

Course Title: Computer Aided Design and Drafting

Course Code: BAE 2101

Credit: 1



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CADD-Experiment 1

Experiment # 01: Introduction to Engineering Drawing and Computer Aided Design & Drafting and Familiarization with AutoCAD software and its different features.

Objective: To familiarize the students with the basic concepts of engineering drawing and computer aided design & drafting.

Description: AutoCAD is a software application for computer-aided design (CAD) and drafting. The software supports both 2D and 3D formats. The software is developed and sold by Autodesk, Inc

Computer Aided Design and Drafting

- The engineering drawing can be accomplished in computer software with much ease.
- It is possible to draw complex drawings, whether 2D or 3D, in computer using commercially available software tools.
- Computer Aided Design (CAD), with the help of computer system and a CAD software, helps the designer to create, modify, analyze engineering drawings.
- CAD improves the productivity of the designer, quality of the design and improve documentations procedures which facilitates manufacturing with higher precision.

Computer Aided Design and Drafting

- It is also possible to manufacturing directly obtaining the CAD file realizing into the manufacturing operations with proper dimension.
- Several CAD software tools are commercially available.
- Following are few CAD software widely used by the engineers for the drawing.
- AutoCAD
- SolidWorks
- Pro-Engineering
- CATIA
- Auto Desk Inventor
- TurboCAD

Why is it important to know how to understand Engineering Drawings?

- The members of the engineering design project team must be able to communicate among themselves and with the rest of the project team in order to contribute to the team's success
- Graphic language is the universal design used to develop and construct products and systems throughout the world.
- The basic principles for communicating information using technical drawings are the same whether you are creating it by hand or using CAD.

Drafting instruments

The most common types of drafting instruments are as follows:

Drawing board

T-scale

Set-square Scales

Compasses

Protractor

Pencils and leads, Eraser

Papers

Standard Sheet Layouts & sizes

Nearest International Size (mm)	International Number of Zones	International Margin	Standard U.S. Size (in.)	U.S. Number of Zones (width)	U.S. Margin (in.)
A4 210 × 297	6	10	A* 8.5 × 11.0	2 (optional)	.50
A3 297 × 420	6	10	B 11.0 × 17.0	2 (optional)	.50
A2 420 × 594	8	10	C 17.0 × 22.0	4	.50
A1 594 × 841	12	20	D 22.0 × 34.0	4	.50
A0 841 × 1189	16	20	E 34.0 × 44.0	8	.50

* May also be used as a vertical sheet size at 11" tall by 8.5" wide.

Introducing AutoCAD

- In this lab course, AutoCAD, created by AutoDesk Corporation, will be used.
- This software is the most widely used technical drawing program.
- People use this AutoCAD to generate different kinds of drawings.
- The major disciplines that used CAD are,
 - I. Civil
 - II. Mechanical
 - III. Electrical/electronic
 - IV. Architecture
 - V. GIS (Geographic Information Systems)
 - VI. Multimedia etc.

Main Parts of AutoCAD Window

- **Title Bar** (Top bar): Placed at the top of the window this shows the name of the program. The name of the current drawing appears in the Title Bar of the drawing area or document window.
- **Menu Bar** (second top bar): Located below the title bar. It contains the default AutoCAD menus. Menus are defined by menu files that can be modified.
- **Toolbars**: A number of toolbars appear on the screen below the menu bar. Commands can be activated by clicking the buttons on the various toolbars. Appearance of various toolbars is optional, and their position can be shifted. The most common toolbars that appear by default include the following:
 - Standard Toolbar (Undo, Redo, Zoom, Open, Save, Cut, Copy, Paste etc.)
 - Object properties Toolbars (Layer Toolbar and Properties Toolbar)
 - Draw Toolbar (left bar)
 - Modify Toolbar (right bar)

Main Parts of AutoCAD Window

Drawing Area: The drawing area size varies, depending on the size of the AutoCAD window and on the number of other elements (such as toolbars and dialog boxes) that are displayed.

