ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY
Collage of Electrical and Mechanical Engineering
Department of Mechanical Engineering

COURSE :ENGINEERING DRAWING [Meng1011

Instructor: Demise Molawork (M.Sc.)
E-mail: demispoly5@gmail.com
Cellphone: +251-924-277-288
Office : BLDG 64
Room No.: 306

CHAPTER 1

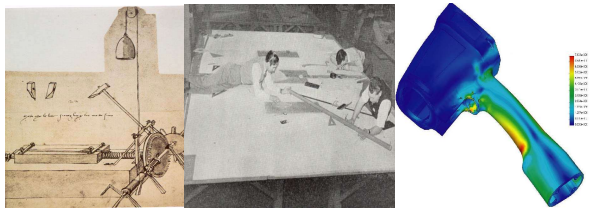
INTRODUCTION TO ENGINEERING DRAWING



TOPICS

- HISTORY OF ENGINEERING DRAWING
- GRAPHICS LANGUAGE
- DRAWING STANDARDS
- DRAWING TOOL
- LETTERING
- TYPES OF LINES

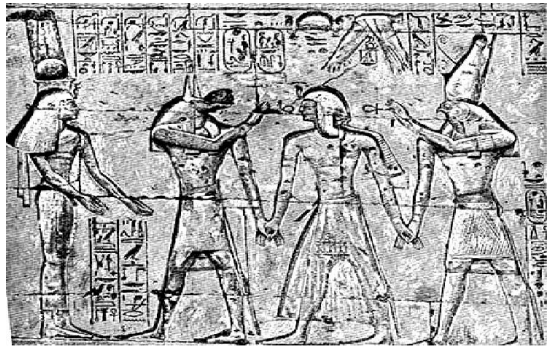
1.1. HISTORY OF ENGINEERING DRAWING



HISTORY OF ENGINEERING DRAWING

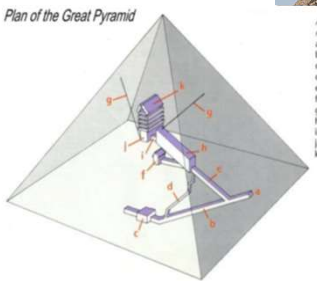
- For centuries, engineering was focused on war and few documents exist today describing how these early *military war machines were built*. Those that do exist were scratched into clay tablets.
- During 15th century, the concept of graphic projections was well understood by early Italian architects.
- Drawings describing machines and buildings date back to the 14th and 15th centuries described more as sketches than as technical drawings.
  - Not to scale nor have dimensions.
  - Documents contain extensive textual descriptions

HISTORY OF ENGINEERING DRAWING



HISTORY OF ENGINEERING DRAWING

Ancient history…

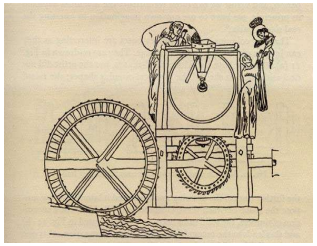




Tombs of the pharaohs

HISTORY OF ENGINEERING DRAWING

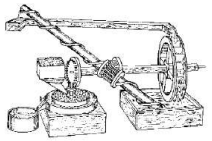
Water Mill

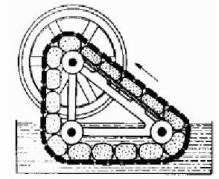


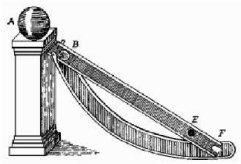
- Perspective projection unknown
- Flattened and distorted, but records basic principles

HISTORY OF ENGINEERING DRAWING

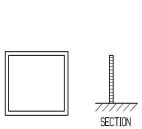
Use of drawing prior to fabrication

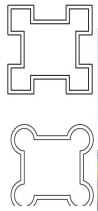






HISTORY OF ENGINEERING DRAWING





- Design of fortifications
- Simple wall geometries





European fortifications

HISTORY OF ENGINEERING DRAWING

- Leon Battista Alberti, in 1435 and 1436, proposed drawings with multiple views rather than the single view then common.
- René Descartes (1596–1650) and Gaspard Monge (1746–1818) developed descriptive geometry.
- Engineering drawing began to evolve more rapidly in the late 18th century and picked up speed with the Industrial Revolution of the 19th century.
  - 1700's - appearance of engineering specialization. ***(Previously all military)***
  - 1750's - Civil Engineering (roads, bridges buildings). Military Engineering (forts, cannon, ships).
  - 1850's - Mechanical Engineering (steam engines, boilers, machine tools)

