# ME251A- Engineering Design and Graphics

Instructor: P. Venkitanarayanan

Tutors: Prof. P.M. Dixit and Prof. Pankaj Wahi

Schedule:

Class: Wednesday 12:00-12:50 PM

Lab: Friday 2:00 to 5:00 PM

Venue: Class: TB201

Lab: Drawing Hall and AutoCAD lab in IME

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# Course Policy

- Grading:
  - Lab assignments including AutoCAD: 30%
  - Project(s):10%
  - Mid Semester Examination: 25%
  - End Semester Examination: 35%
- **If you are absent in more than 30% of the classes and/or labs anytime during the semester, you may be deregistered**
- Only medical reasons with certificate from Health Center specifically saying that you are sick and need rest will be given consideration
- Same policy applies for missing exams
- No other leave will be accepted

# Course details

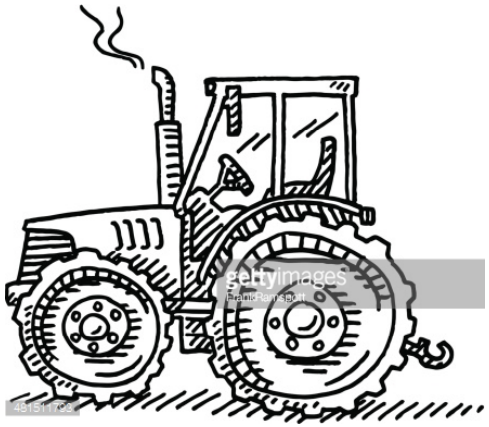
- **Objectives**: Enable the student to **draw/design/model** individual **machine components/parts** and **assemble** them to function as a system
- **Syllabus**:
  - Drawing standards and CAD softwares
  - Dimensioning
  - Threaded fasteners/ Keys, cotters, pins/Couplings
  - Bearings/Gears/Shafts
  - CAD and Geometrical Modeling
  - Assembly principles
  - Fits and Tolerances
  - Design Process
  - 3D modeling and Animation

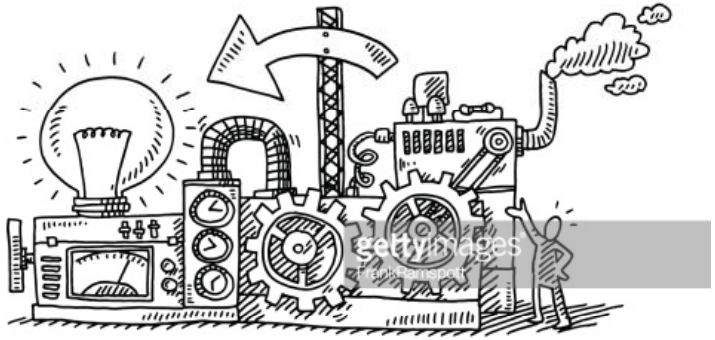
- **Text book**
  - **Machine Drawing by N. D. Bhatt & V. M. Panchal**
  - **Machine Drawing by Ajeet Singh**

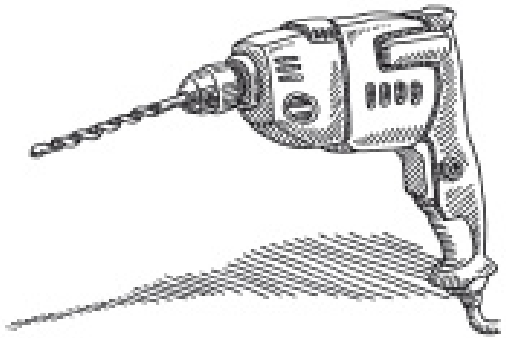
- **You should have the following for the lab**
  - **One drafter**
  - **One large compasses**
  - **One large divider**
  - **A pair of set squares, protractor and a scale**
  - **Drawing pencils: H, HB, 2H**
  - **Pencil sharpener, eraser, fine sand paper, blade, clean soft cloth, cello tape**

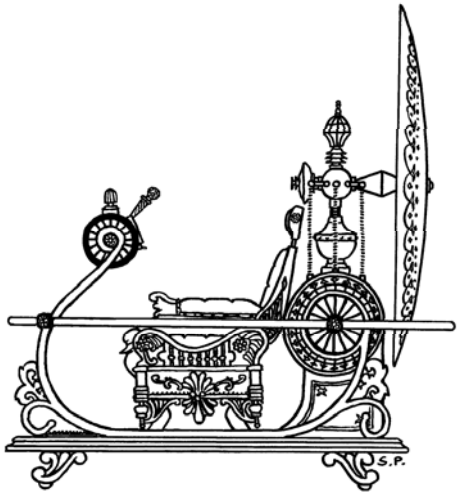
# Graphics

- Graphics: From Greek word “graphikos” means pictorial representation of an idea, story, a narration or even a calculation
- Used extensively since pre-historic times





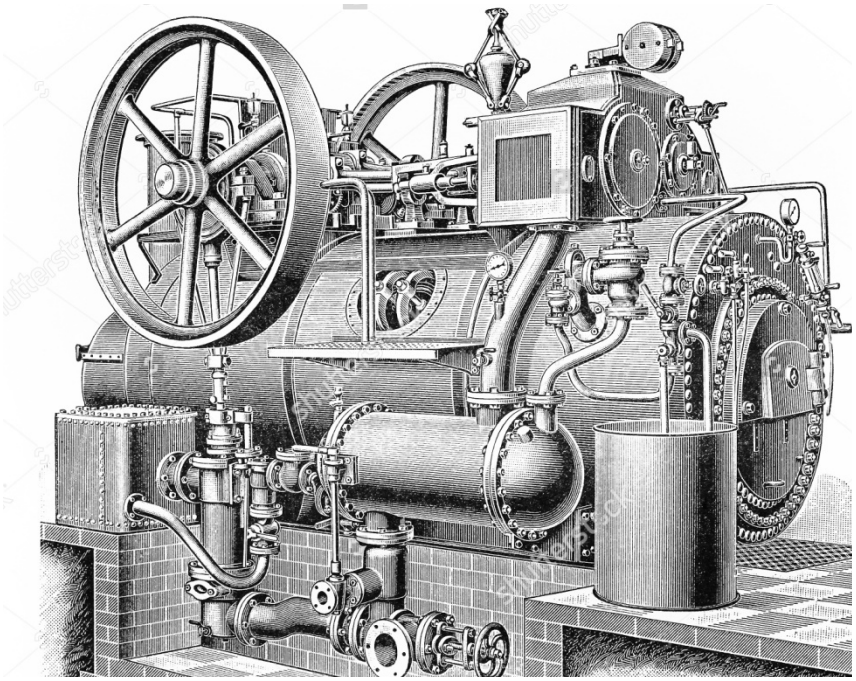




# Engineering use

- Graphics or drawings are extensively used in engineering to communicate ideas, details, procedures etc.

