Engineering
Drawing
Traditional Drawing Tools
DRAWING TOOLS
DRAWING TOOLS

1. T-Square
2. Triangles
DRAWING TOOLS

3. Adhesive Tape

4. Pencils

HB for thick line
2H for thin line
5. Sandpaper

6. Compass
DRAWING TOOLS

7. Pencil Eraser
8. Erasing Shield
DRAWING TOOLS

9. Circle Template

10. Tissue paper
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
Arc

Method 1 : Starting with a square

Method 2 : Starting with a center line
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
The text’s body height is about 2/3 the height of a capital letter.
Example: Good and Poor Lettering

ESTIMATE GOOD
EstiMaTe
ESTIMATE
ESTIMATE
ESTIMATE
ESTIMATE
ESTIMATE
ESTIMATE
ESTIMATE
ESTIMATE

ABILITY WILL NEVER CATCH UP WITH THE DEMAND FOR IT

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

ALLODIMENSIONSOAREOIN
MILLIMETERSOUNLESS
OTHERWISEOPECIFIED.
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 uses **lines** to represent the **surfaces**, **edges** and **contours** of objects.

The language is known as “**drawing**” or “**drafting**”.

A drawing can be done using **freehand**, **instruments** or **computer** methods.
Freehand drawing

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

Example
Instrument drawing

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

Example
Computer drawing

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

Example
Architectural Graphics
Elements

Drawing comprises 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

Graphics language
- Line types
- Projection method
- Geometric construction

Word language
- Lettering
PROJECTION METHOD
PROJECTION METHOD

- Perspective
- Parallel
  - Oblique
  - Orthographic
    - Axonometric
    - Multiview
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.
Disadvantage of Perspective Projection

1) It is difficult to create.
2) It does not reveal exact shape and size.
Orthographic Projection
Orthographic projection is a parallel projection technique in which the parallel lines of sight are perpendicular to the projection plane.
Orthographic view depends on relative position of the object to the line of sight.

More than one view is needed to represent the object.

Multiview drawing

Three dimensions of an object is shown.

Axonometric drawing
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 hole becomes ellipse.
- Right angle becomes obtuse angle.
Types of Axonometrics

A. ISOMETRIC
B. DIMETRIC
C. TRIMETRIC
Multiview Drawing

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

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

**Example** Multiviews drawing (2-view drawing)
The Glass Box Approach
Orthographic Projection

Parallel projectors perpendicular to frontal plane
Opening the Box

Horizontal and Profile planes are opened into the frontal plane.
Final Views

The standard arrangement of three orthographic views:
Top View above the Front View
R Side View right of the Front View

Fold line between Horizontal and Frontal planes labeled H–F.
Fold line between Frontal & Profile labeled F–P.

Views project to adjacent views.

Outlines of projection planes are omitted in final drawings.
Six Orthographic Views
Laying Out All Six Views

The glass box is opened into a single plane to show the six principal views.
The outlines of glass box are omitted in an orthographic drawing.
Three Primary Views
Construction of Views
First and Third Angle Projections

- First Angle – International
- Third Angle – U.S.
## Basic Line Types

<table>
<thead>
<tr>
<th>Types of Lines</th>
<th>Appearance</th>
<th>Name according to application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous thick line</td>
<td>—</td>
<td>Visible line</td>
</tr>
<tr>
<td>Continuous thin line</td>
<td>—</td>
<td>Dimension line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extension line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leader line</td>
</tr>
<tr>
<td>Dash thick line</td>
<td>— — — — —</td>
<td>Hidden line</td>
</tr>
<tr>
<td>Chain thin line</td>
<td>— — — — — —</td>
<td>Center line</td>
</tr>
</tbody>
</table>
Meaning of Lines

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

**Hidden lines** represent features that cannot 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

- Dimension line (Thin)
- Extension line (Thin)
- Leader line (Thin)
- Center line (Thin)
- Visible line (Thick)
- R8
- 50
Good practice

Good Corners

Hidden lines butt against outside lines

Good Corner

Poor Corner

Should touch outside line

Incorrect Centerline

GOOD

POOR
Exercise

• Complete three orthographic views of the object shown on the next slide.
• Include visible, hidden, and center lines where appropriate.
• You will be given 7 minutes.
Object for exercise
Solution
Drawing Standard
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.
<table>
<thead>
<tr>
<th>Country</th>
<th>Code</th>
<th>Full name</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>ANSI</td>
<td>American National Standard Institute</td>
</tr>
<tr>
<td>Japan</td>
<td>JIS</td>
<td>Japanese Industrial Standard</td>
</tr>
<tr>
<td>UK</td>
<td>BS</td>
<td>British Standard</td>
</tr>
<tr>
<td>Australia</td>
<td>AS</td>
<td>Australian Standard</td>
</tr>
<tr>
<td>Germany</td>
<td>DIN</td>
<td>Deutsches Institut für Normung</td>
</tr>
<tr>
<td>ISO</td>
<td></td>
<td>International Standards Organization</td>
</tr>
</tbody>
</table>
# Partial List of Drawing Standards

<table>
<thead>
<tr>
<th>Code number</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS Z 8311</td>
<td><strong>Sizes and Format of Drawings</strong></td>
</tr>
<tr>
<td>JIS Z 8312</td>
<td><strong>Line Conventions</strong></td>
</tr>
<tr>
<td>JIS Z 8313</td>
<td><strong>Lettering</strong></td>
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<tr>
<td>JIS Z 8314</td>
<td><strong>Scales</strong></td>
</tr>
<tr>
<td>JIS Z 8315</td>
<td>Projection methods</td>
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<tr>
<td>JIS Z 8316</td>
<td>Presentation of Views and Sections</td>
</tr>
<tr>
<td>JIS Z 8317</td>
<td>Dimensioning</td>
</tr>
</tbody>
</table>
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)

   - Drawing space
   - Title block
   - Border lines

   - Sheet sizes and minimum dimensions:
     - A4: c = 10, d = 25
     - A3: c = 10, d = 25
     - A2: c = 10, d = 25
     - A1: c = 20, d = 25
     - A0: c = 20, d = 25

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

   - Drawing space
   - Title block
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.
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
- SCALE 1:X for *reduction* scales