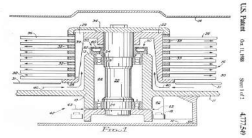
HISTORY OF ENGINEERING DRAWING

Industial Revolution…





- Mass production made accurate, formal drawings a necessity
- Engineering vs. art
- Patent drawings were another animal



HISTORY OF ENGINEERING DRAWING

- 1875 - Electrical engineering (**motors, generators, power distribution**)
- 1895 - Chemical Engineering (**dyes, solvents, polymers, chemical processes**)
- 1950's - Nuclear Engineering (**reactors, nuclear processes**).
- 1950's - Industrial Engineering (**efficiency, material flow**)

HISTORY OF ENGINEERING DRAWING

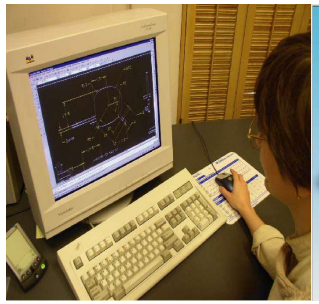
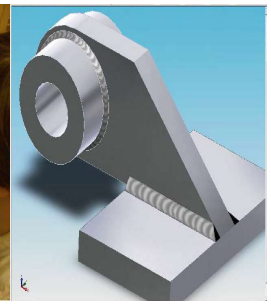
Tools for Engineering Graphics (old tools)

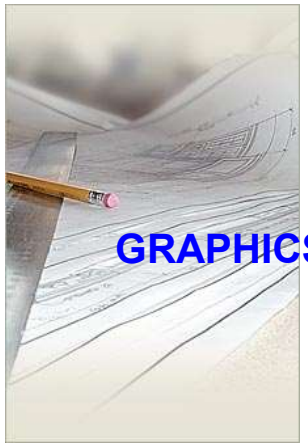




HISTORY OF ENGINEERING DRAWING

Tools for Engineering Graphics (New tools)



1.2. GRAPHICS LANGUAGE

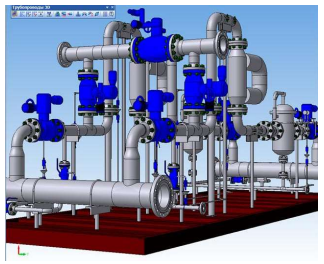
GRAPHICS LANGUAGE




Try writing the *description* of these pictures……

GRAPHICS LANGUAGE

…….Or these pictures



And let someone attempt to *make a sketch or visualize* from your description.

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.

GRAPHICS LANGUAGE

Composition of Graphic Language

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

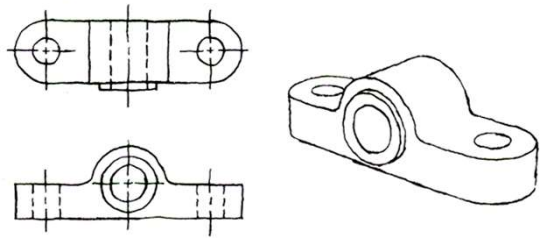
- The language is known as "***drawing***" or "***drafting***" .
- A drawing can be done using ***freehand***, ***instruments*** or ***computer*** methods.

GRAPHICS LANGUAGE

Freehand drawing

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

Example



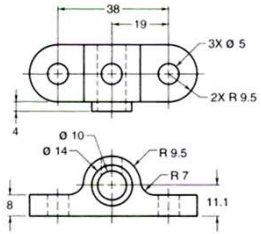
GRAPHICS LANGUAGE

Instrument drawing

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

Example





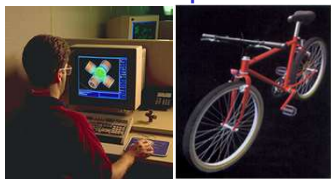
GRAPHICS LANGUAGE

Computer drawing

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

- Computer has a major impact on the methods used to design and create technical drawings.
- Design and drafting on computer are cheap and less time consuming.
- To be an expert in technical drawing, this first course on Engineering (manual) Drawing is the first step.