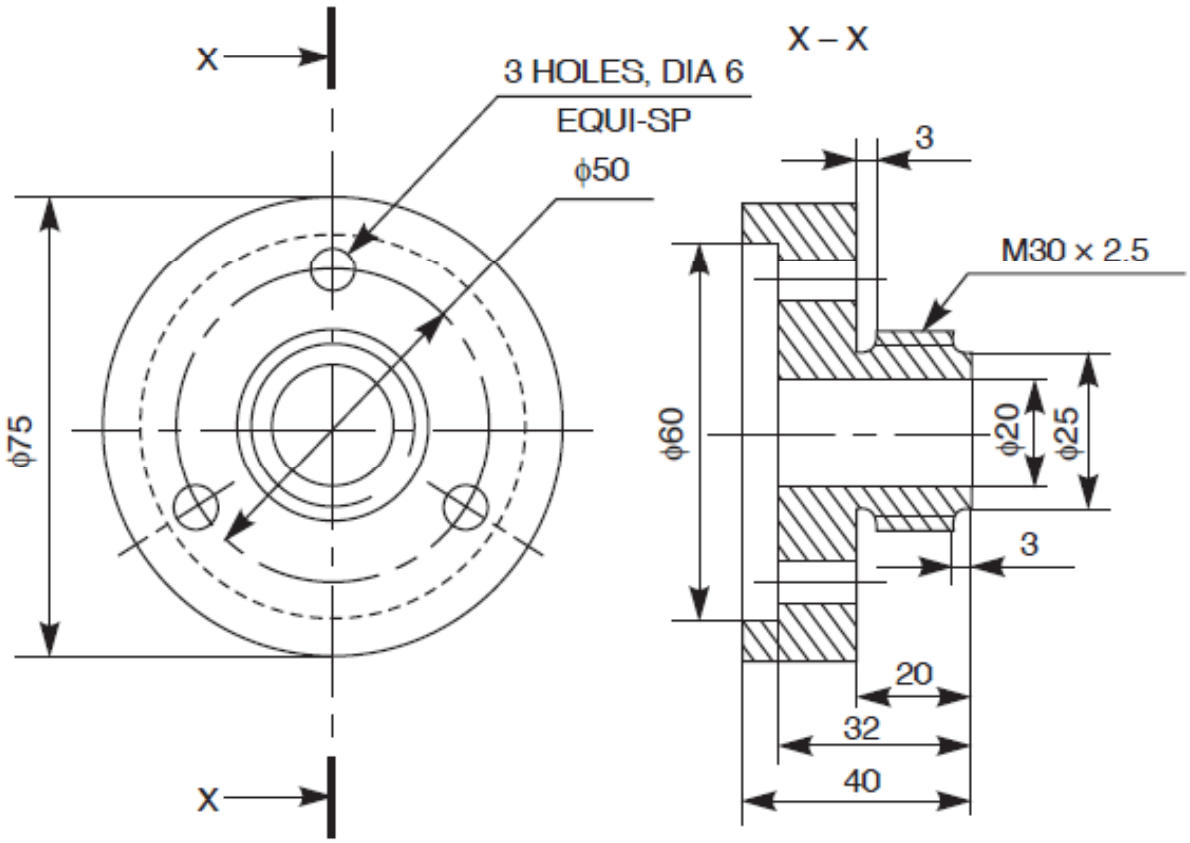

# Engineering use



- Design of engineering systems involves several steps
- Graphics or drawings are used to create, record, analyze and communicate design concepts or ideas so that
- Ideas can be made into machines, structures or real products