This contains the following main features:

- Cursor (to locate points and select objects)
- User Co-ordinate System (UCS) Icon (displayed in the lower-left corner of the drawing area)
- Model Tab and Layout Tabs (use model space to draw the drawings and layouts to plot and print the drawings)

Command Window:

- Displays command prompts and command history.
- If anyone chooses commands from menu and toolbars, AutoCAD may display the command history in the command window.

Main Parts of AutoCAD Window

Status Bar (bottom bar):

- Displays the cursor co-ordinates in the lower-left corner.
- The status bar also contains buttons that you can use to turn on command drawing aids.
- These include:
 - SNAP (F9)
 - GRID (F7)
 - ORTHO (F8)
 - POLAR (F10)
 - OSNAP (F3)
 - OTRACK (F11)
 - LWT
 - MODEL

Frequently used AutoCAD Features:

Drawing Units: Go Format Menu then **Units**

Type – Engineering or Architectural, Unit- Inches
Type – Decimal, Unit- millimeter.

- Object Layers: Go Format Menu then Layer

Line type: Format Menu then Line type
Line weight: Format menu then Line weight,
Default line weight 0.25mm or 0.01inch.

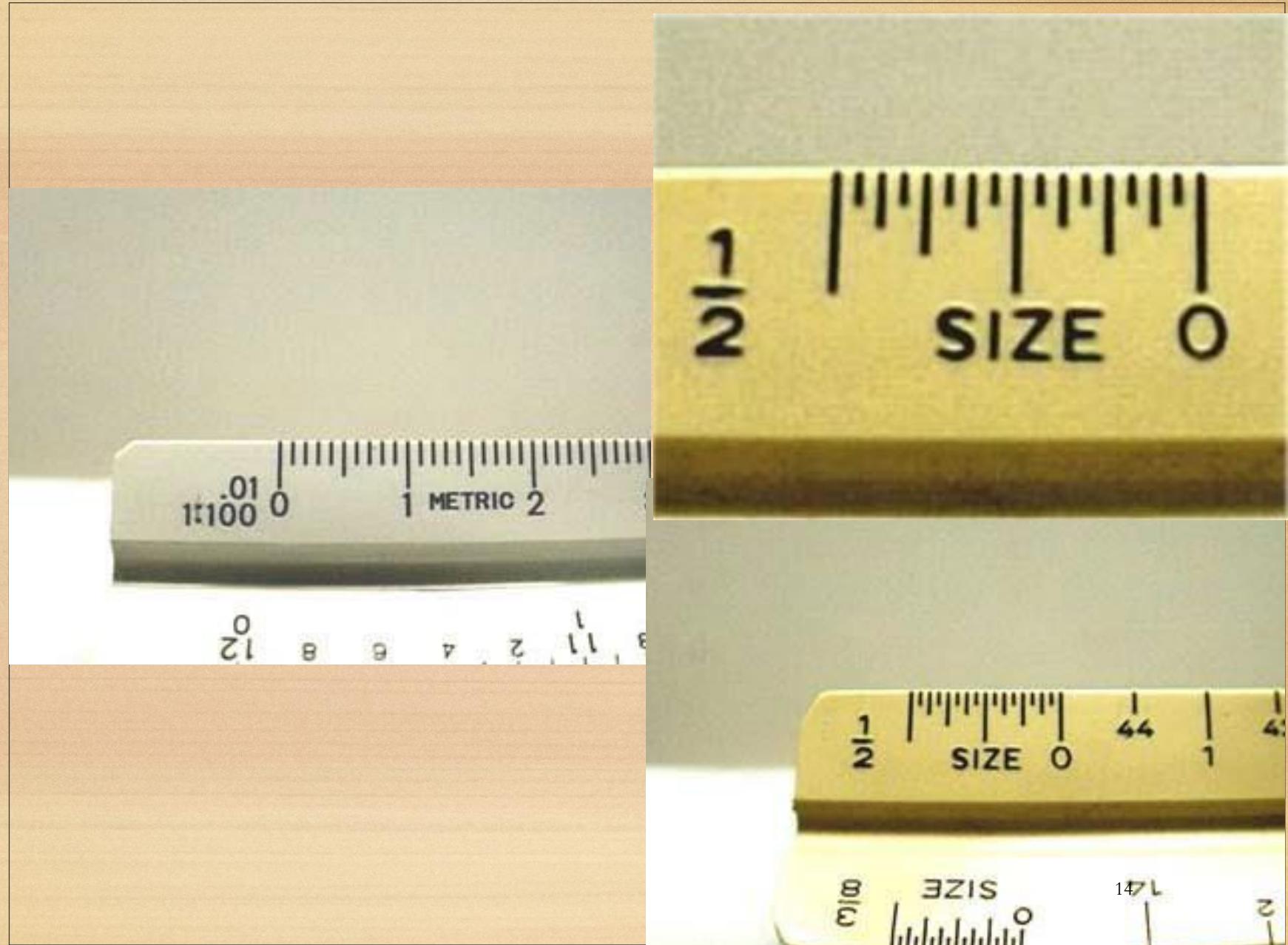
Frequently used AutoCAD Features:

Object Snap Settings: move mouse on the **OSNAP** at the status bar then right click then settings.

- Options: Tools menu then Options
- File Save: Tools menu then Options then Open and Save
- Text Style: Go Format Menu then Text Style
- Dimension Style: Go Format Menu then Dimension Style
- Object Properties: Tools menu then Properties or Modify menu then Properties
- Viewports: View menu then Viewports

Measurements and Drawing Scales

- Metric
- Engineers'
- Decimal
- Mechanical Engineers'
- Architects'



Measurements and Drawing Scales

U.S. Customary Units

- Based on inch-foot and yard measurements
- Drawings with these units still follow ANSI standards
- Drawing units must be clearly stated on the drawing

The Metric system

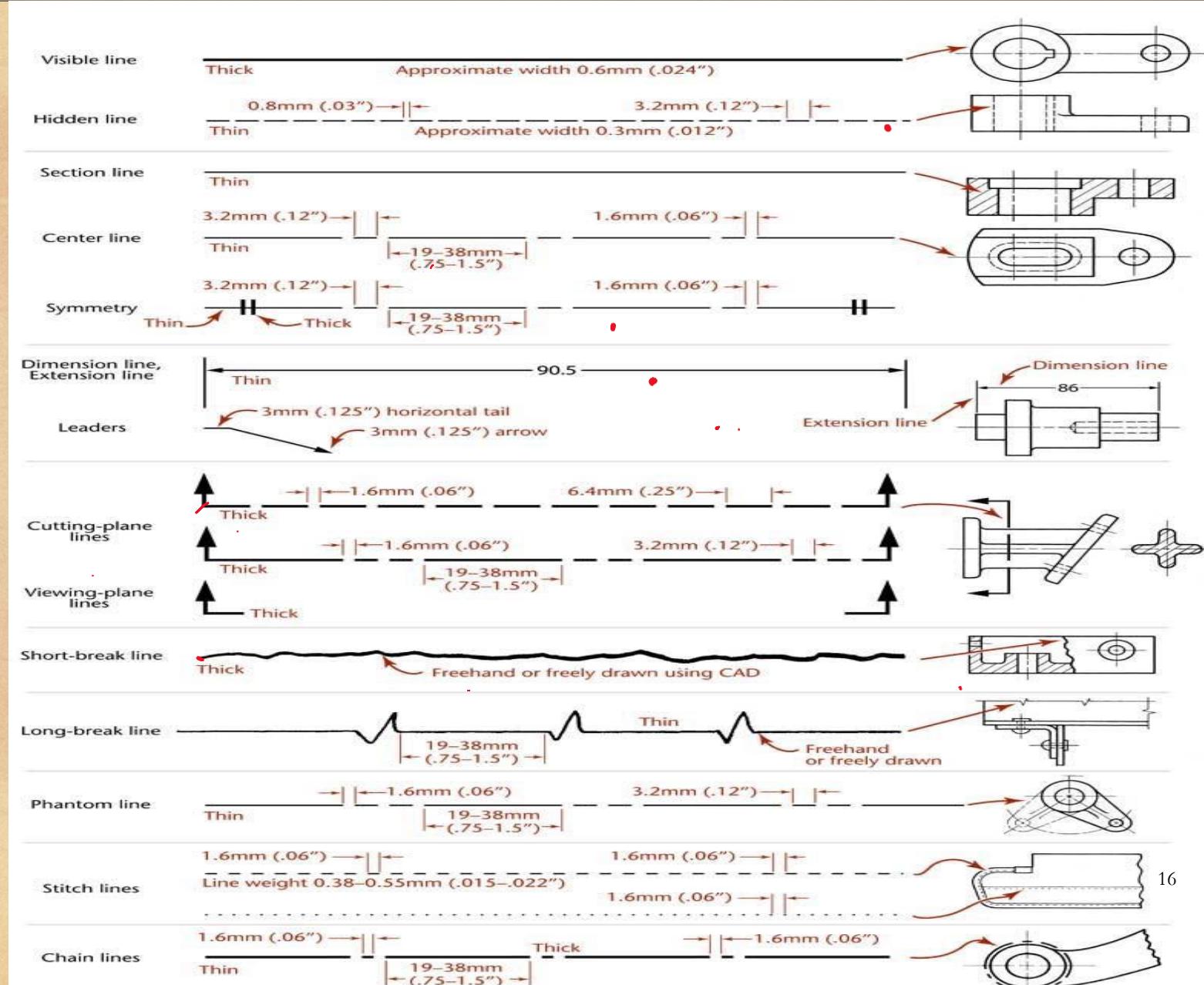
- This is the International System of Units, commonly referred to as SI system.
- The primary unit of measurement for engineering drawings and design in the mechanical industries is the millimeter (mm)