Example



GRAPHICS LANGUAGE

Elements of Engineering Drawing

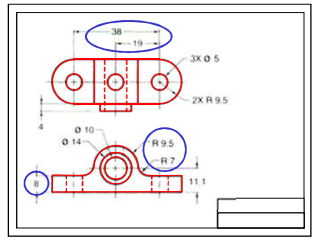
Engineering drawing are made up of ***graphics language*** and ***word language***.

Graphics language

Describe a shape (mainly).

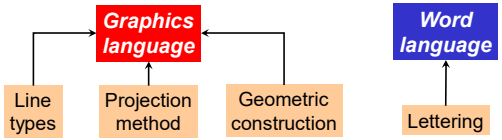
Word language

Describe size, location and specification of the object.



GRAPHICS LANGUAGE

Basic Knowledge for Drafting





1.3. DRAWING STANDARD



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.

DRAWING STANDARD

Standard Code

Country	Code	Full name
Turkey	TS	Turkish Standard
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**

DRAWING STANDARD

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

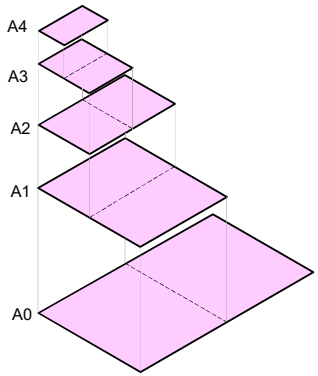
DRAWING STANDARD

Drawing Sheet

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

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

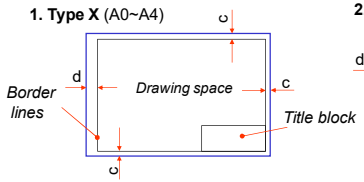
(Dimensions in millimeters)



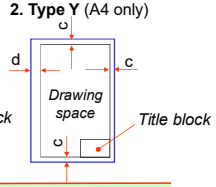
DRAWING STANDARD

- Orientation of drawing sheet

1. Type X (A0~A4)



2. Type Y (A4 only)



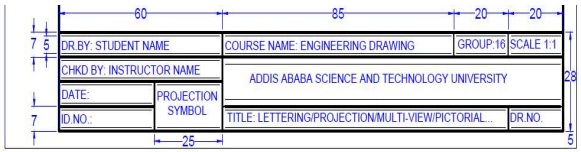
Sheet size	c (mm)	d (mm)	FOR THIS COURSE
A4	10	25	c(5mm) & d(20mm)
A3	10	25	
A2	10	25	
A1	20	25	
A0	20	25	

DRAWING STANDARD

Any engineering drawing contains a title block. The title block can providing the following information:

- Title of the drawing
- Drawing number
- Scale
- Symbol denoting the method of projection
- Name of the firm
- Initials of staff who have designed and checked
- Date

A simplified title block used for engineering Drawing

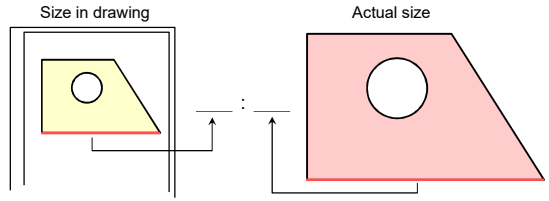


DRAWING STANDARD

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 STANDARD

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.