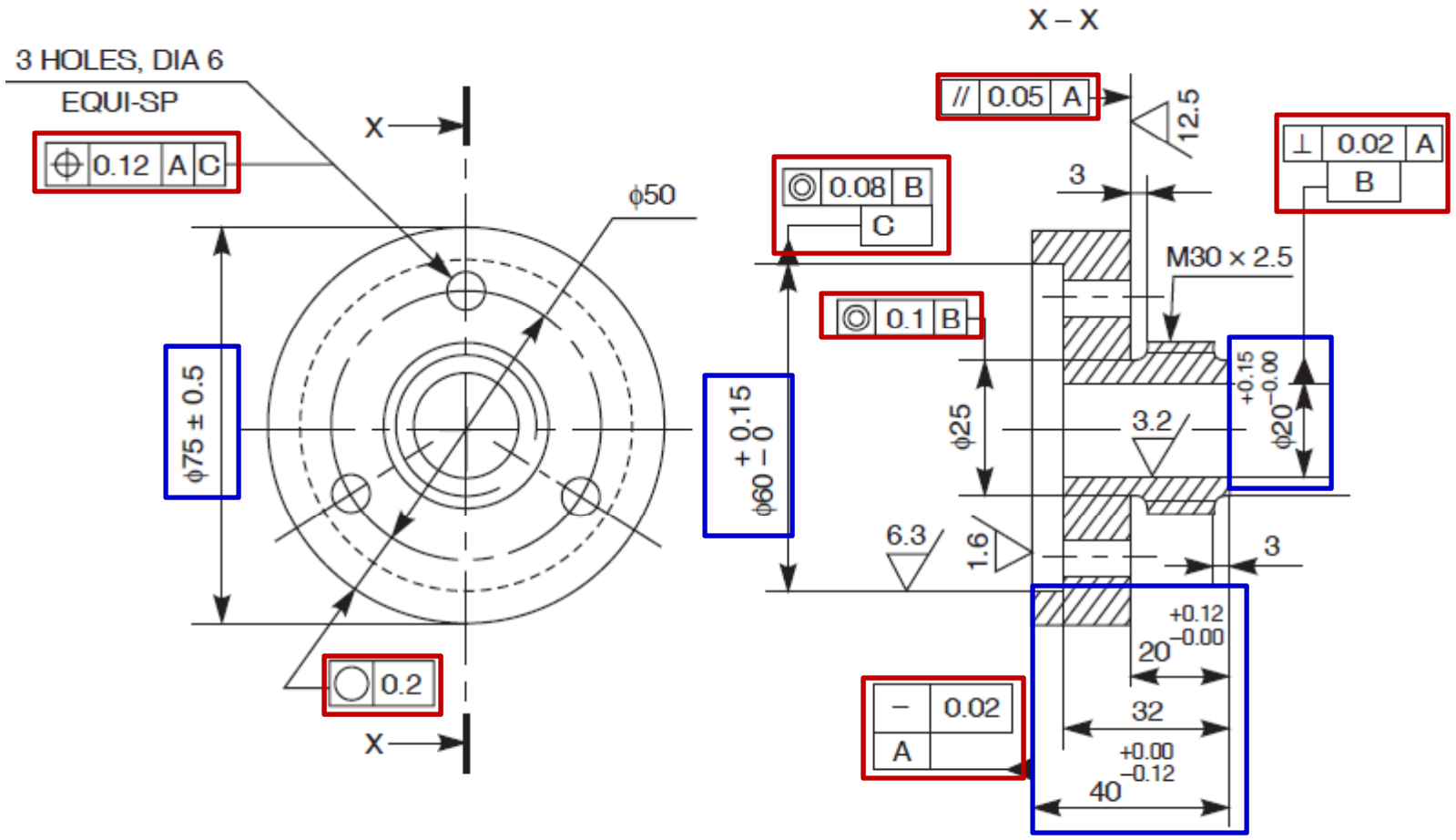
# Types of mechanical drawings

- **Machine drawing**: Provides details of a machine part or component
- Depending on the complexity of the part, orthographic views (top, front, profile etc.) and or sectional views are given



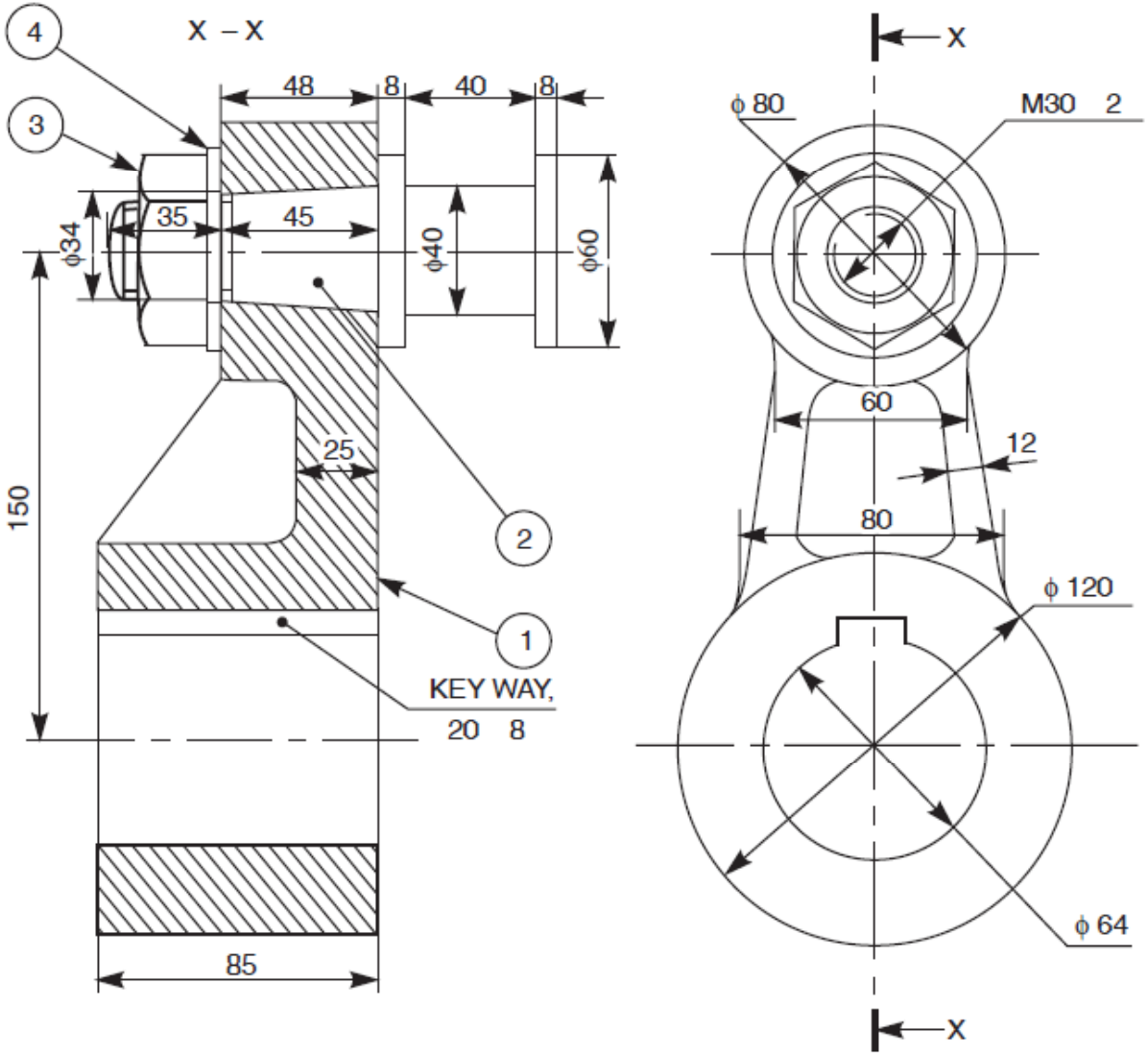
# Types of mechanical drawings

- **Production or working drawing**: Machine drawings with additional details on tolerances, surface finish, processes etc.



