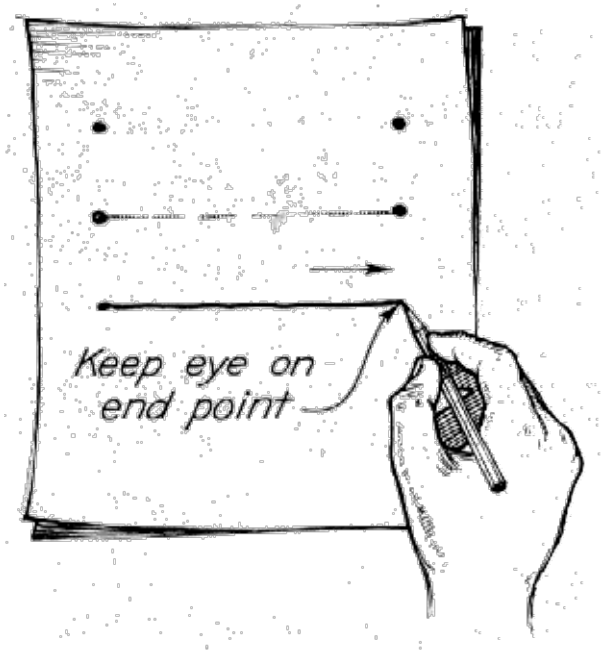
1. Hold the pencil naturally.

2. Spot the beginning and end points.

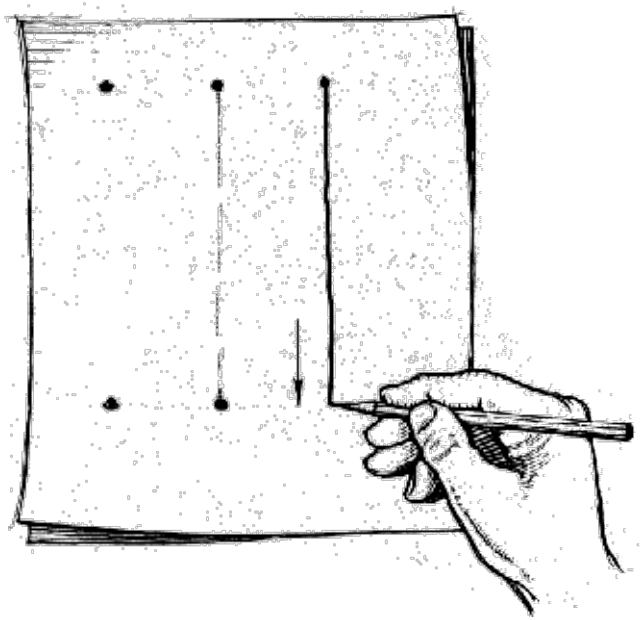
3. Swing the pencil back and forth between the points, barely touching the paper until the direction is clearly established.