DRAWING STANDARD

Drawing Scales : Standard scale

- Standard reducing scales are

  1:2, 1:5, 1:10, 1:20, 1:50, 1:100

- Standard enlarging scales are

  2:1, 5:1, 10:1, 20:1, 50:1, 100:1

1.4. DRAWING TOOLS

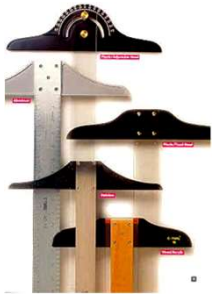




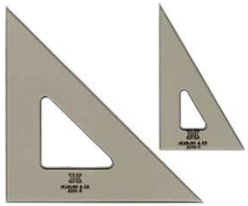
DRAWING TOOLS



DRAWING TOOLS



1. T-Square



2. Triangles

DRAWING TOOLS

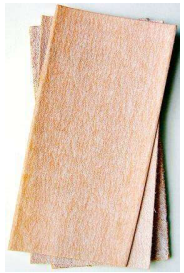


3. Adhesive Tape



4. Pencils

DRAWING TOOLS



5. Sandpaper



6. Compass

DRAWING TOOLS

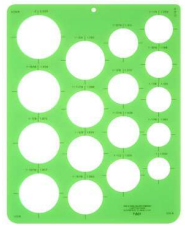


7. Pencil Eraser



8. Erasing Shield

DRAWING TOOLS



9. Circle Template



10. Tissue paper

DRAWING TOOLS



11. Sharpener



12. Clean paper

1.5. LETTERING

LETTERING

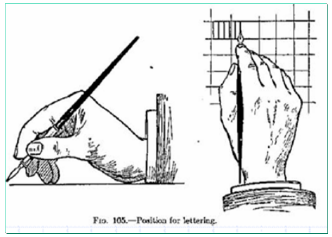
Introduction

- Developing good lettering is a personal skill which takes practice. Letters must be formed properly
- They must be open shaped very legible.
- Clear communication is essential to avoid mistakes and reduce waste.
- Lettering may be done using a drafting type pencil, lead holder or technical pen. Which ever tool is used, the letters must properly formed and very black

LETTERING

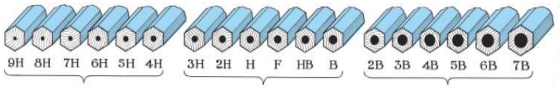
Pencil Techniques

- The best pencil for lettering on most surface are **H**, **F** and **HB** grades.
- Hold your pencil in the position shown. It should make approximately a 60° angle with the paper.

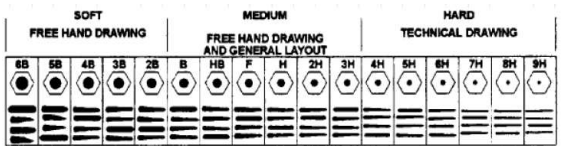


LETTERING

Pencil Lead Designation



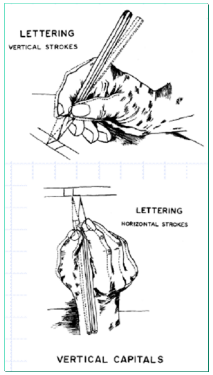
Note: Reverse order below



LETTERING

Free Hand Lettering

- Pull the pencil or pen across the paper. All lettering strokes should be a pulling motion.
- Right-handed and left-handed drafters may have to develop different styles for forming letters.
- Press down hard when using a pencil



LETTERING

Lettering Standard

ANSI Standard

- Use a Gothic text style, either inclined or vertical.
- Use all capital letters.
- Use 3 mm for most text height.
- Space between lines of text is **at least** 1/3 of text height.

This course

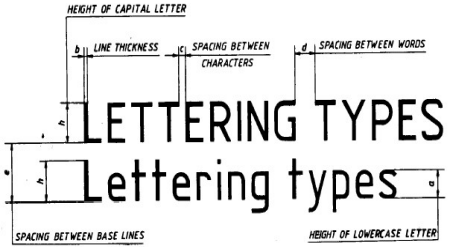
- Use only a vertical Gothic text style.
- Use both capital and lower-case letters.
- Same. For letters in title block it is recommend to use 5 mm text height
- Follows ISO rule.

LETTERING

Lettering types

Lettering A – Height of the capital letter is divided into 14 equal parts

Lettering B – Height of the capital letter is divided into 10 equal parts



LETTERING

Heights of Letters and Numerals

- Height of the capital letters is equal to the height of the numerals used in dimensioning
- Height of letters and numerals – different for different purposes

Sr. No.	Item	Size (mm)
1	Name of the company	**10**, 14, 20
2	Drawing numbers, letters denoting section planes	**10**, 14
3	Title of the Drawing	**7**, 10
4	Sub-titles and heading	5, **7**
5	Dimensioning, Notes, Schedules, Material list	3.5, **7**
6	Alteration entries and tolerances	3.5

LETTERING

Specifications of A -Type Lettering

Specifications	Value	Size (mm)						
Capital letter height	**h**	2.5	3.5	5	7	10	14	20
Lowercase letter height	**a = (5/7)h**	-	2.5	3.5	5	7	10	14
Thickness of lines	**b = (1/14)h**	0.18	0.25	0.35	0.5	0.7	1	1.4
Spacing between characters	**c = (1/7)h**	0.35	0.5	0.7	1	1.4	2	2.8
Min. spacing b/n words	d = (3/7)h	1.05	1.5	2.1	3	4.2	6	8.4
Min. spacing b/n baselines	**e = (10/7)h**	3.5	5	7	10	14	20	28