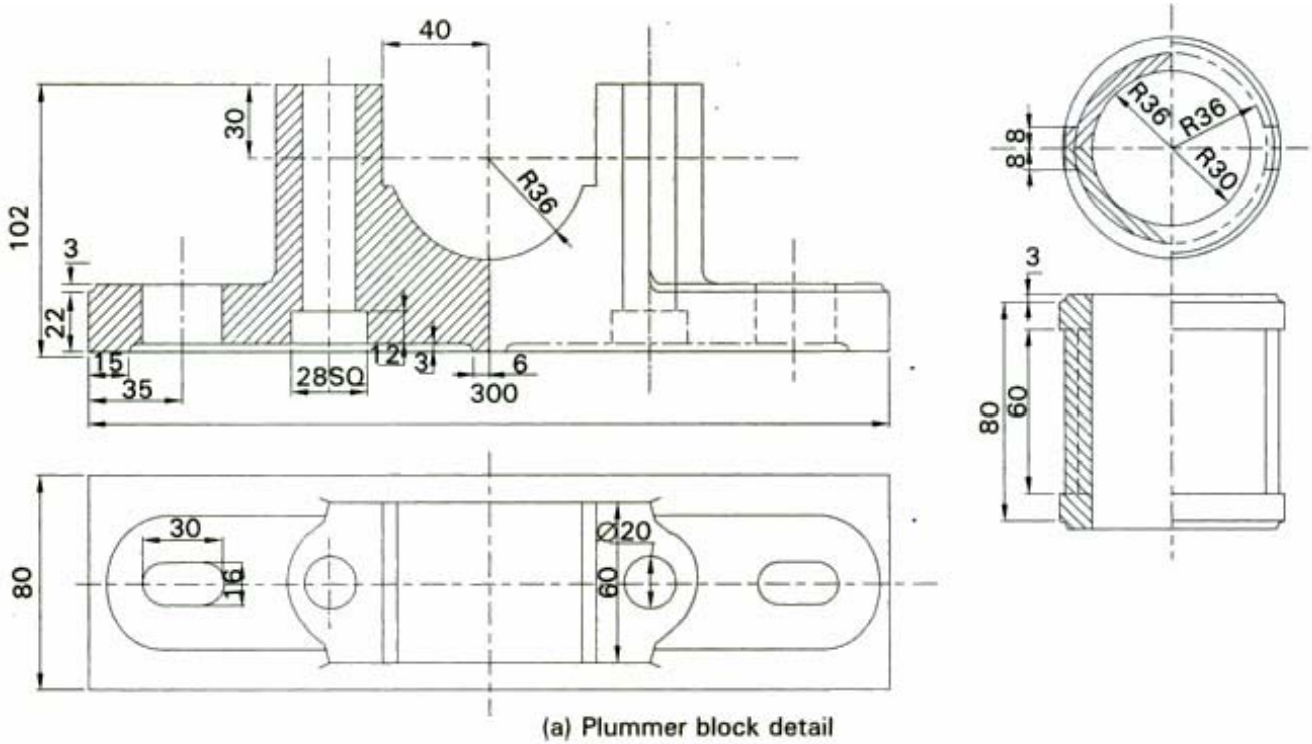
# Types of mechanical drawings

- **Assembly drawing:** Shows the various parts of a machine in their correct working location with respect to each other
- If the machine is too complex having large number of parts, then sub-assembly drawings are made for each sub-assembly
- For example, in the case of a car, sub-assembly drawings are given for each of the following
  - Engine, Clutch, Gear box, Suspension etc
- More than one view and/or sectional views required to correctly indicate the assembled location of parts is to be given
- A list of parts is given