Types of Lines

- The meaning of each line on a technical drawing is indicated by its width and its particular line style

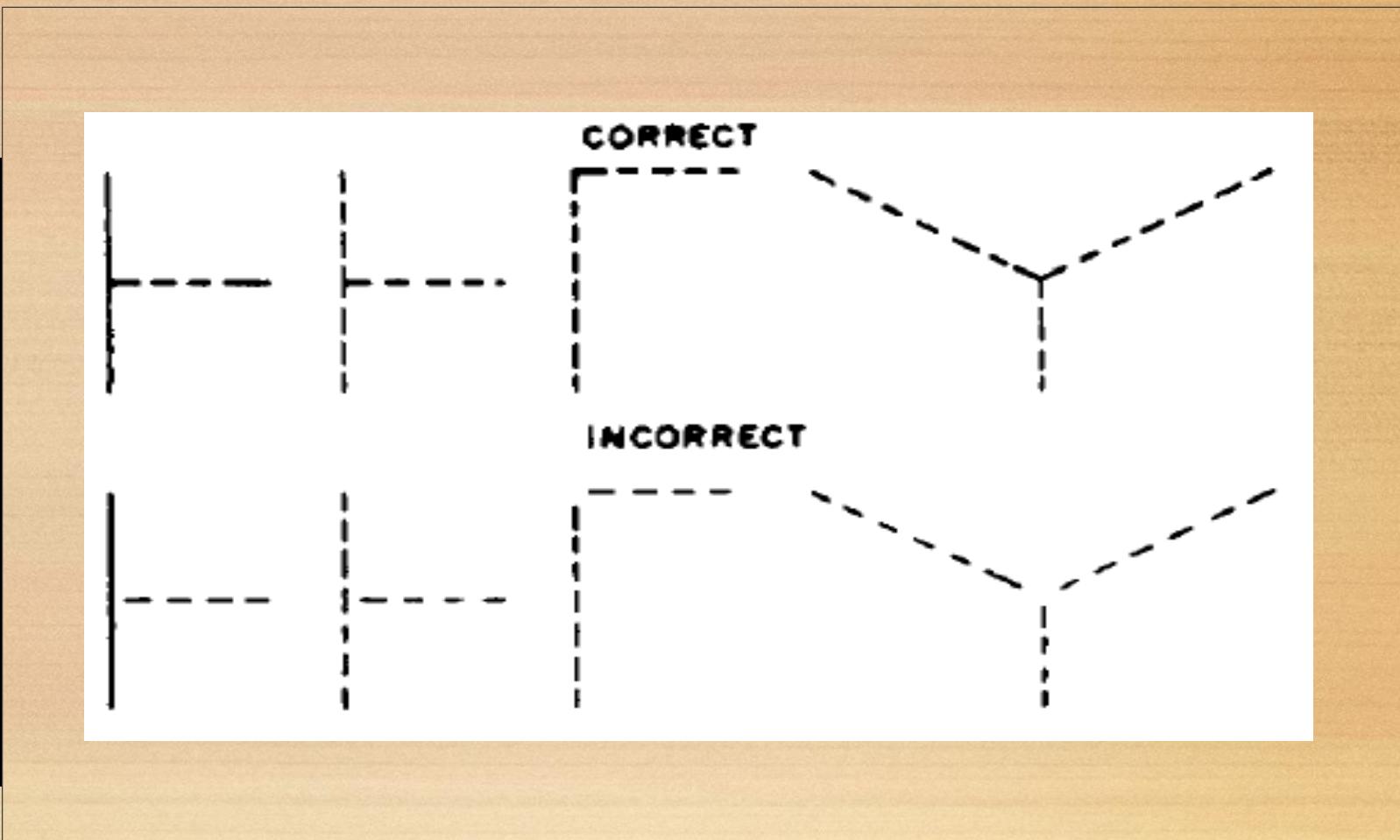
- A variety of line styles graphically represent physical objects.
- Types of lines include the following:

- Visible line**
- Hidden lines**
- Section lines**
- Centre lines**
- Symmetry**
- Dimension line**



Hidden lines

- It is standard practice to use dashes to represent any line of an object that is hidden from view.
- Shown below are ways hidden lines should intersect other lines.



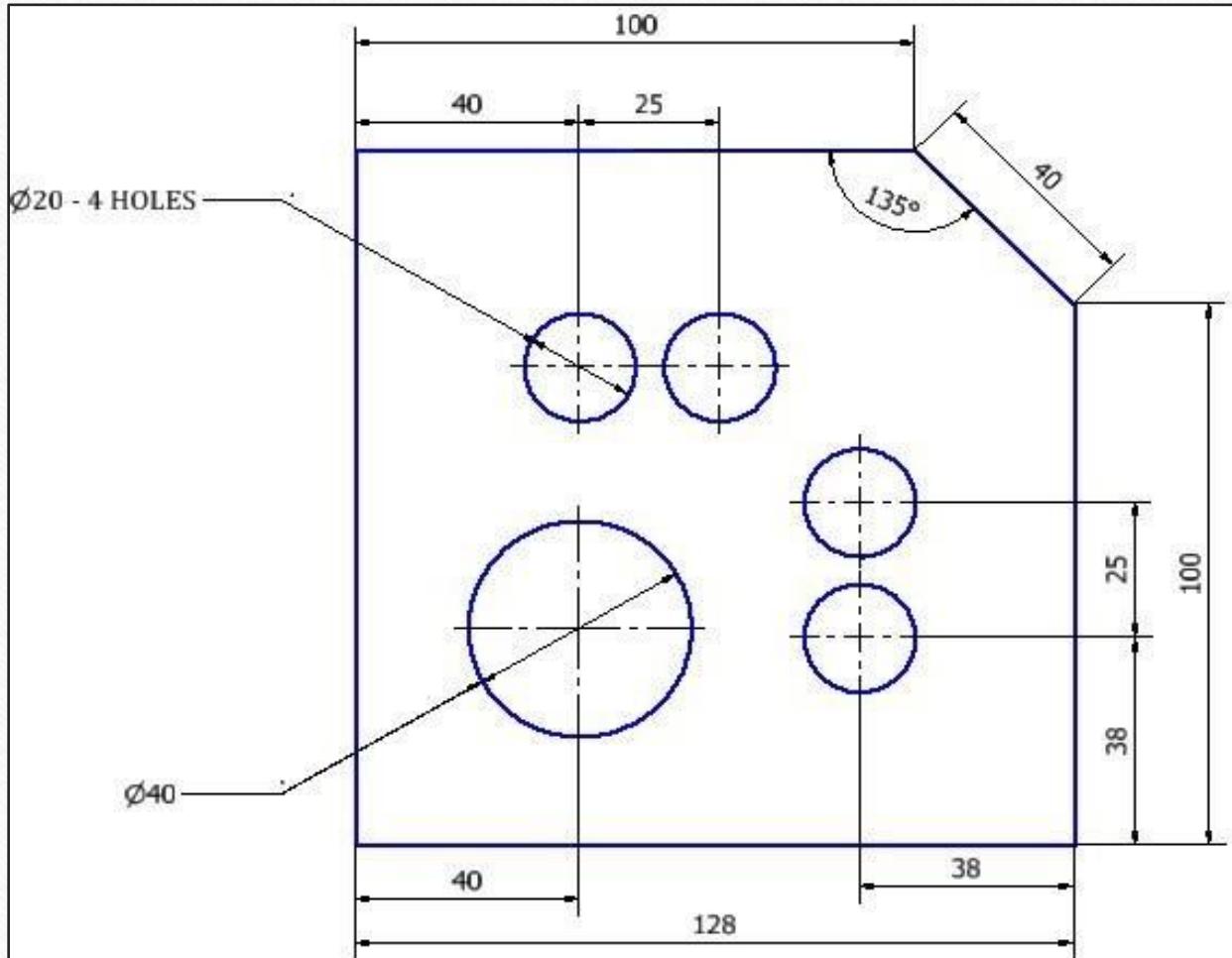
Scale of drawings

Scale is the ratio of the linear dimension of an element of a machines part as represented in the original drawing to the real linear dimension of the same element of the machine part itself. The scale of drawings are of three categories. a) Full size, b) Enlargement scale and c) Reduction scale.

Dimensioning

To manufacture a part, dimensioning plays a vital role. Engineering drawing without dimensioning is valueless. Dimensioning is essential in manufacturing a product with precision. Dimension are indicated on the drawings by arrowheads, extension line, dimension lines, leaders, figures, notes, symbols etc. to define the geometric characteristics such as, length, diameters, angles, locations etc.