LETTERING

Specifications of B -Type Lettering

Specifications	Value	Size (mm)						
Capital letter height	**h**	2.5	3.5	5	7	10	14	20
Lowercase letter height	**a = (7/10)h**	-	2.5	3.5	5	7	10	14
Thickness of lines	**b = (1/10)h**	0.25	0.35	0.5	0.7	1	1.4	2
Spacing between characters	**c = (1/5)h**	0.5	0.7	1	1.4	2	2.8	4
Min. spacing b/n words	**d = (3/5)h**	1.5	2.1	3	4.2	6	8.4	12
Min. spacing b/n baselines	**e = (7/5)h**	3.5	5	7	10	14	20	28

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.

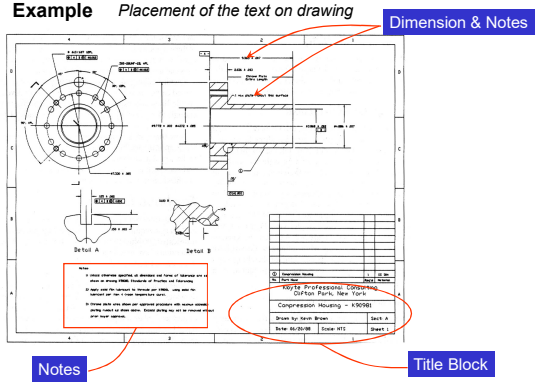
Thus, it must be written with

Legibility - shape
- space between letters and words

Uniformity - size
- line thickness

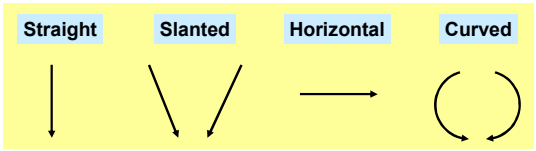
LETTERING

Example *Placement of the text on drawing*

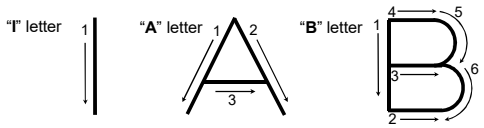


LETTERING

Basic Strokes



Examples : *Application of basic stroke*



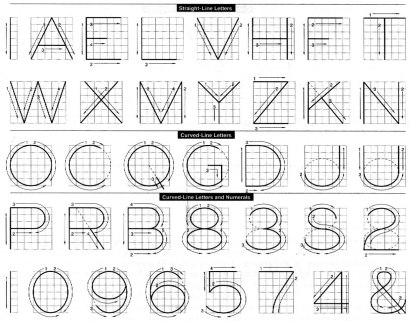
LETTERING

Upper-case letters & Numerals

Straight line letters

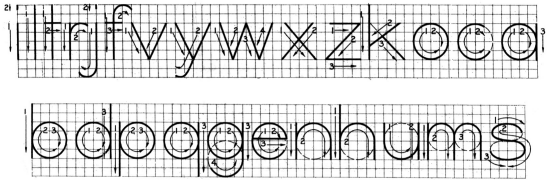
Curved line letters

Curved line letters & Numerals



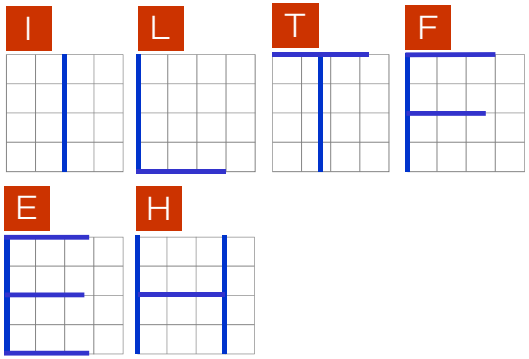
Suggested Strokes Sequence

Lower-case letters

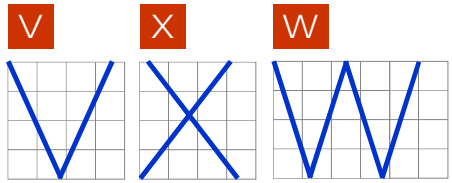


- The text' s body height is about 2/3 the height of a capital letter.