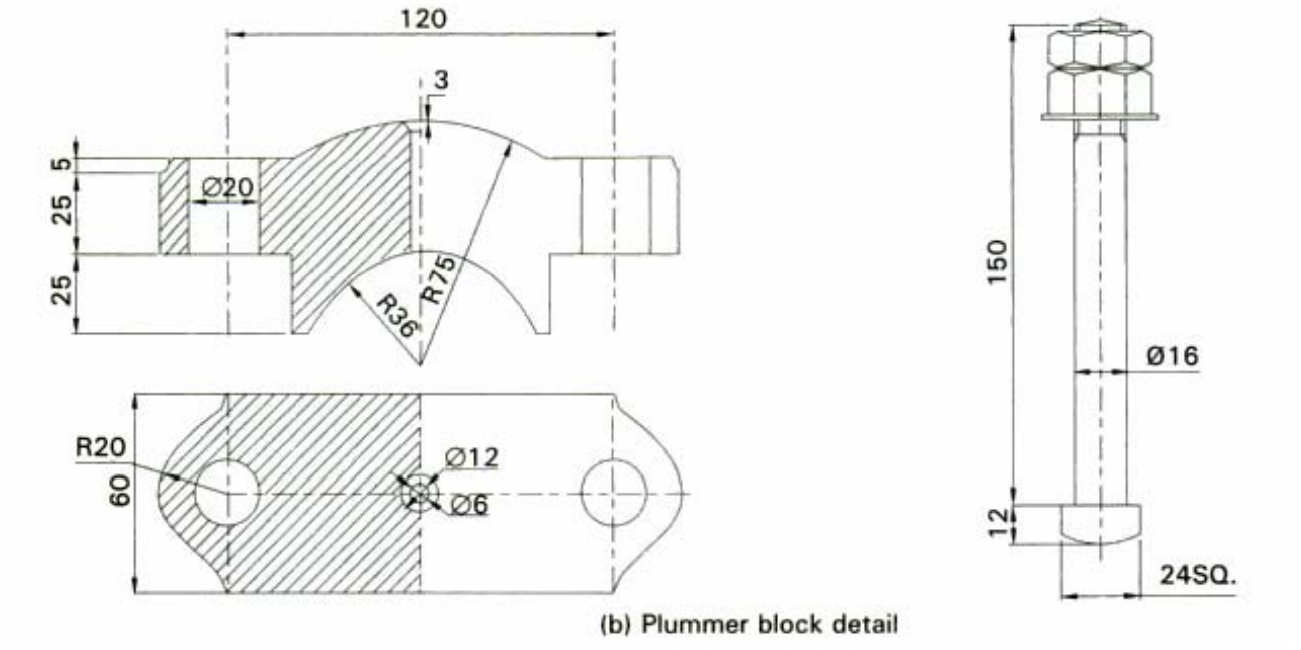



**Parts List**

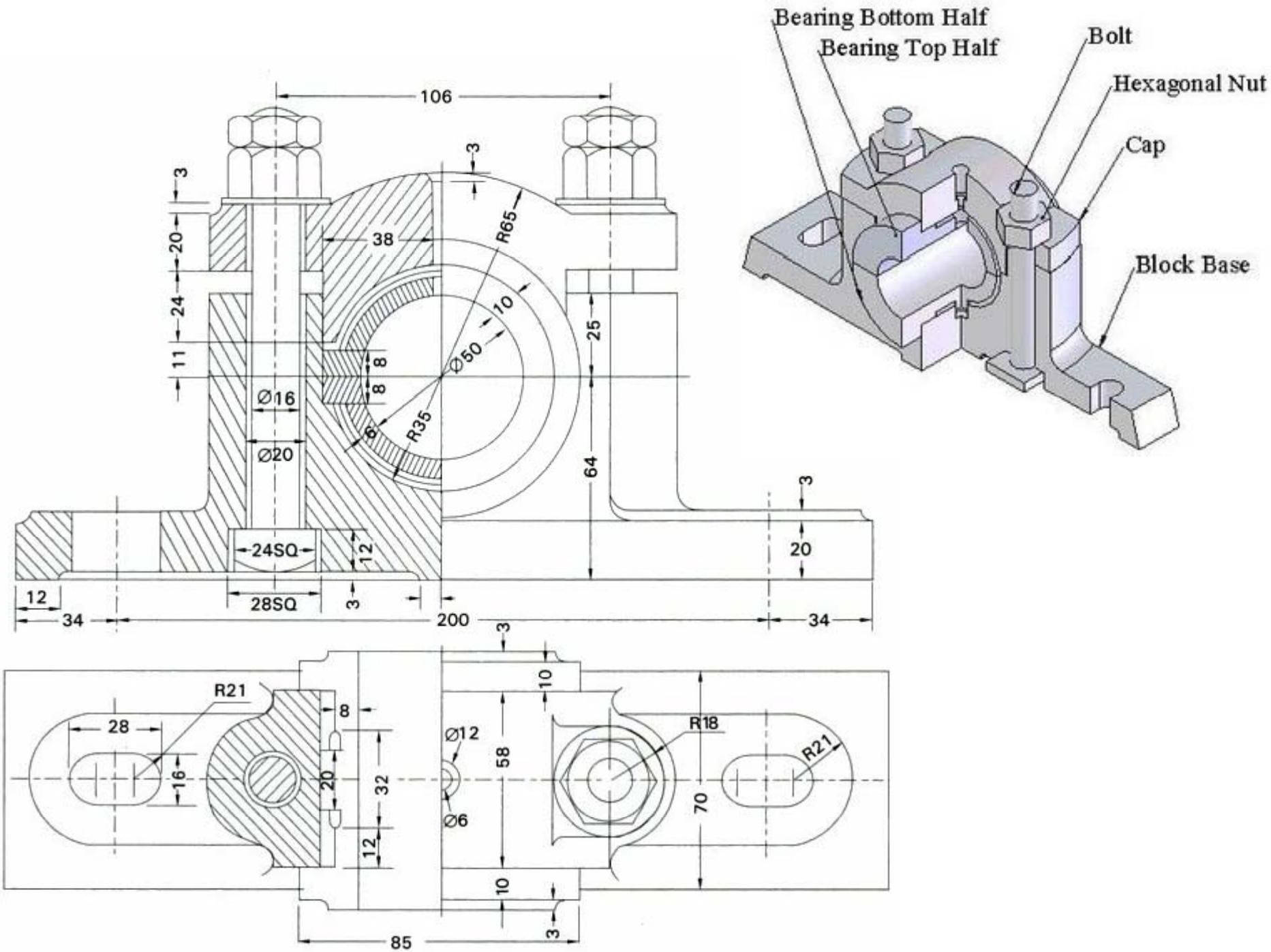
| Part No. | Name | Material | Qty |
|---|---|---|---|
| 1 | Crank | Forged Steel | 1 |
| 2 | Crank Pin | 45C | 1 |
| 3 | Nut | MS | 1 |
| 4 | Washer | MS | 1 |




(a) Plummer block detail

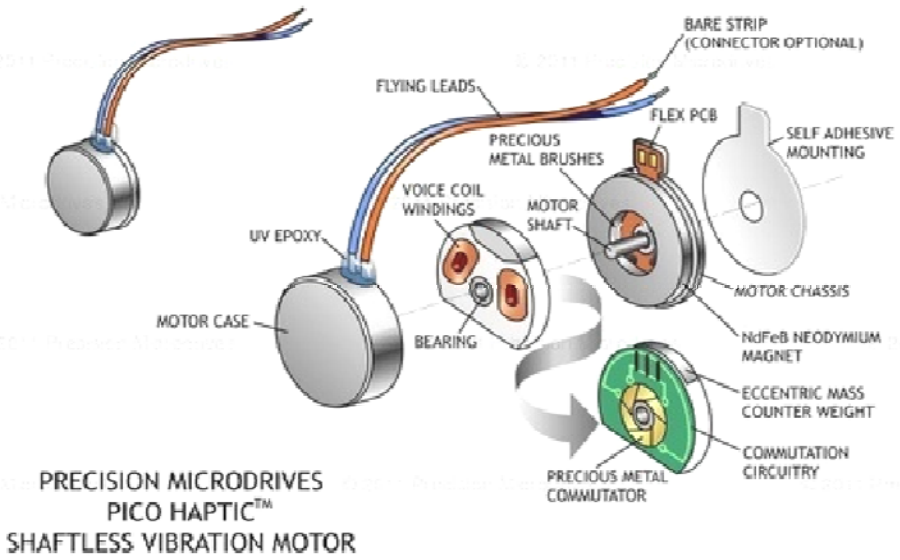


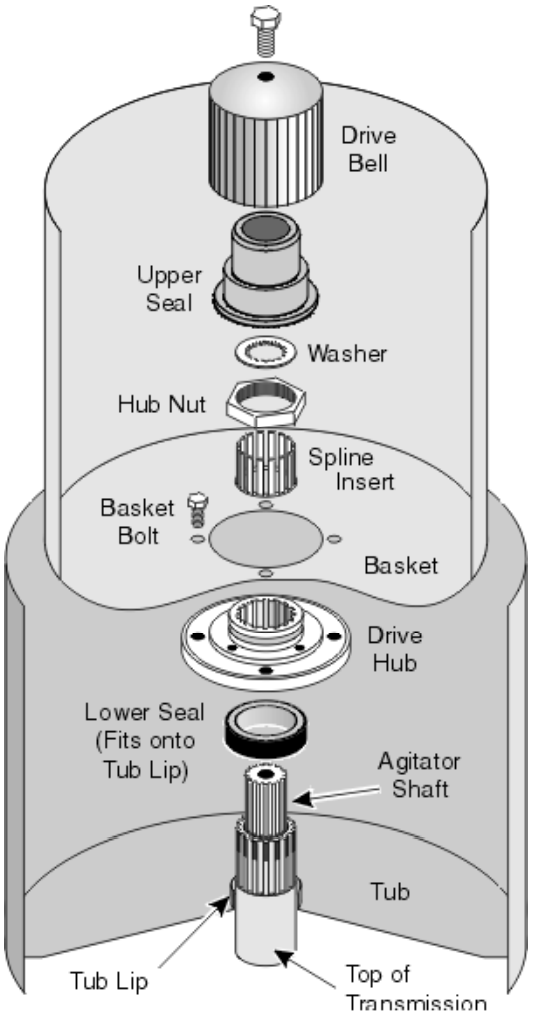

(b) Plummer block detail


Bearing Bottom Half
Bearing Top Half
Bolt
Hexagonal Nut
Cap
Block Base
106
3
3
20
24
11
38
R65
10
Ø50
8
8
Ø16
Ø20
6
R35
25
64
3
20
24SQ
12
28SQ
3
12
34
200
34
3
10
R21
28
8
16
20
32
12
Ø12
Ø6
58
R18
R21
70
10
3
85

