
MECH 220

Engineering Graphics

TECHNICAL DRAWINGS

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MECH 220: 1st LECTURE

Topics

- ◆ Design process
- ◆ Definition of a drawing
- ◆ Drawing Format & sizes
- ◆ Anatomy of a drawing
- ◆ Freehand Sketching Techniques
- ◆ Sketching Exercise

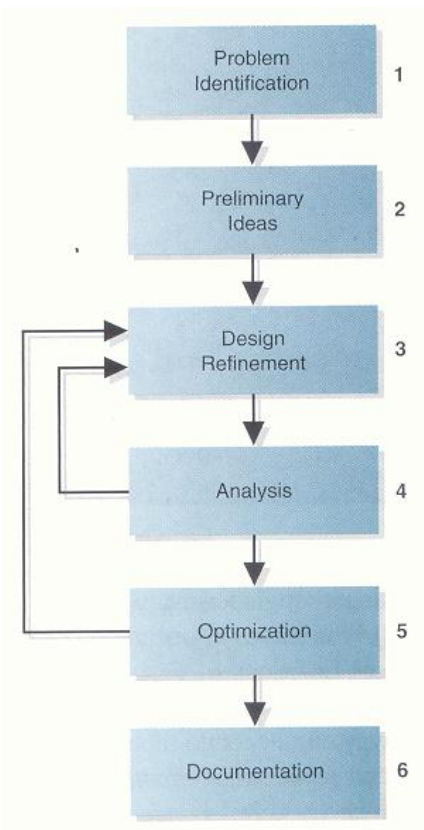
Design process

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Design is an Iterative Process

- ◆ Begins with a recognition of a need for a product, service, or system
- ◆ The idea phase encourage a wide variety of solutions through brainstorming, literature search, and talking to users
- ◆ Best solutions are selected for further refinement
- ◆ Models or prototypes are tested and problems may arise requiring new solutions and return to an earlier stage in the design process

- ◆ Finally drawings are released for manufacturing



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Engineering Design Uses Sketching & CAD

- ◆ Ideas are initially sketched then more accurate CAD drawings are created
- ◆ A single accurate CAD database can be used to go from ideation to manufacturing and documentation.
- ◆ Finite Element Analysis, 3D rendering, animation, documentation, rapid prototyping tools are available for use with CAD.
- ◆ Technical drawings are generated to proceed in the manufacturing phase

DEFINITION

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TECHNICAL DRAWING: DEFINITION

TECHNICAL DRAWING is a “formatted document that specifies the required attributes of a part to be manufactured”.

DRAWING ATTRIBUTES:

1. GEOMETRIC:

dimensions & tolerances

factors of form (flatness, squareness..)

2. CONSTRUCTION:

material, assembly, finish,..

FORMAT

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TECHNICAL DRAWINGS: Drawing Format

◆ ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE):

English units (inches)

- ANSI_A
- ANSI_B
- ANSI_C
- ANSI_D
- ANSI_E

◆ ISO (INTERNATIONAL STANDARDS ORGANIZATION)

SI units (mm, m)

- ISO_A4
- ISO_A3
- ISO_A2
- ISO_A1
- ISO_A0

◆ DIN (DEUTSCH INSTITUTE NATIONAL):

SI units (mm, m)

- DIN_A4
- DIN_A3
- DIN_A2
- DIN_A1
- DIN_A0

◆ JIS (JAPANESE INDUSTRIAL STANDARDS)

SI units (mm, m)

- JIS_A4
- JIS_A3
- JIS_A2
- JIS_A1
- JIS_A0

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TECHNICAL DRAWINGS:

Drawing Sizes

<u>DRAWING</u>	<u>OVERALL SIZE</u>	<u>PLOTTING AREA (approx.)</u>
◆ AMERICAN (ANSI)		
– A	10.5" WIDE X 8.00" HIGH	9.50" WIDE X 4.25" HIGH
– B	16.0" WIDE X 10.0" HIGH	15.0" WIDE X 6.25" HIGH
– C	21.0" WIDE X 16.0" HIGH	19.5" WIDE X 11.25" HIGH
– D	32.5" WIDE X 21.0" HIGH	30.0" WIDE X 16.00" HIGH
– E	43.0" WIDE X 33.0" HIGH	40.5" WIDE X 28.00" HIGH
–		
◆ OTHER (DIN, JIS, ISO..)		
– A4	285mm WIDE X 198mm HIGH	
– A3	396mm WIDE X 273mm HIGH	
– A2	570mm WIDE X 396mm HIGH	
– A1	817mm WIDE X 570mm HIGH	
– A0	1165mm WIDE X 817mm HIGH	