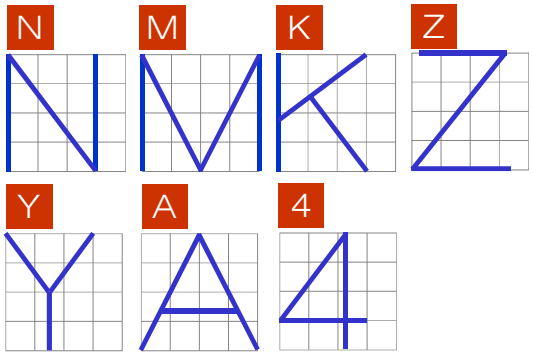
Stroke Sequence



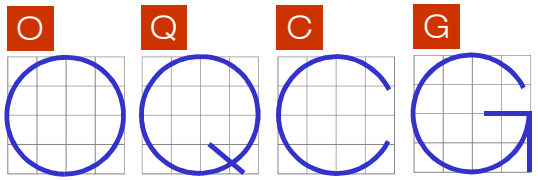
Stroke Sequence



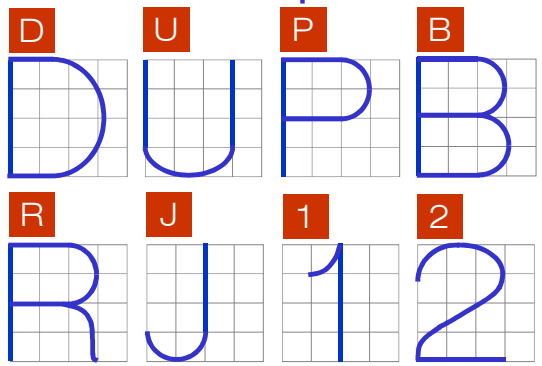
Stroke Sequence



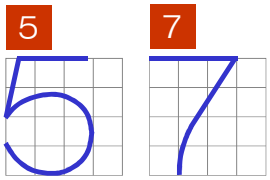
Stroke Sequence



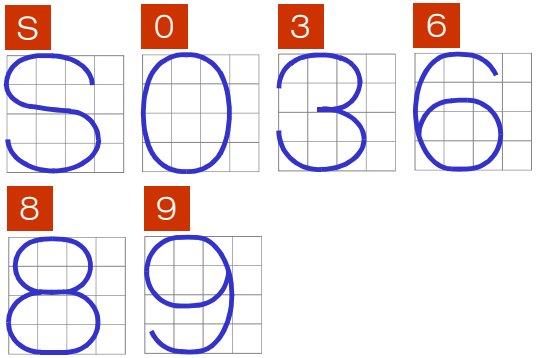
Stroke Sequence



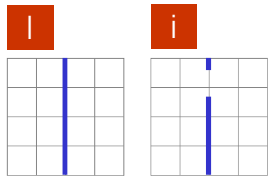
Stroke Sequence



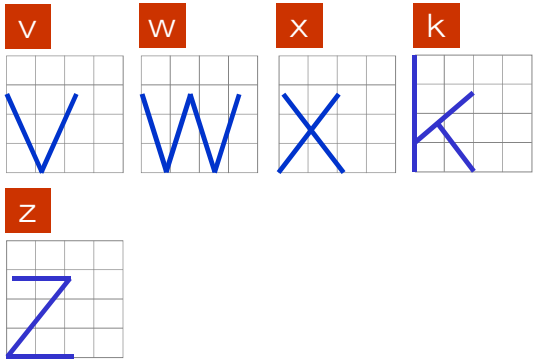
Stroke Sequence



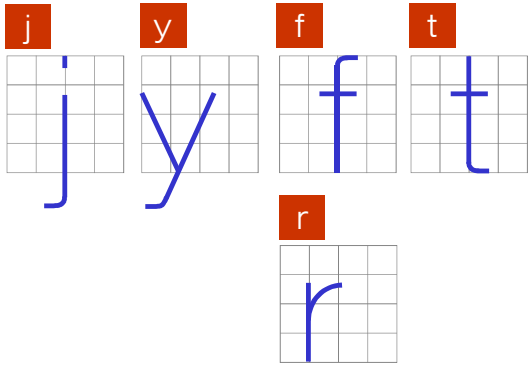
Stroke Sequence



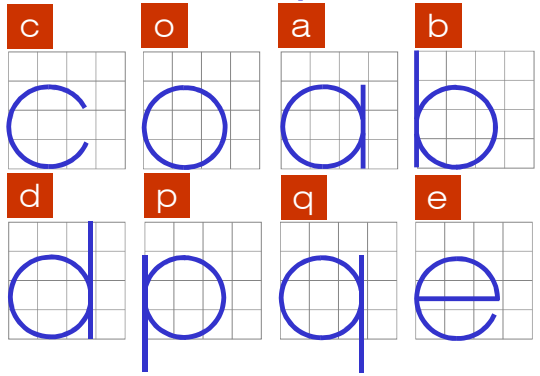
Stroke Sequence



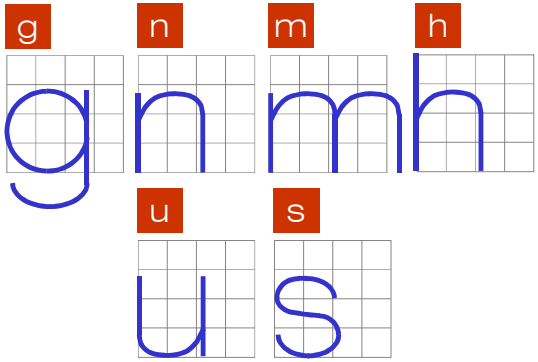
Stroke Sequence



Stroke Sequence



Stroke Sequence



Word Composition

Look at the same word having different spacing between letters.

A) Non-uniform spacing

JIRAPONG

B) Uniform spacing

JIRAPONG

Which one is easier to read ?

Word Composition

JIRAPONG

Spacing

Contour

General conclusions are:

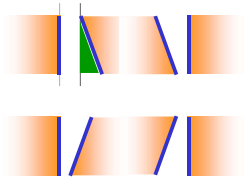
- Space between the letters depends on the contour of the letters at an adjacent side.
- Good spacing creates approximately equal ***background area*** between letters.

Space between Letters

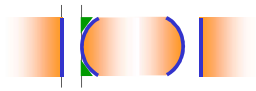
1. Straight - Straight



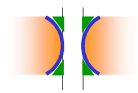
3. Straight - Slant



2. Straight - Curve

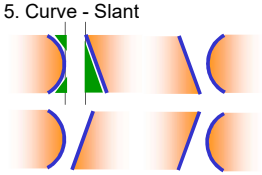


4. Curve - Curve



Space between Letters