# Types of mechanical drawings

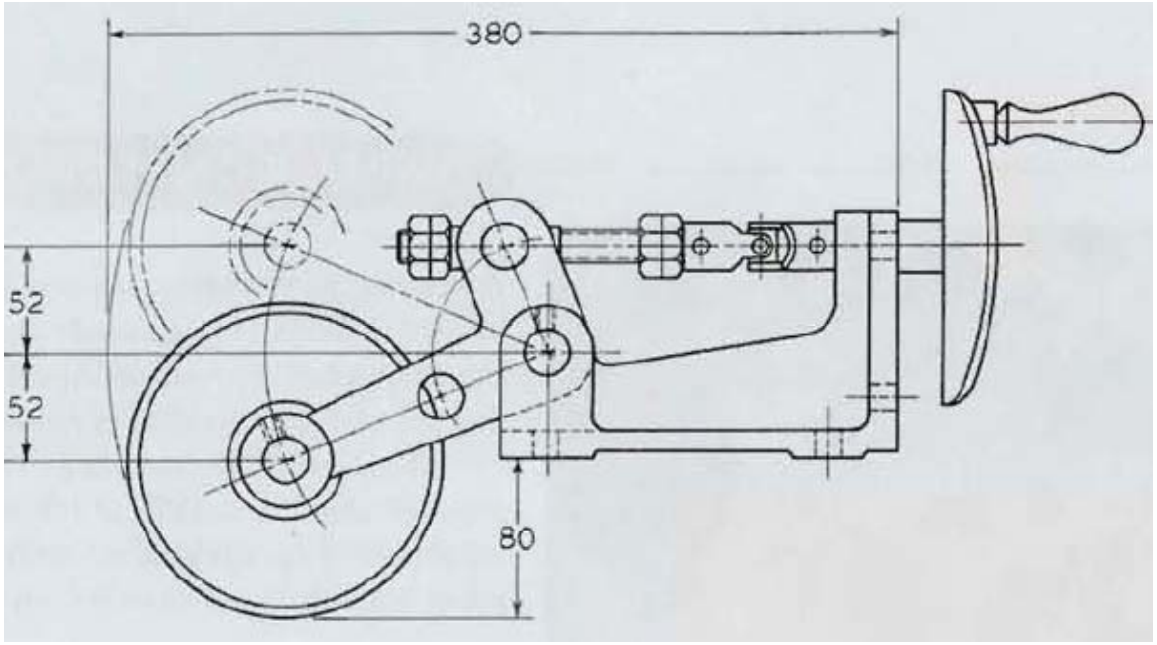
- **Exploded Drawings:** Pictorial views of each component of an assembly arranged in the same sequence in which they are to be assembled.



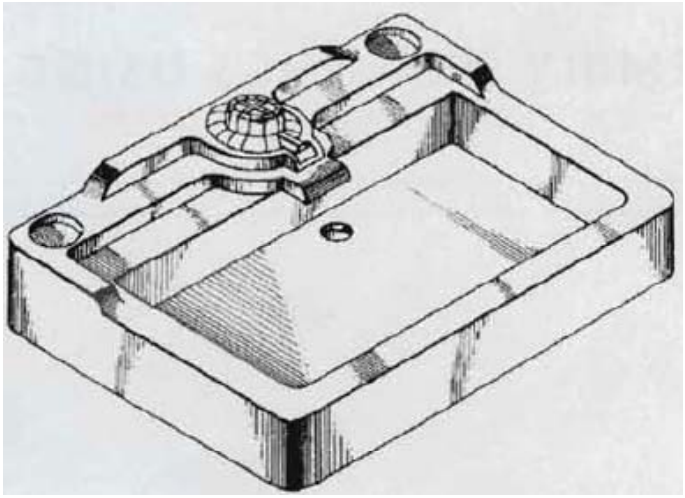



# Types of mechanical drawings

- **Part drawing:** Detailed drawing of each part of a system
- **Installation drawing:** Location and dimensions of few important parts and overall dimensions of assembled system are given
- **Patent drawings:** Self-explanatory pictorial drawings explaining the invention