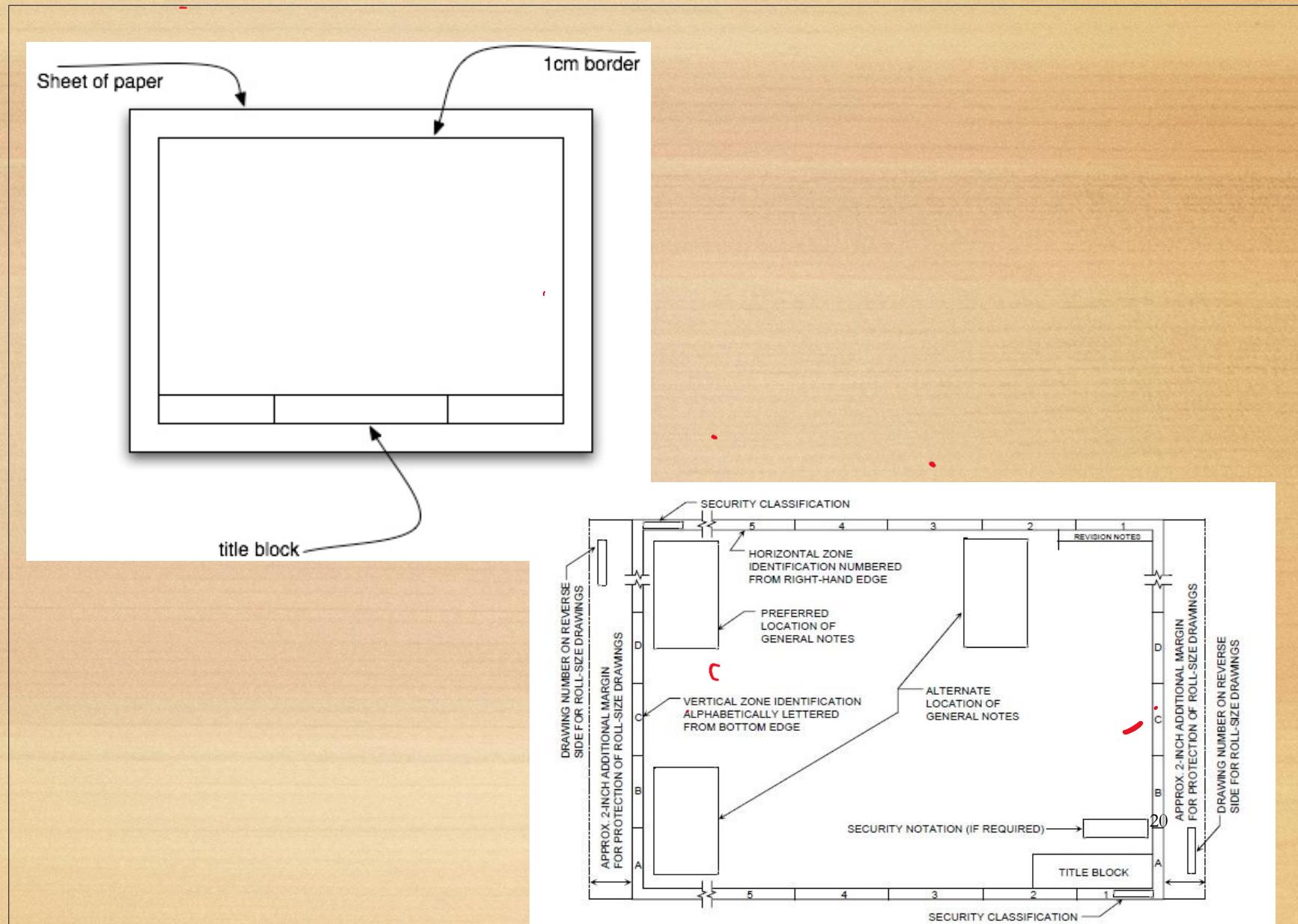
Dimensioning an object



Standard Sheet Layouts & Sizes

- Margins and Borders
- Zones
- Typical letter sizes
- Title block

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Drawing Toolbar

1. Line

Drawing Procedure:

- a. Input Line command
- b. Pick any point as first point of line (just click or input x,y value of first point)
- c. Pick another point as last point of line (just click or input x,y value of last point)
- d. Press enter to terminate.

2. Polygon

Drawing Procedure:

- a. Input polygon command
- b. Input number of sides
- c. Pick any point as center (just click)
- d. Input I or C for Inscribed or Circumscribed option
- e. Input value for the radius

Drawing Toolbar

3. Rectangle

Drawing Procedure:

- a) Input rectangle command
- b) Pick any point as first corner
- c) Pick other corner point of the rectangle (click or input value)

4. Arc

Drawing Procedure:

- a) Input arc command
- b) Pick any point as first point
- c) Pick another point as second point
- d) Pick another point as third point

Drawing Toolbar

5. Circle

Drawing Procedure:

- a) Input circle command
- b) Pick any point as center point
- c) Input value for the radius

6. Ellipse

Drawing Procedure:

- a) Input Ellipse command
- b) Input C for center
- c) Pick any point as center point
- d) Input value for maximum axis
- e) Input value for minimum axis

Drawing Toolbar

7. Donut

Drawing Procedure:

- a) Input Donut command
- b) Input value for inside diameter
- c) Input value for outside diameter
- d) Pick point to place donut
- e) Press Enter to terminate

8. Point

Drawing Procedure:

- a) Input Point command
- b) Pick desire point
- c) Press Esc to terminate.