Drawing Sheet

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

A4 210 x 297

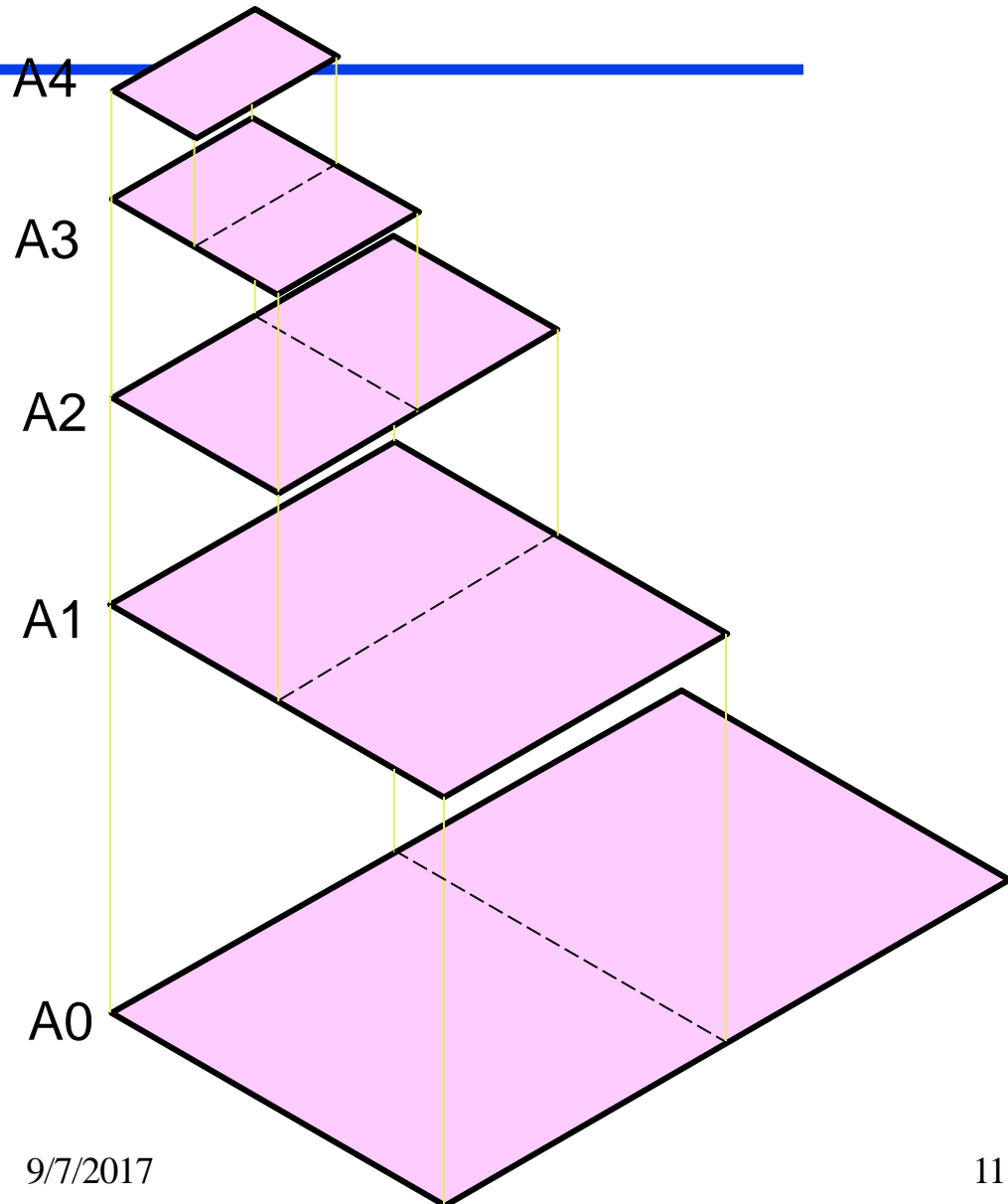
A3 297 x 420

A2 420 x 594

A1 594 x 841

A0 841 x 1189

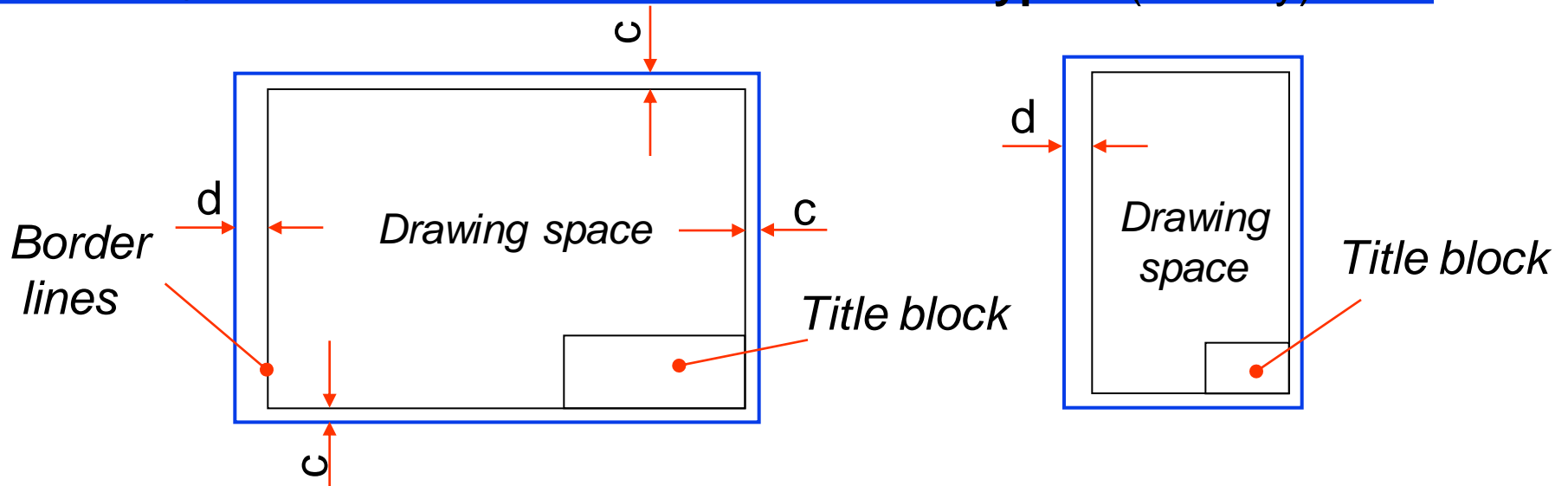
(Dimensions in millimeters)



Orientation of drawing sheet

1. Type X (A0~A4)

2. Type Y (A4 only)



Sheet size	c (min)	d (min)
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A4	10	25
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A3	10	25
----	----	----

A2	10	25
----	----	----

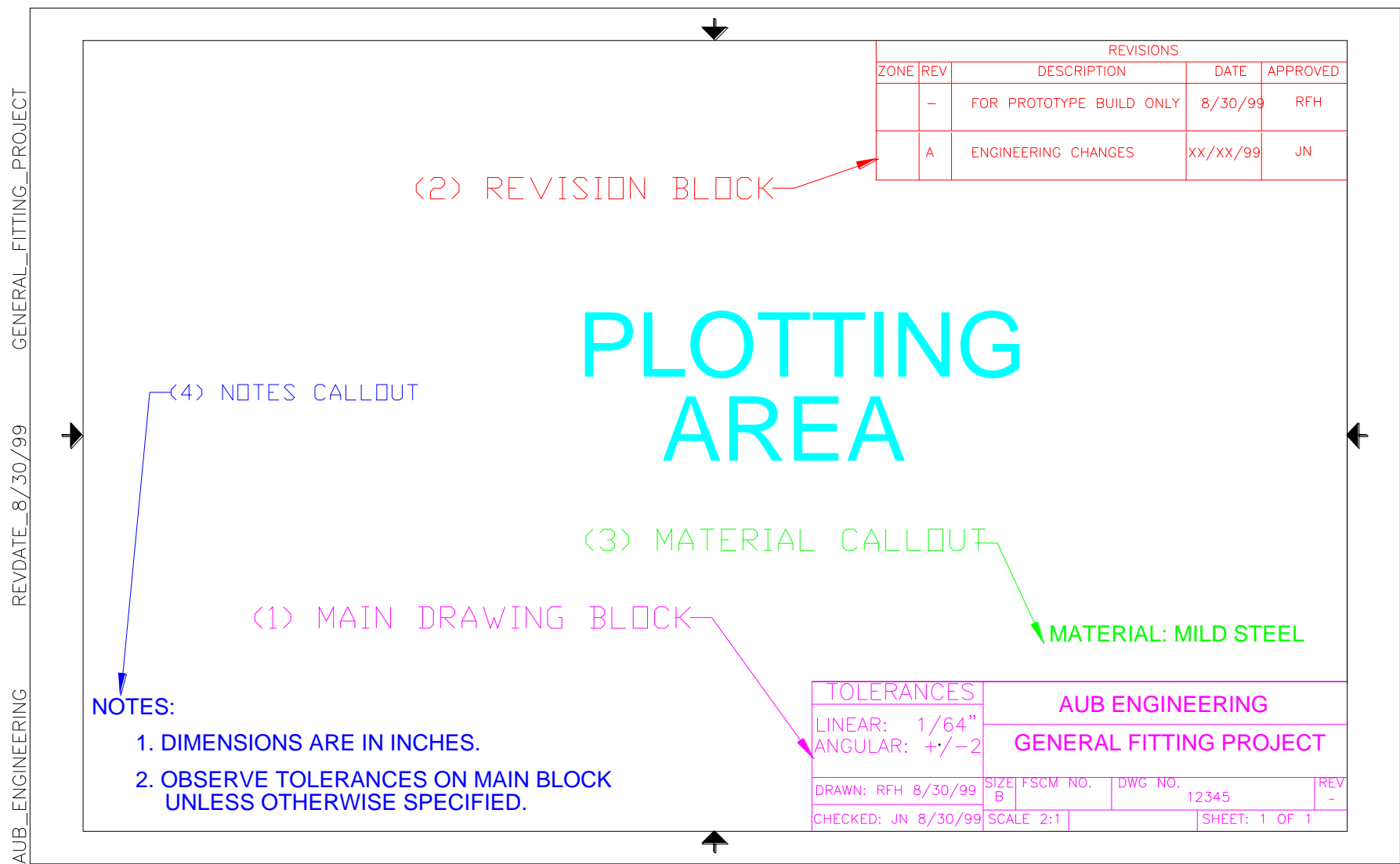
A1	20	25
----	----	----

A0	20	25
----	----	----

**ANATOMY OF A
DRAWING**

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TECHNICAL DRAWINGS: the anatomy of a drawing



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TECHNICAL DRAWINGS: 1) Main Block Description

TOLERANCES		AUB ENGINEERING			
LINEAR: 1/64" ANGULAR: + ^o / ₋ 2					GENERAL FITTING PROJECT
DRAWN: RFH 8/30/99		SIZE	FSCM NO.	DWG NO.	
CHECKED: JN 8/30/99		B		12345	A
		SCALE 2:1		SHEET: 1 OF 1	

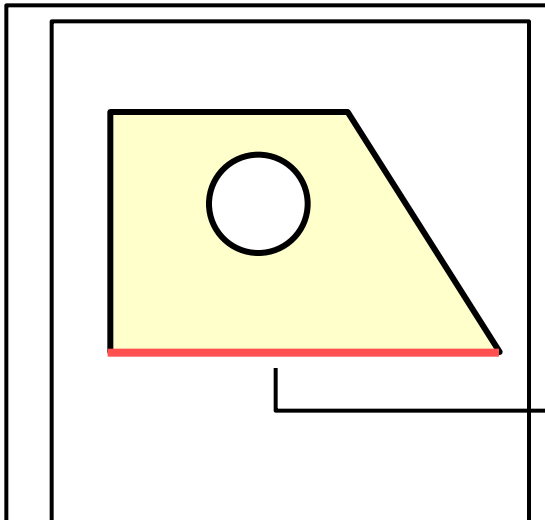
MAIN BLOCK

Drawing Scales

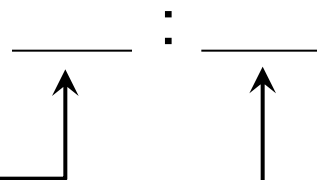
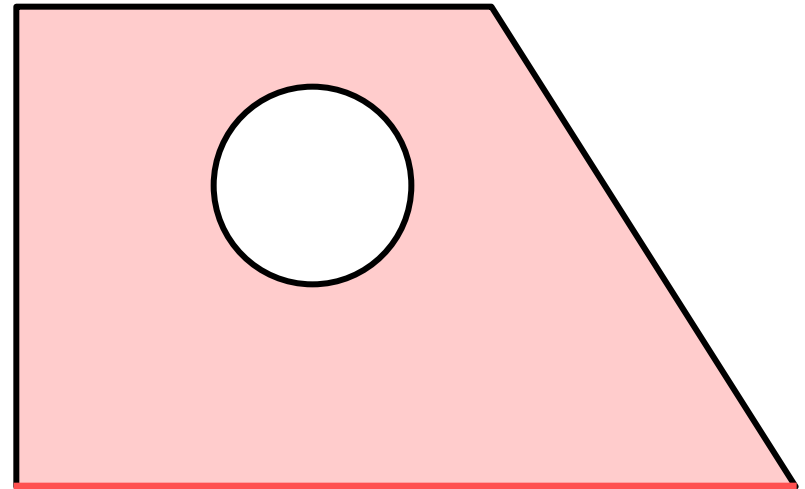
Length, size

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.