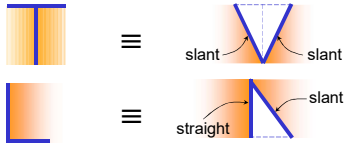
5. Curve - Slant



6. Slant - Slant



7. The letter "L" and "T"



Example : *Good and Poor Lettering*

ESTIMATE → **GOOD**

EsTiMaTE → Not uniform in style.

ESTIMATE
ESTIMATE → Not uniform in height.

ESTIMATE
ESTIMATE → Not uniformly vertical or inclined.

ESTIMATE
ESTIMATE → Not uniform in thickness of stroke.

ESTIMATE → Area between letters not uniform.

ABILITY WILL NEVER CATCH UP WITH THE DEMAND FOR IT → Area between words not uniform.

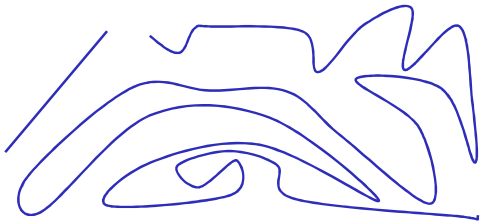
Sentence Composition

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

Example

ALLODIMENSIONSOAREOIN
MILLIMETERSOUNLESS
OTHERWISEOSPECIFIED.

1.6. TYPES OF LINES



TYPES OF LINES

Types of Lines	Appearance	Name according to application
Continuous very light & thin	———	Construction line
Continuous thick line	———	Visible line
Dash medium line	– – – –	Hidden line
Chain thin line	—·—·—	Center line
Continuous thin line	———	Dimension line Extension line Leader line
Thin zigzag line	⌇⌇⌇	Long break
Thick freehand drawn line	~~~	Short break
Thin 2 short & 1 long line Alternatively drawn	– – —– – –	Phantom line

TYPES OF LINES

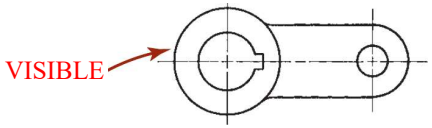
CONSTRUCTION

- Used to initially lay out a drawing.
- Used for guide lines for lettering.
- Draw very light and thin so they are barely visible.
- Draw with a 0.5 mm pencil.