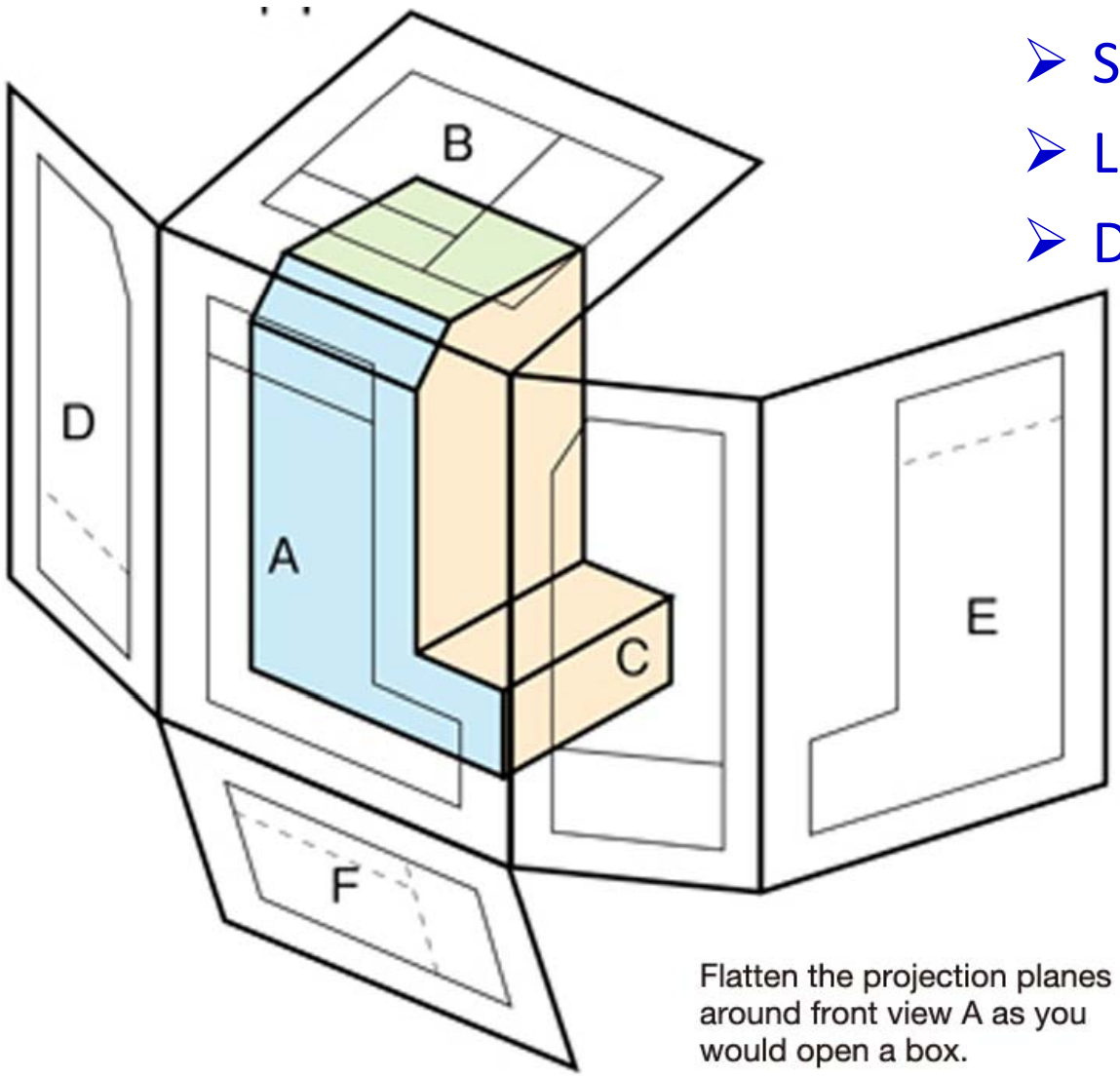

Installation assembly drawing



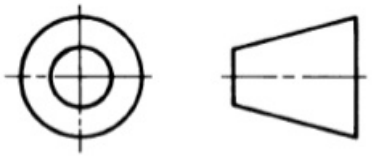
Patent drawing

# What you already know? (from TA101)

- Orthographic projections
- Auxiliary Projections
- Sections
- Lettering
- Dimensioning




Flatten the projection planes around front view A as you would open a box.



# Drawing Standards

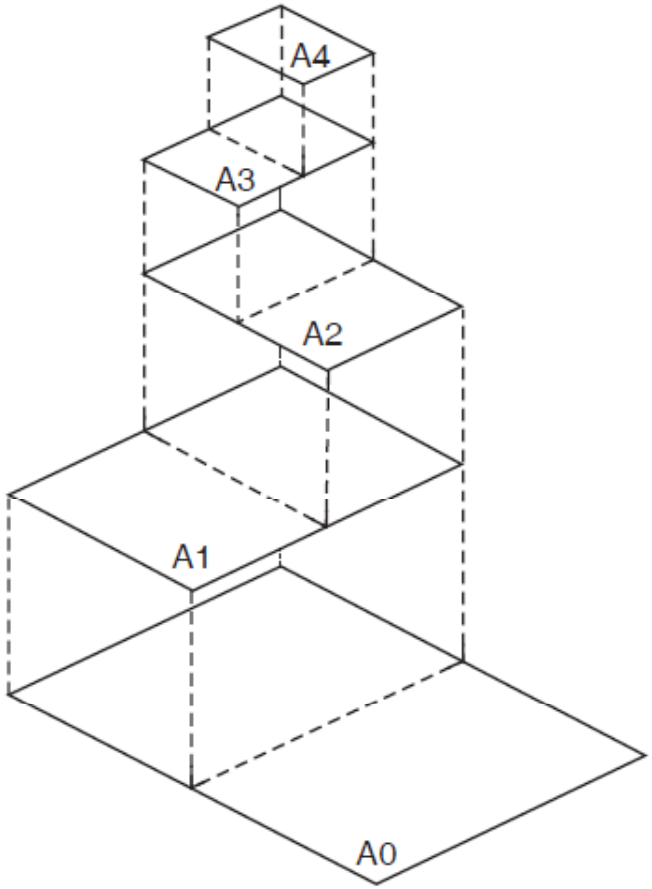
- Drawing standards prescribe the **conventions** to be used in preparing , revising and completing drawings.
  - Sheet size
  - Scale
  - Line types
  - Dimensioning
  - Lettering
  - Symbols used
  - Numbering
  - Templates etc.
- American National Standards Engineering Drawing and Related Documentation Practices
- ISO- International Organization for Standardization

# Engineering Drawing Practice for Schools and Colleges (Bureau of Indian Standards)

- **Purchase a copy of this from Copy point and bring to every lab**
- **Strictly follow this standard in preparing all your drawings**
- **Drawing Sheet Size:** x:y = 1: $\sqrt{2}$, xy=1 $m^2$

First Choice (ISO-A)

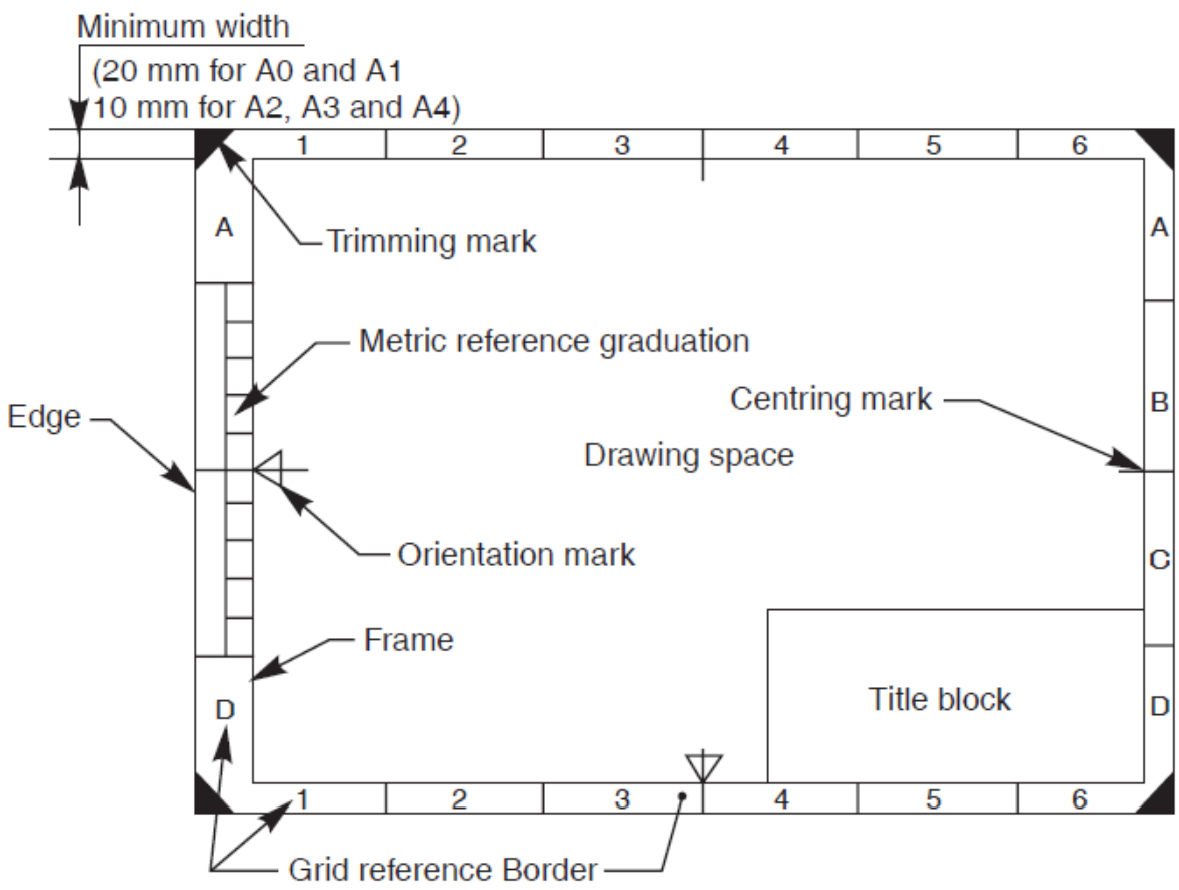
| *Designation* | *Dimensions* (mm) |
|---|---|
| A0 | 841 × 1189 |
| A1 | 594 × 841 |
| A2 | 420 × 594 |
| A3 | 297 × 420 |
| A4 | 210 × 297 |