Size in drawing



Actual size



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.

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TECHNICAL DRAWINGS: 2) Revision Block

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
—	—	FOR PROTOTYPE BUILD ONLY	8/30/99	RFH
C2	A	ENGINEERING CHANGES	XX/XX/99	JN

REVISION BLOCK

◆ MATERIALS CALLOUT SPECIFIES:

– TYPE OF MATERIAL & HEAT TREATMENT:

Examples: Aluminum 6061-T6
die-cast Aluminum A360

– SURFACE HARDNESS:

Examples: SURFACE -X- TO HAVE HRC 60-70

– SURFACE TREATMENTS: Paint, Conversion Coating, ..

Examples: Apply Chromate coating Class II prior to painting black (color chip xxx-xx)
polyurethane (Dow Chemical p/n xxxxx).

◆ NOTES SPECIFY:

- Dimensioning convention:

Example: drawing dimensions in accordance with ANSI Y14.5M-1982.

- Dimension Tolerances:

Example: obey tolerance block for dimensional tolerances unless otherwise specified.

- Recommended Part Manufacturer.

Example: Joe Cool Tool & Die Inc.
1234 Main Street
Acme, U.S.A. 54321-9
Tel (xxx) yyy-zzzz

SAMPLE DRAWING

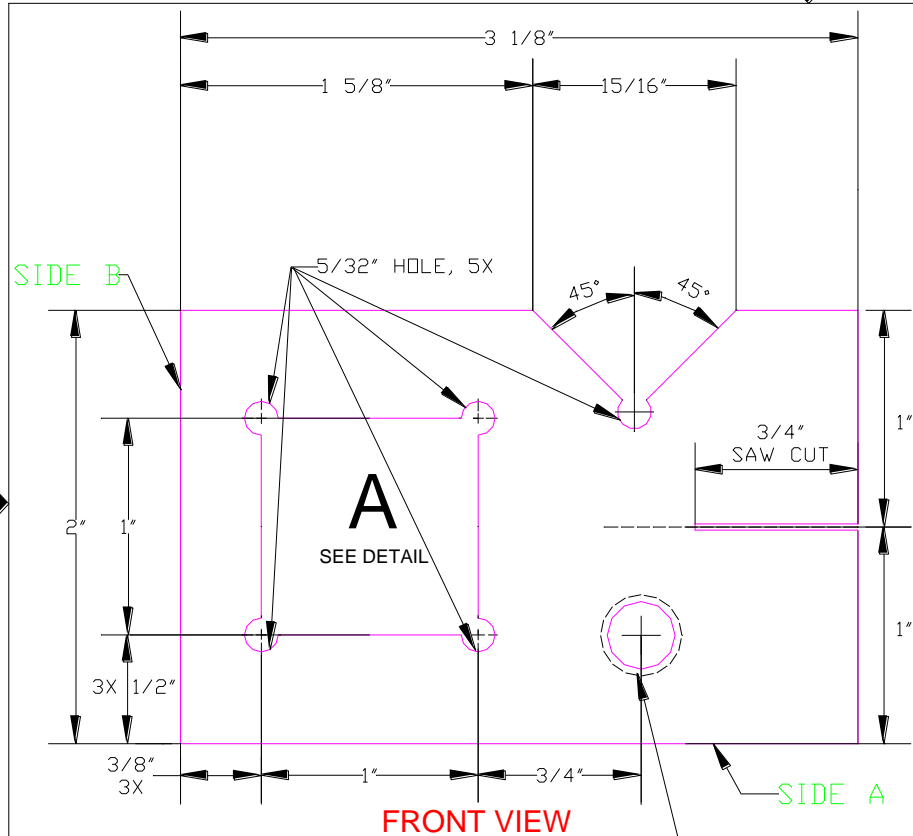
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Sample Mech 220 *Intro to Cad* Project

GENERAL_FITTING_PROJECT

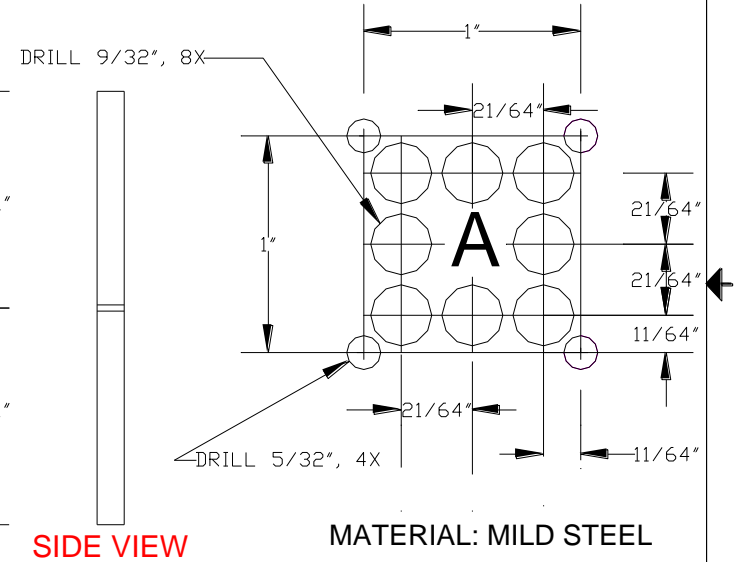
REVDATE_8/30/99

AUB_ENGINEERING



DRILL THRU AND TAP FOR 3/8"-16 U.N.C. SCREW (USE 5/16" DRILL)

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	-	FOR PROTOTYPE BUILD ONLY	8/30/99	RFH



TOLERANCES		AUB ENGINEERING			
LINEAR:	1/64"	GENERAL FITTING PROJECT			
ANGULAR:	+/- 2				
DRAWN BY: RFH 8/30/99	SIZE B	FSCM NO.	DWG NO. 12345	REV -	
CHECKED BY: JN 8/30/99	SCALE 2:1			SHEET: 1 OF 1	

Utility & Techniques





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Freehand Sketching: Utility

- ◆ Freehand sketching is used in engineering graphics to quickly communicate your ideas or designs.
- ◆ Drawing instruments and CAD are not always available, especially during field trips
- ◆ Freehand sketches are used to communicate with others, so they should be neat and correctly prepared.
- ◆ Freehand sketching is not sloppy sketching! Your sketches need to be interpreted by others in your design team – use good lettering.