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

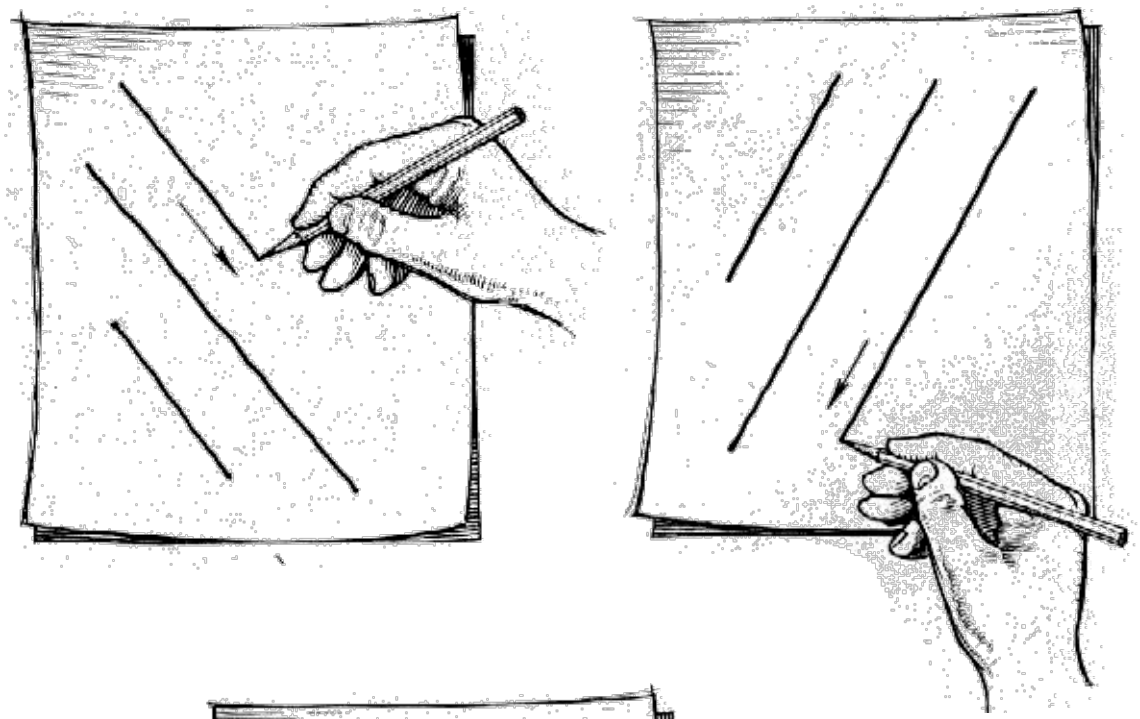
Horizontal line



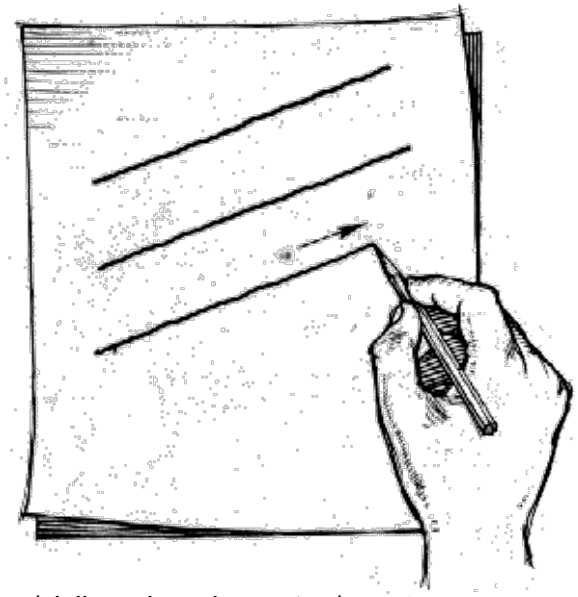
Vertical line



Nearly vertical inclined line



Nearly horizontal inclined line



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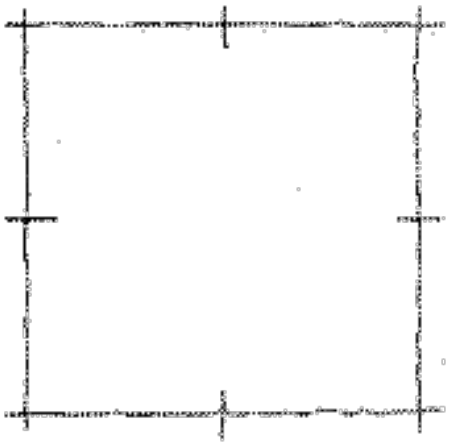
Small Circle

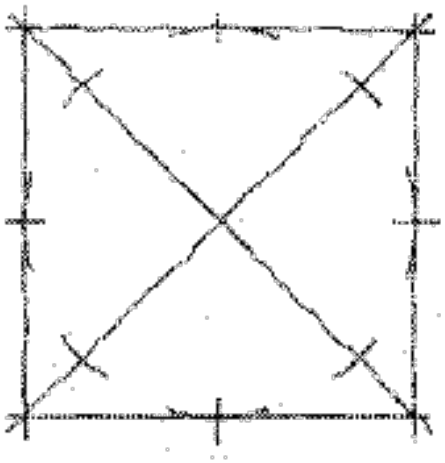
Method 1 : Starting with a square

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.