TYPES OF LINES

VISIBLE/OBJECT — Thick .024″–.028″ (0.60 mm–0.70 mm)

- These lines are thick and dark solid (unbroken) lines that are used on drawings to indicate the edges and details of an object.
- These lines should be the most prominent on the drawing as they are drawn thicker (wider) than most other lines.
- We will use the 0.9 mm pencil.



TYPES OF LINES

HIDDEN — Medium .015″ (0.4 mm)

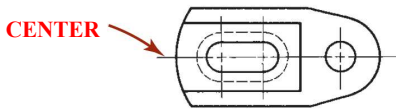
- These lines are medium dashed lines used to indicate a surface, edge, or contour of an object that cannot be seen, or is hidden from view.
- The dashed lines are 1/8" long with a 1/16" space.
- Hidden lines will be drawn with a 0.7 mm pencil.



TYPES OF LINES

CENTER — Thin .012″–.014″ (0.30 mm–0.35 mm)

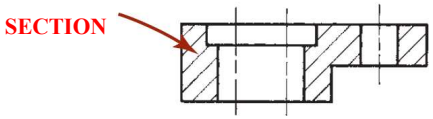
- These lines are thin lines made up of alternating long and short dashes. They are used to indicate the center of circles and of symmetrical features. Also as an aid in dimensioning.
- The short dashed lines are 1/8" long, the space is 1/16", & the long line ranges from 3/4" to 1 ½".
- Lines will be drawn with 0.5 mm pencil



TYPES OF LINES

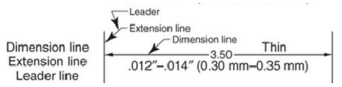
SECTION — Thin .012″–.014″ (0.30 mm–0.35 mm)

- Section lines are thin "cross hatching" lines used in sectional views to symbolize different parts of an object or different materials from which an object is manufactured.
- Section lines are normally drawn at a 45° with a 0.5 mm pencil.

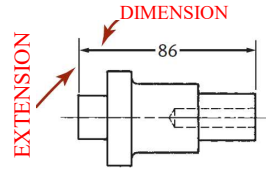


TYPES OF LINES

DIMENSION, EXTENSION,& LEADER

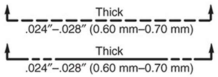


- These lines are thin lines (0.5 mm)used for dimensioning purposes.
- Dimension and leader lines generally end with arrowheads and are accompanied by a number indicating a size or location dimensions.
- Extension lines aid dimension lines by extending the surface of the object so it can be dimensioned.

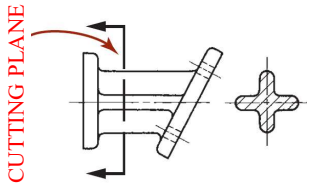


TYPES OF LINES

CUTTING PLANE
OR VIEWING PLANE

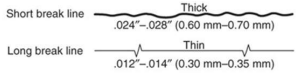


- These lines are very thick lines (0.9 mm) that indicate where an imaginary cutting plane passes through an object, for viewing or sectioning purpose.
- Arrowheads on both ends of the line point to the surface to be viewed.

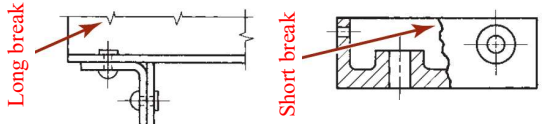


TYPES OF LINES

BREAK

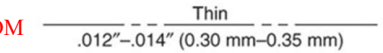


- These lines are used to shorten a view, or to eliminate repetitive details when an entire view is not necessary.
- **Short break lines** are thick wavy freehand lines.
- **Long break lines** are thin straight zigzags.



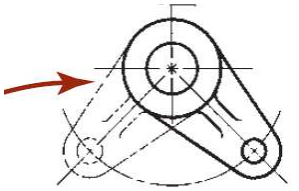
TYPES OF LINES

PHANTOM



- These lines are thin lines used to indicate alternate positions of moving parts, lines of motion, adjacent parts and repetitive details.
- They are similar in style to a Cutting Plane Line, but much thinner in weight.

PHANTOM



TYPES OF LINES

This list ranks the line type precedence from highest to lowest:

1. Visible line
2. Hidden line
3. Cutting plane line
4. Center line
5. Break line
6. Dimension and extension lines
7. Sectioning lines