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

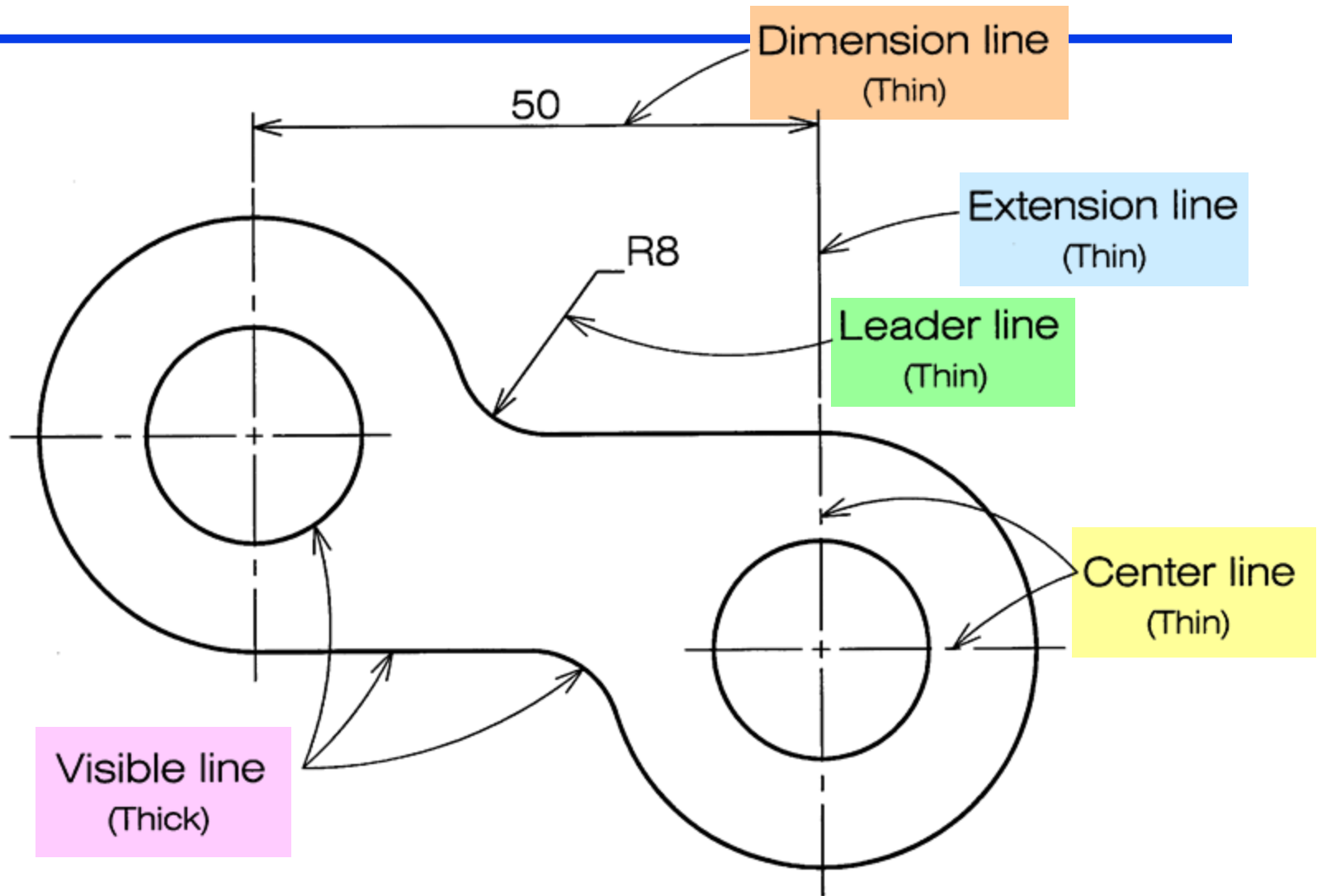
Visible lines represent features that can be seen in the current view

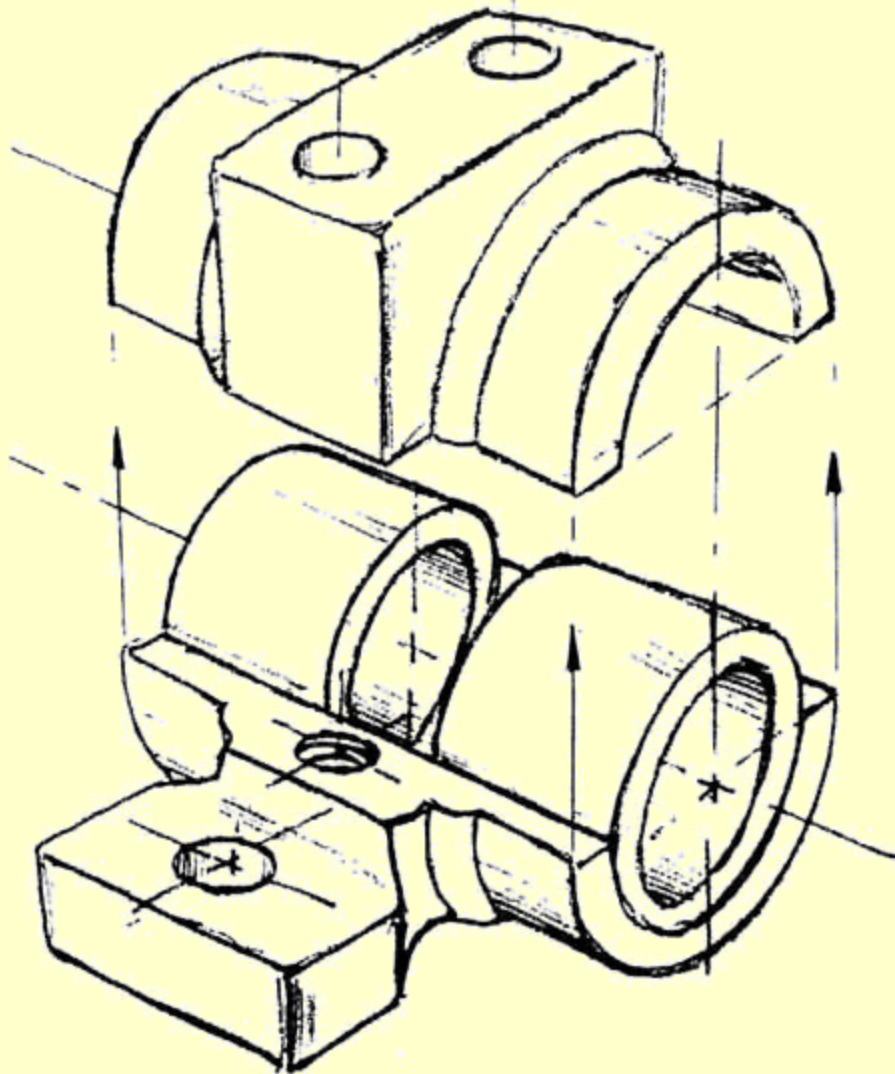
Hidden lines represent features that can not be seen in the current view

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





Freehand Sketching

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Freehand Sketching: Supplies

- ◆ **HB (#2) or other medium grade pencil**
- ◆ **A4 white paper**
- ◆ **Fade-out grid sketch paper**
- ◆ **Grid templates available on Moodle**

DRAWING TOOLS



2H or HB for thick line
4H for thin line

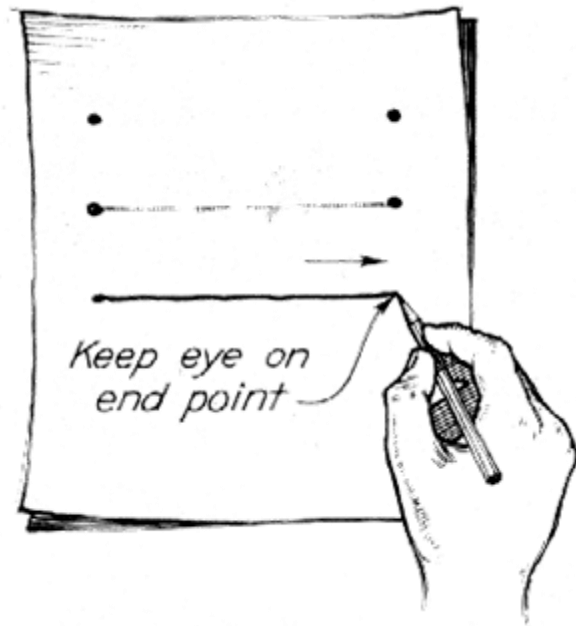


Pencils

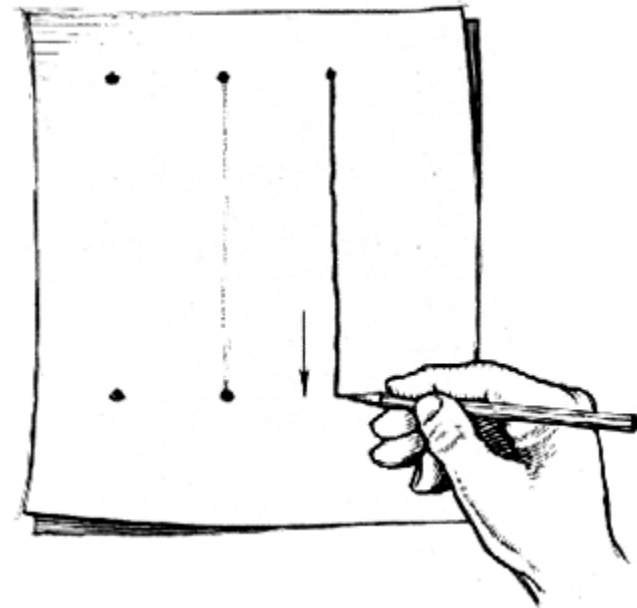
Straight Line

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



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Sketching Lines

- ◆ Horizontal lines are drawn from left to right
- ◆ Vertical lines are drawn from top to bottom
- ◆ Inclined lines are drawn in the downward direction

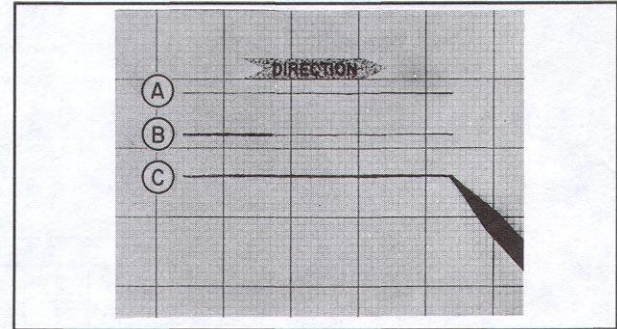


FIG. 58 Technique of sketching lines. (A) Set direction with a *light* construction line; (B) first stroke; (C) complete line with a series of overlapping strokes.