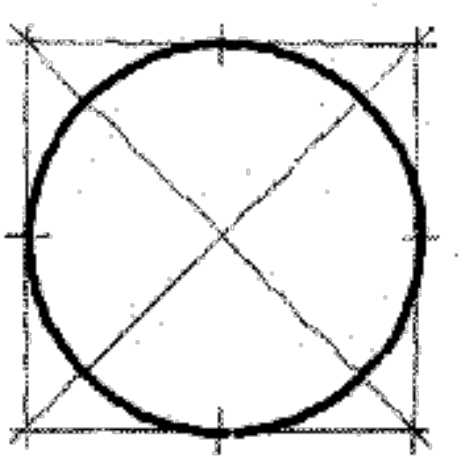
Step 1



Step 2



Step 3

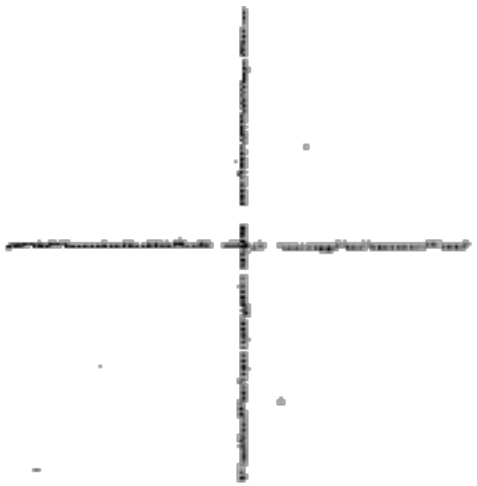


Small Circle

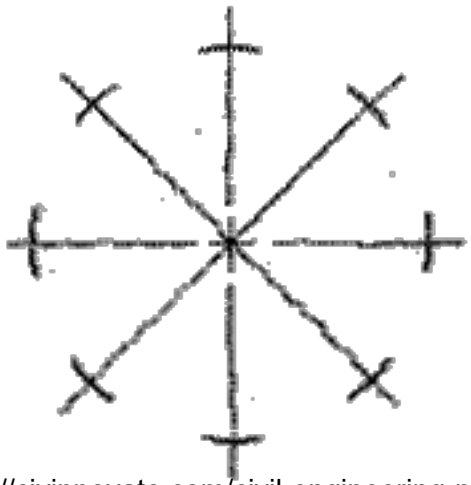
Method 2 : Starting with center line

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

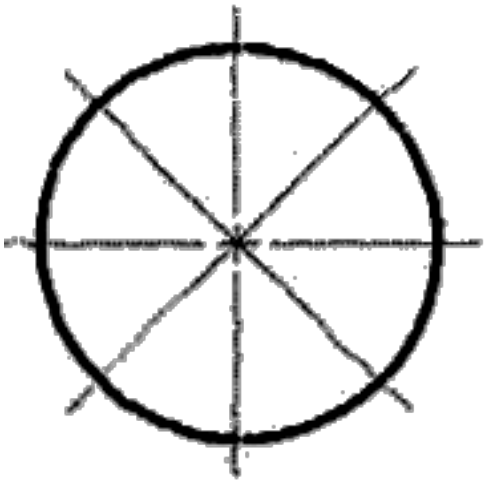
Step 1



Step 2

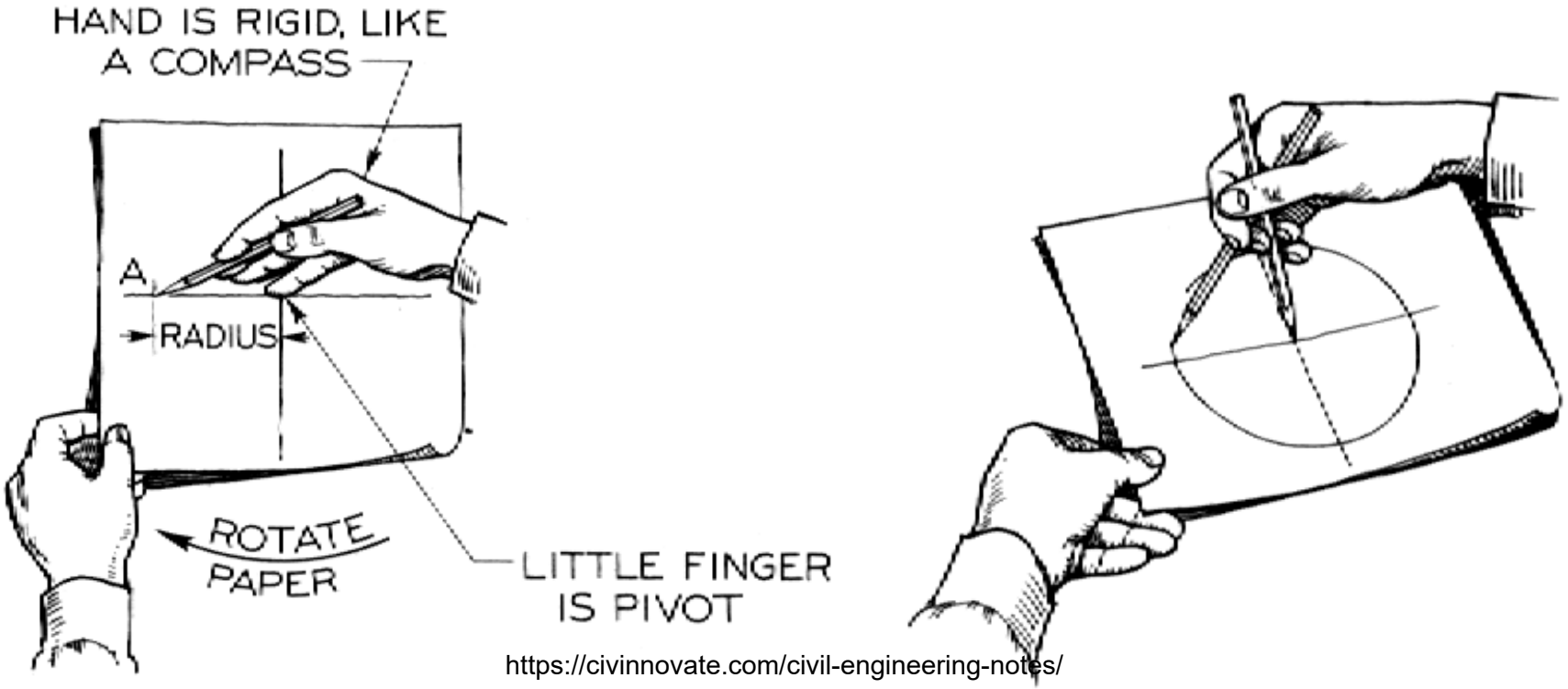


Step 3