Drawing Toolbar

9. Hatch

Drawing Procedure:

- a) Input Hatch command
- b) Open pattern box
- c) Choose any pattern and select OK
- d) Select pick point button and pick any point inside closed object, then press enter
- e) Select preview button to see the view of hatch and press spacebar to return
- f) If necessary, change Scale and Angle
- g) Press Enter to terminate

10. Text

Drawing Procedure:

- a) Input Multiline Text command
- b) Pick two corner points for text area
- c) Write text and press enter
- d) Change font if necessary
- e) Change height if needed
- f) Change text format
- g) Press OK to terminate

Modify Toolbar

1. Erase

Drawing Procedure:

- I. Input Erase command
- II. Select object and press enter

2. Copy

Drawing Procedure:

- I. Input Copy command
- II. Select object (objects) and press enter
- III. Input M for multiple copy (for single copy, no need this step)
- IV. Pick a point as base point
- V. Pick displacement point
- VI. Press enter to terminate

Modify Toolbar

3. Mirror

Drawing Procedure:

Input Mirror command

Select object (objects) and press enter

Draw a line as a mirror line by picking two points

Press enter to retain source object or input Y to delete source.

4. Offset

Drawing Procedure:

Input Offset command

Input value for offset ditance

Select object (objects) and then click on desire side
press enter

Modify Toolbar

5. Move

Drawing Procedure:

Input Move command

Select object (objects) and press enter

Pick a point as a base point

Click on the point where object will be moved

6. Rotate

Drawing Procedure:

Input Rotate command

Select object (objects) and press enter

Pick a point as a base point

Input value in angle for rotation

Modify Toolbar

7. Scale

Drawing Procedure:

Input Scale command

Select object (objects) and press enter

Pick a point as a base point

Input value for scaling (for example 2 for double)

8. Trim

Drawing Procedure:

Input Trim command

Select object (from where objects to be trimmed) and press enter

Select objects to trim

Modify Toolbar

9. Extend

Drawing Procedure:

Input Extend command

Select object (limits up to objects to be extended) and press enter

Select objects to extend

10. Explode

Drawing Procedure:

Input Explode command

Select object and press enter

Print or Plot a Drawing

Procedure

- Input plot command
- From plot device tab option, select the printer/ploter
- From plot style table option, select monochrome.ctb
- From plot setting tab option, select the paper size and choose the unit
- From drawing orientation option, select the Portrait or Landscape
- From plot scale option, select scaled to fit
- From plot offset option, select center the plot
- From plot area option, click on Window button
- Click two corner point to make a window for necessary part of drawing
- If necessary, click on Full Preview button to view the drawing and press spacebar
- Click ok button to print the drawing.

Some useful commands in Auto CAD

Command Name	Shortcut	Uses
Unit	UN + Enter	To set the unit system
Dimension	D + Enter	To set dimension system
Limit	Limits + Enter	To set the size of drawing sheet
Line	L + Enter	To draw line
Erase	E + Enter	To erase or delete selected part of the drawing
Trim	Tr + 2Enter	To cut unwanted extra line
Move	M + Enter	To move drawing object
Copy	Ctrl + C	To make other copy of the drawing object
Rectangle	Rec + Enter	To draw rectangle
Circle	C + Enter	To draw circle
Arc	Arc + Enter	To draw arc
Ellipse	El + Enter	To draw ellipse
Donut	Do + Enter	To draw the cross section of pipe or reinforcement

Some useful commands in Auto CAD

Fill	Fill + Enter	To fill the inside area of a boundary
Point	Po + Enter	To draw point
Point Style	Pointstyle + Enter	To modify Point
Scale	Sc + Enter	To increase or decrease the size of the drawing object using factor
Divide	Div + Enter	To divide the object in multiple segment
Measure	Me + Enter	To divide the object in multiple segment using measurement
Hatch	H + Enter	To hatch or insert different symbol inside a boundary
Line weight	Lw + Enter	To modify line
Array	Ar + Enter	To copy a object in different row and column
Drafting Setting	Ds + Enter	To modify the drafting elements
Linear Dimension	Dli + Enter	To show the length of drawing
Regen	Re + Enter	To make the circle and arc smooth
Block	B + Enter	To save any object in computer with definite name.
Insert	I + Enter	To insert the objects those were saved using block command
Minsert	Minsert + Enter	To insert the objects those were saved using block command and modify them
Extend	Ex + Enter	To increase the length of line up to the next perpendicular line.