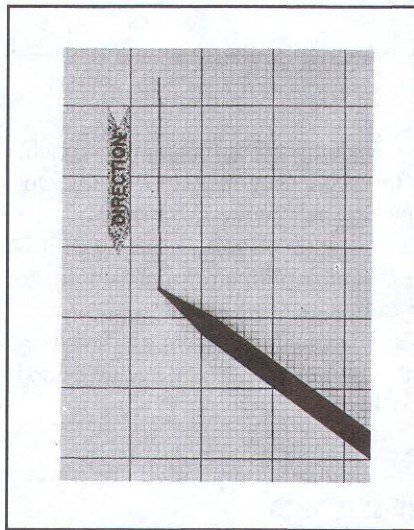


FIG. 59 Sketching a vertical line.

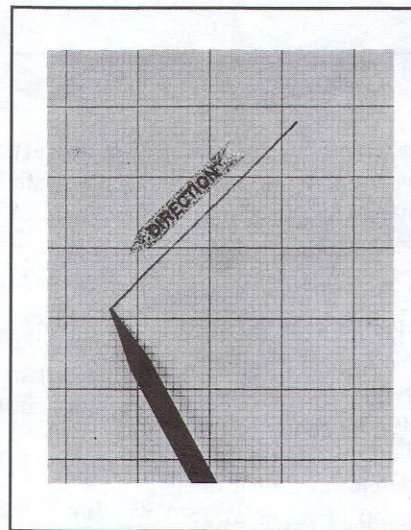


FIG. 60 Sketching an inclined line sloping downward from right to left.

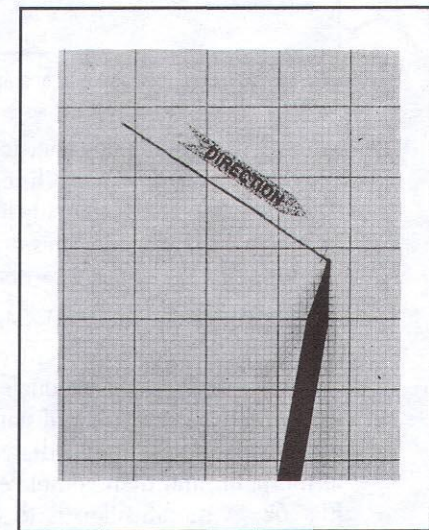
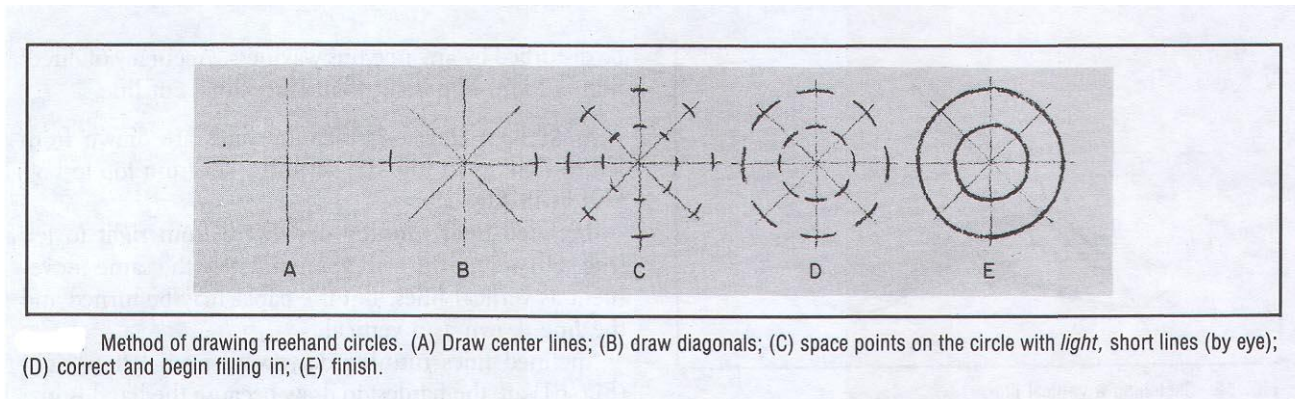


FIG. 61 Sketching an inclined line sloping downward from left to right.

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Sketching Circles

- ◆ Identify the Circle centre
- ◆ Draw the horizontal and vertical centerlines
- ◆ Identify minimum 8 point Equidistance from the center
- ◆ Draw short arc passing through those points
- ◆ Connect arcs

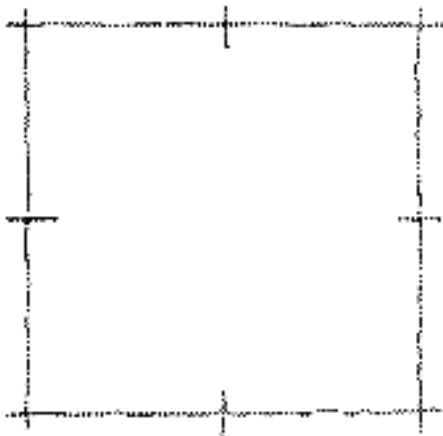


Small Circle

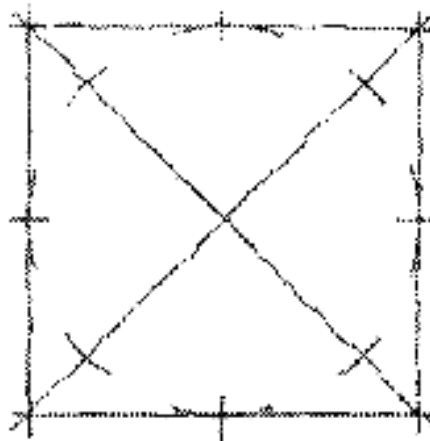
Method 1 : Starting with a square

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.