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.



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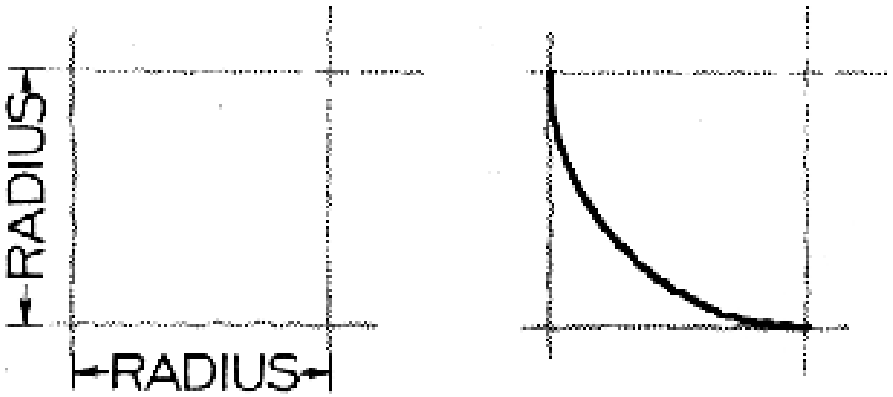
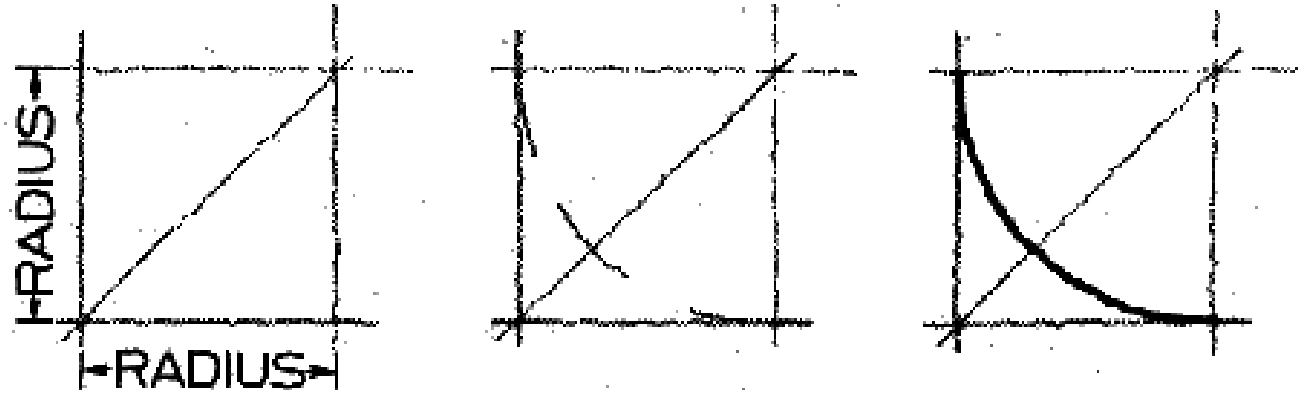
Arc

Method 1 : Starting with a square



Method 2 : Starting with a center line



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Steps in Sketching

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

Example