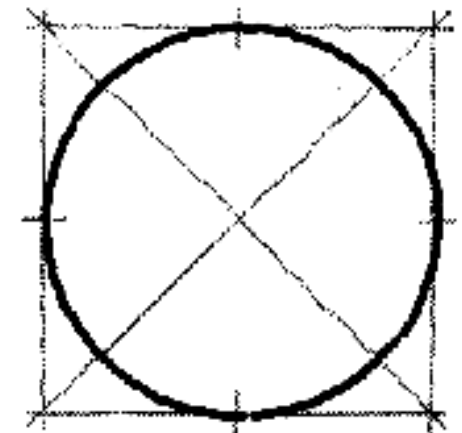
Step 1



Step 2

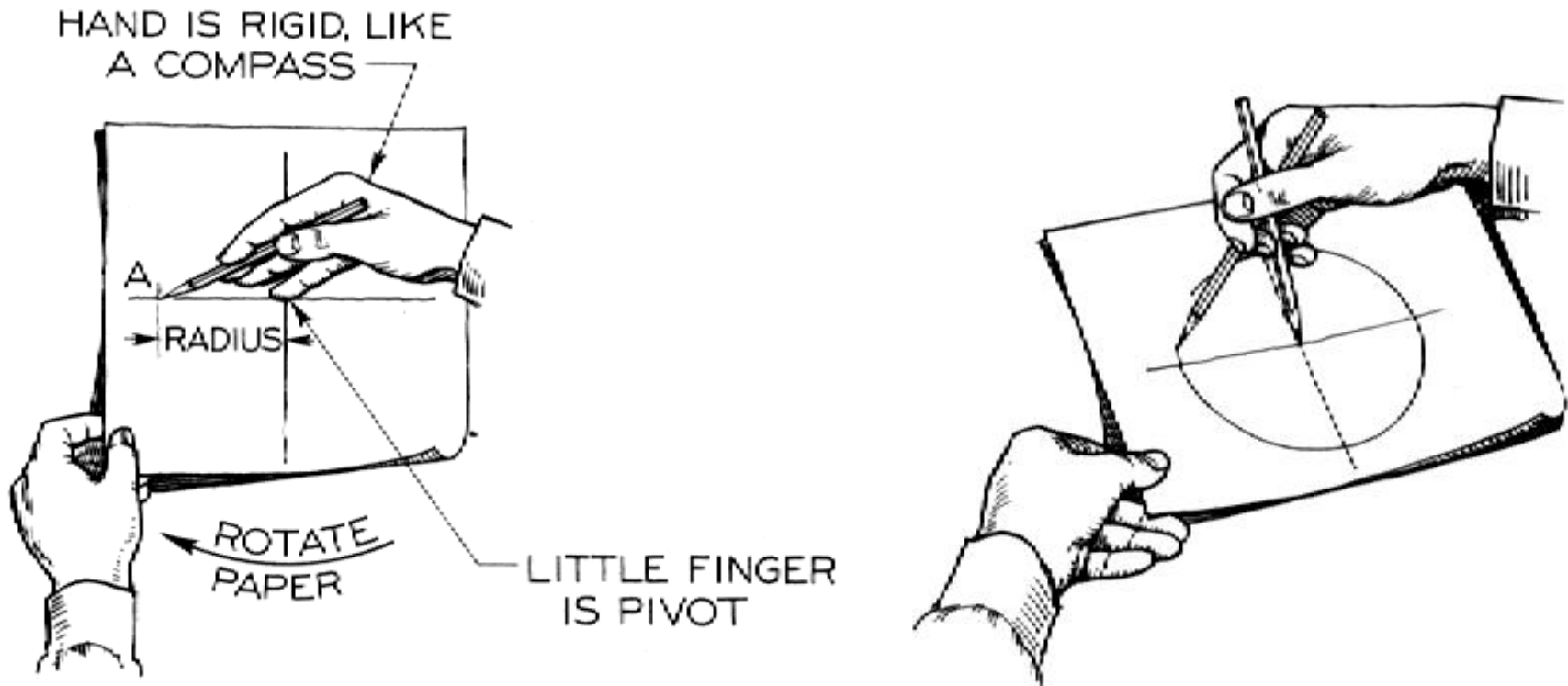


Step 3



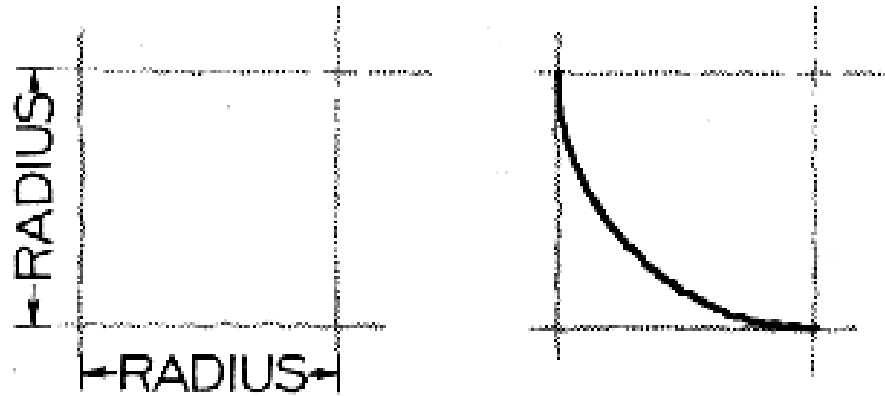
Large Circle

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

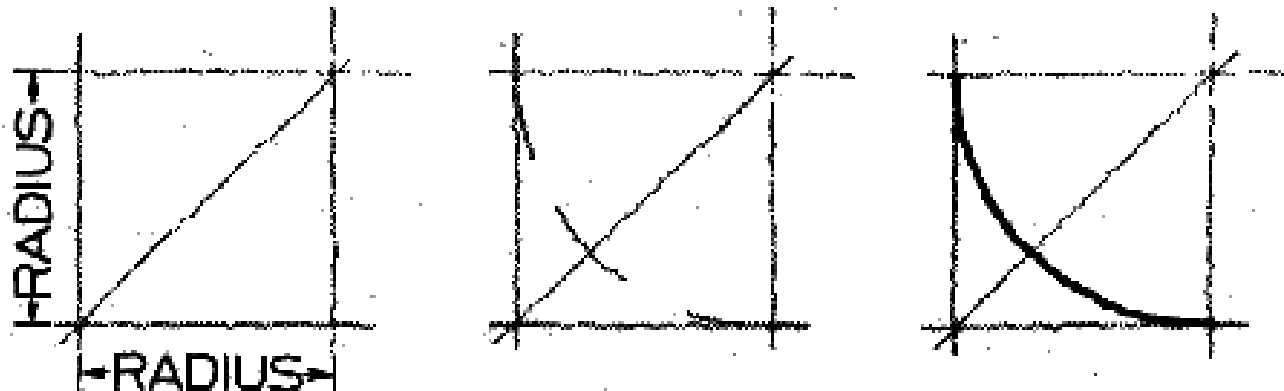


Arc

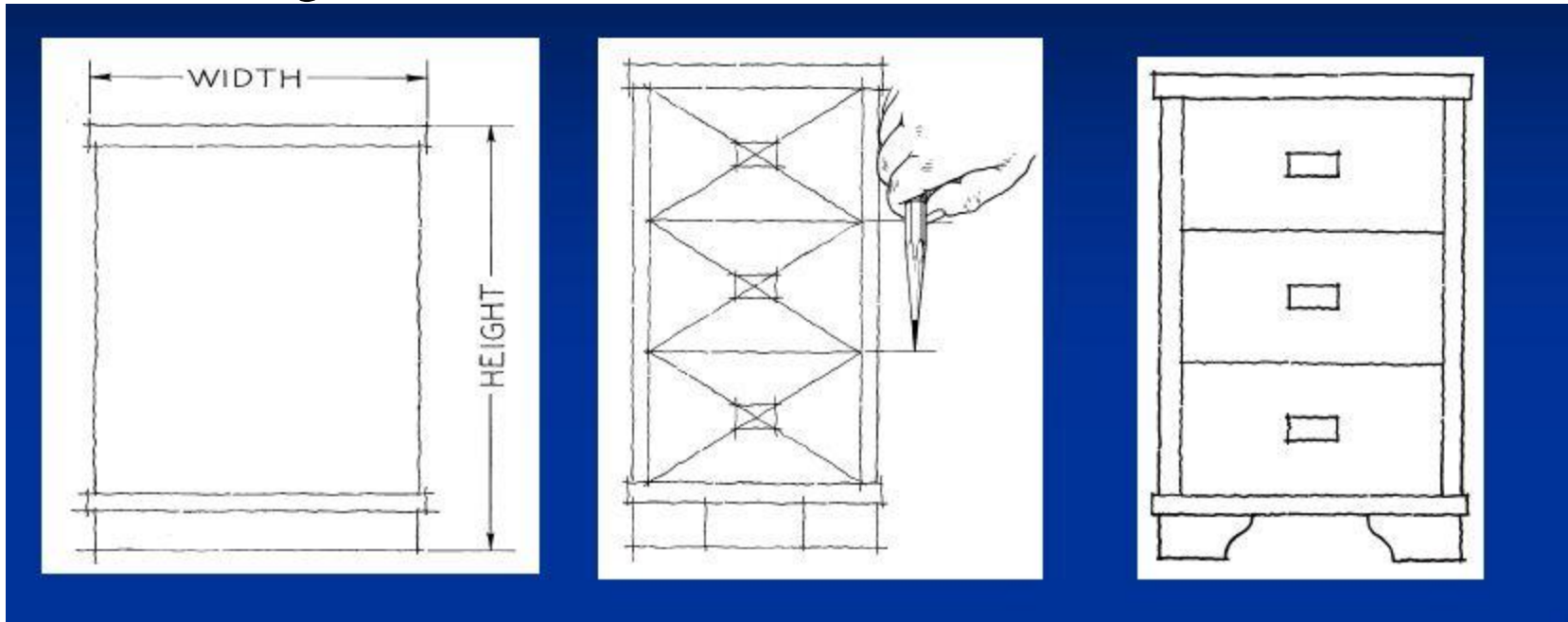
Method 1 : Starting with a square



Method 2 : Starting with a center line



Sketch Large Features, Then Add Small Details

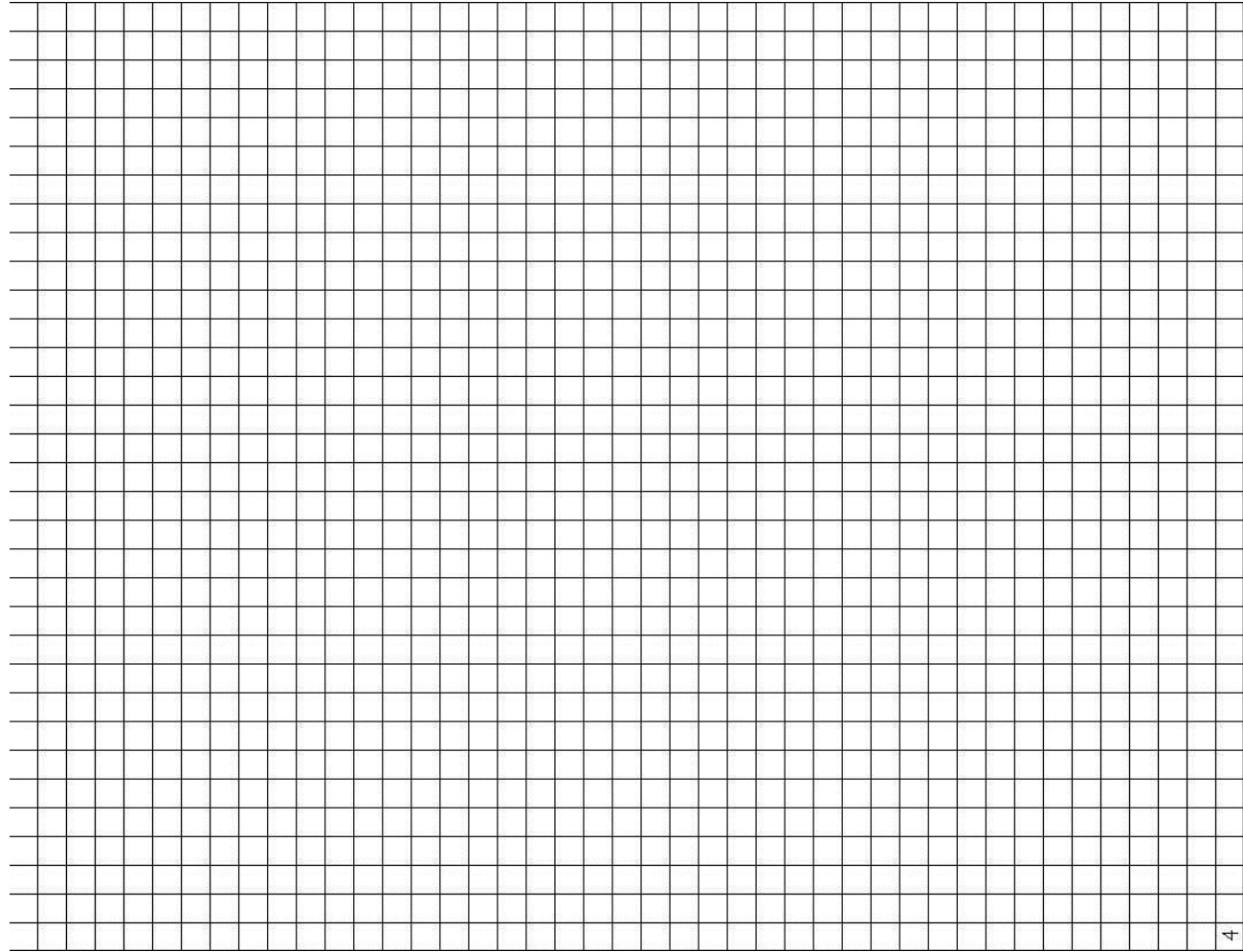


- Look at overall dimensions first and lightly block in
- Block in secondary details lightly
- Add final details
- Darken sketch

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4x4 Grid sketching paper

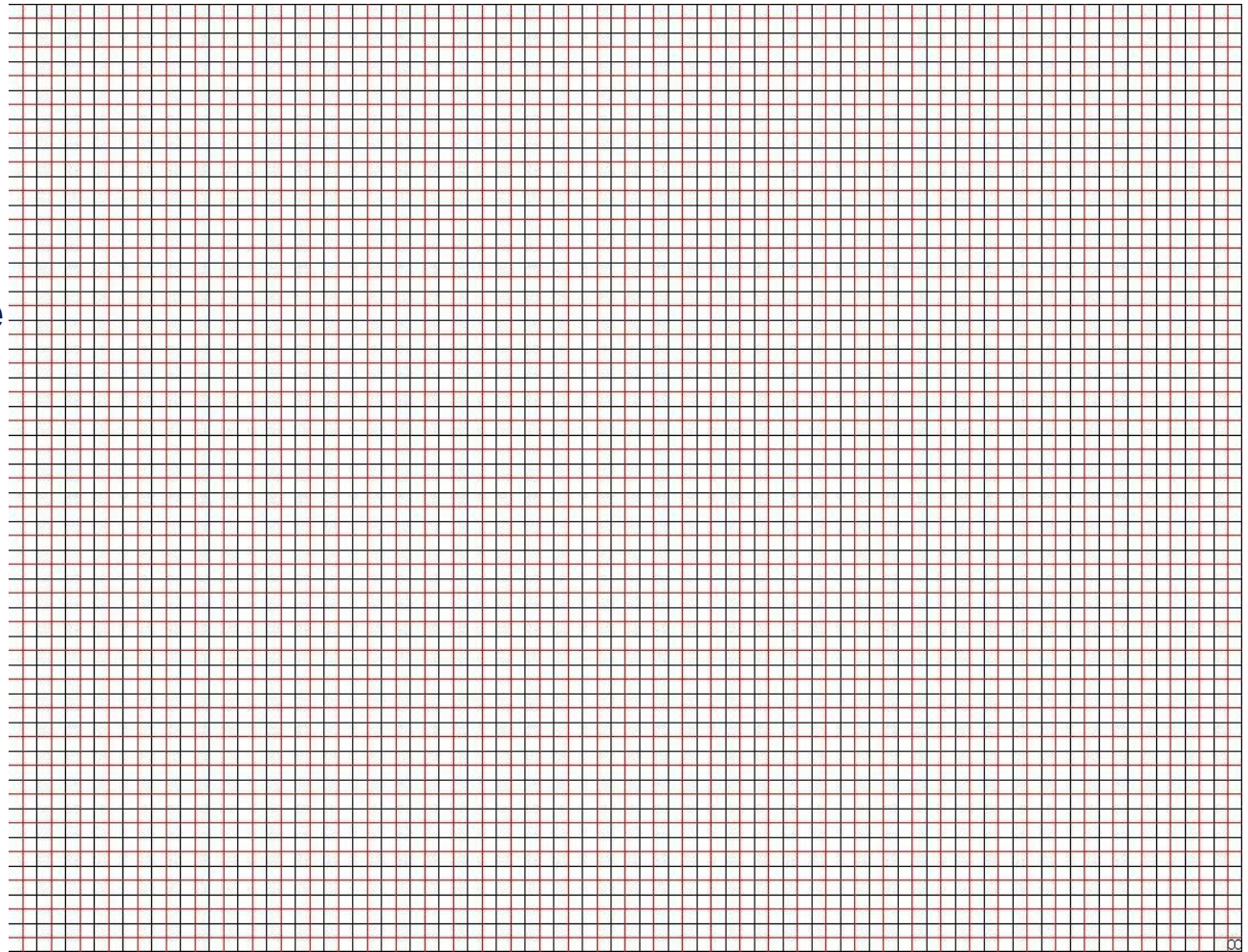
- ◆ Grid paper is used as a scaling tool
- ◆ 4 boxes per in are provided along the horizontal and vertical directions



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8x8 Grid sketching paper

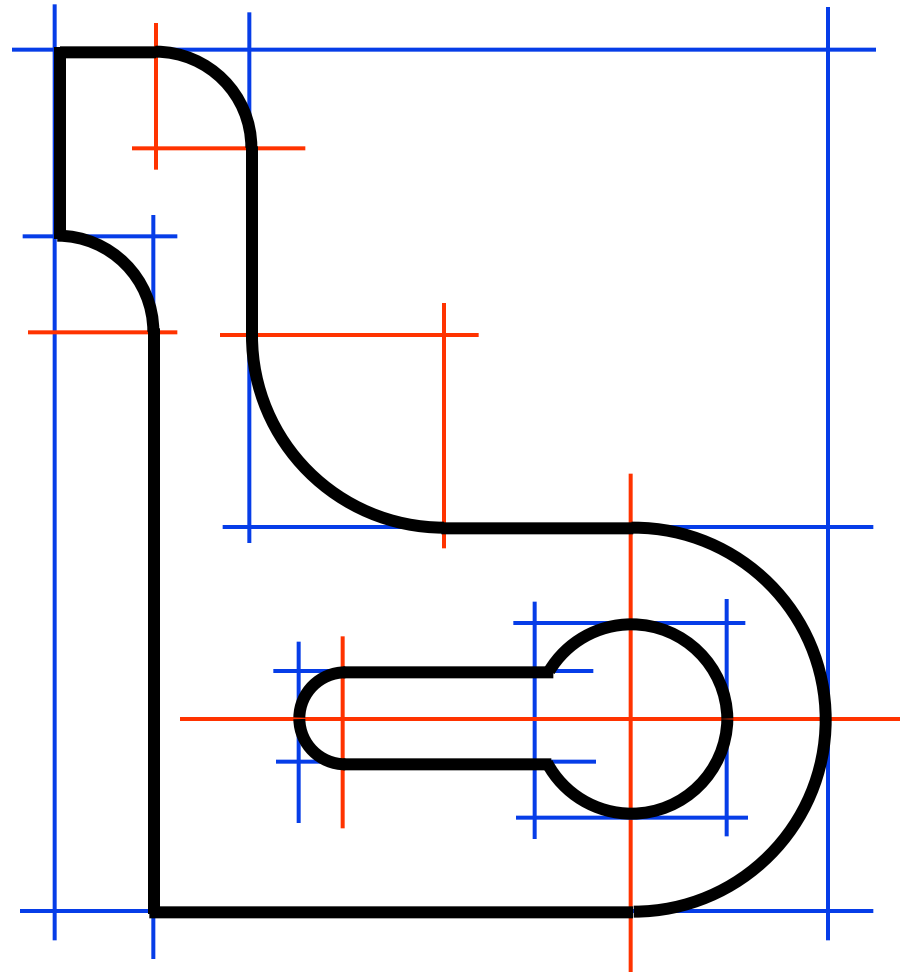
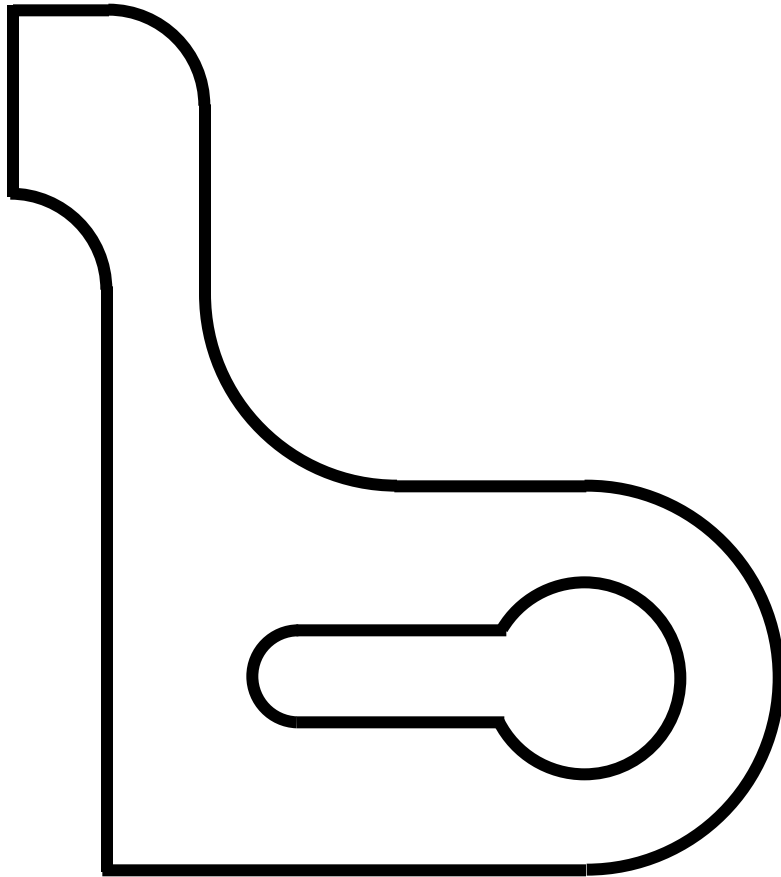
- ◆ 8 boxes per in are provided along the horizontal and vertical directions



Steps in Sketching

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

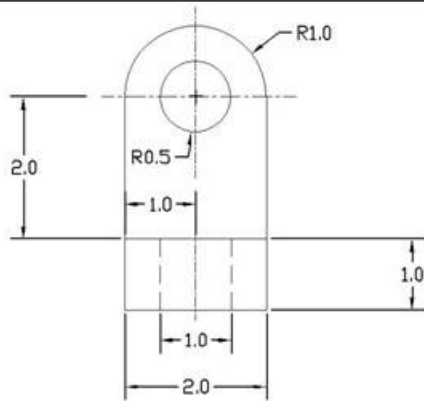
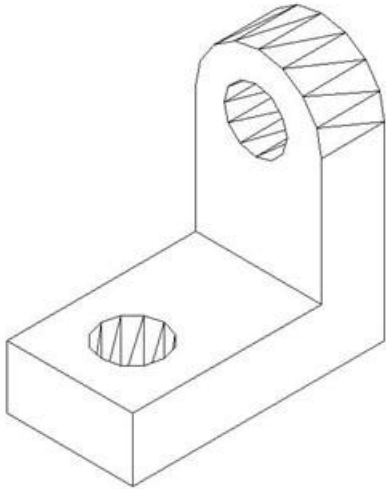
Example



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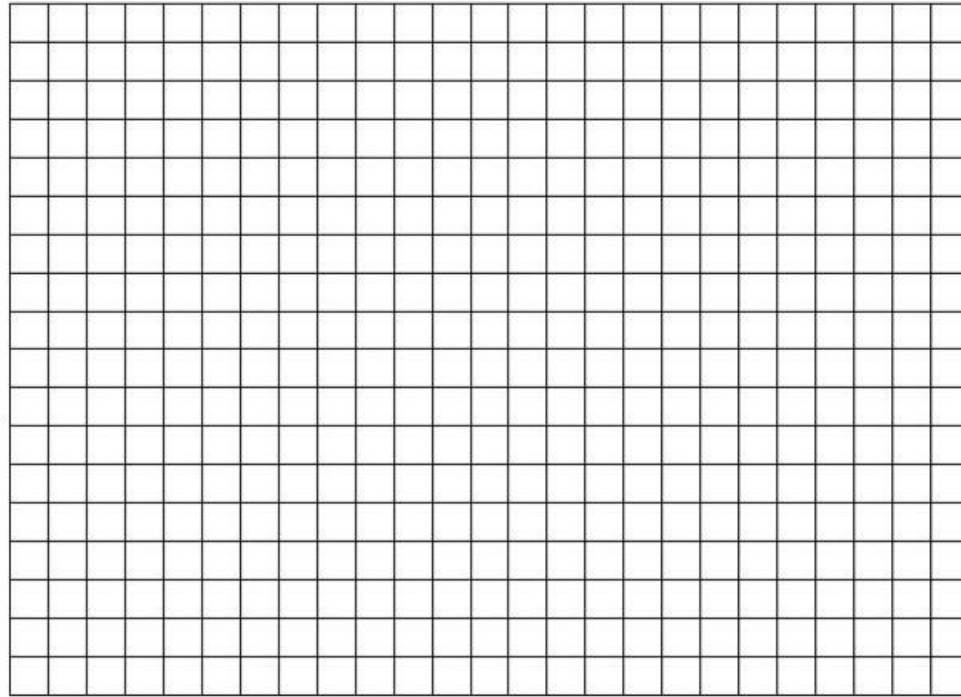
Freehand sketching exercise

☒ Draw the front view of the 3D model below on the 4x4 grid paper.



Front View

Scale: 1 model unit= 4 Drawing blocks.



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Summary

- ◆ **Engineering drawing can be a universal language to communicate your ideas.**
- ◆ **The engineering design process uses sketching and CAD to communicate and record ideas.**
- ◆ **A single CAD database can be used to produce many types of drawings and models used throughout the design process.. ie: NC manufacturing, inspection, shipping containers**

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Assignment for next week

- ◆ Assignment will be posted on Moodle
- ◆ A grided paper is available On Moodle

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Terminology

CAD: **Computer Aided Design**

CADD: **Computer Aided Design & Drafting**

CAM: **Computer Aided Manufacturing**

CIM: **Computer Integrated Manufacturing**

CAE: **Computer Assisted Engineering**

Reading Drawings: **Interpreting drawings made by others**

Technical Drawing: **Drawings used to express technical ideas**

Engineering Design Graphics: **Technical Drawings representing designs & specifications for physical objects**

Thank you