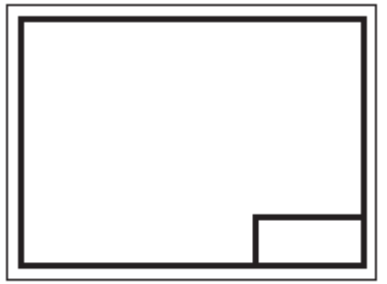


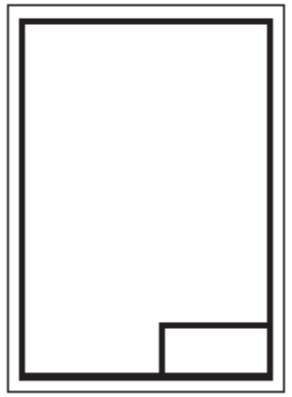

- **Sheet selection:** Original drawing should be made on the smallest sheet permitting the necessary clarity and resolution

# Sheet layout

- **Title block:** Lower right hand corner within the drawing
  - Title of drawing, sheet number, scale, name, roll number and date, projection used



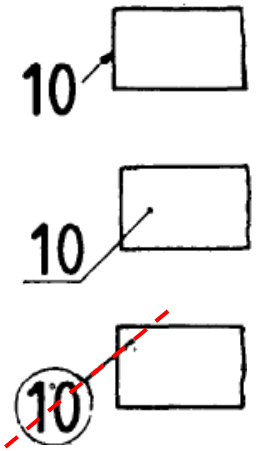





- **Grid reference:** For easy location of details

# Item references and item lists

- Item references
  - Placed outside the outline of the item and should be connected to the item through a leader line
  - Leader lines should not intersect each other
  - Hindu-Arabic numerals only
  - All references should be of same type
  - Use letters of larger height than that used in dimensioning



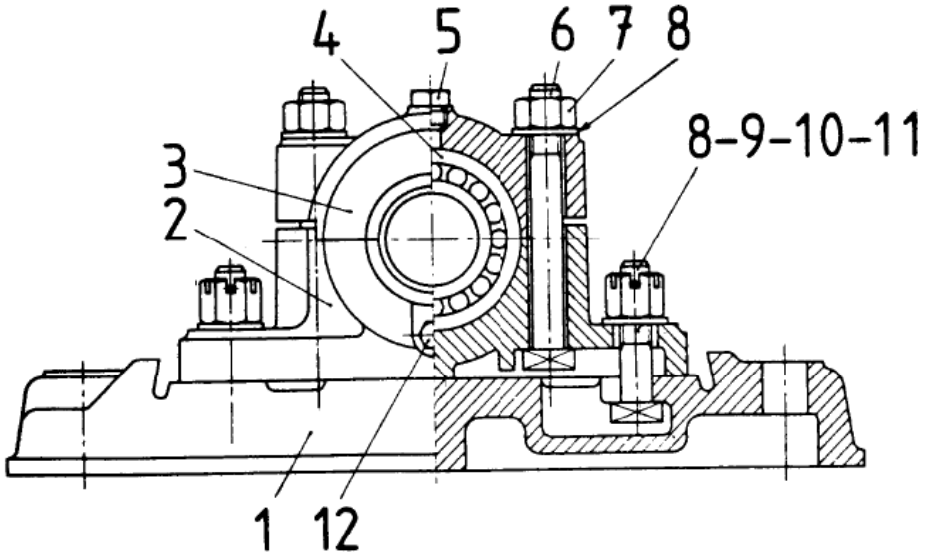




**TABLE 2.1 ITEM LIST**

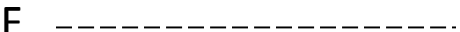
| *Item* | *Quantity* | *Description* | *Reference* |
|---|---|---|---|
| 1 | 1 | Base | |
| 2 | 1 | Bottom housing | |
| 3 | 1 | Top housing | |
| 4 | 1 | Bearing | |
| 5 | 1 | Filling plug | |
| 6 | 2 | T-bolt | |
| 7 | 2 | Hex nut | |
| 8 | 4 | Washer | |
| 9 | 2 | T-bolt | |
| 10 | 2 | Castle nut | |
| 11 | 2 | Split pin | |
| 12 | 1 | Drain plug | |

# Scales

- **Scale:** Ratio of linear dimension of an object in the drawing to the corresponding actual dimension of the object
- 1:1- Full size, X:1- Enlargement, 1: X- Reduction
- Scale should be chosen based on the complexity of the object
- Should be large enough to provide easy and clear interpretation of the information depicted in the drawing

- Folding of drawing sheets (see standard for details)
  - Folded to A4 sheet size
  - Title block should appear in the top position

# LINES

| | | |
|---|---|---|
| A  | Continuous thick | Visible outlines- **$A_1$**<br>Visible edges- **$A_2$** |
| B  | Continuous thin (straight or curved) | Imaginary Lines of intersection- **$B_1$**<br>Dimension Lines- **$B_2$**<br>Projection lines- **$B_3$**<br>Leader Lines- **$B_4$**<br>Hatching- **$B_5$**<br>Outlines of revolved sections- **$B_6$**<br>Short center lines- **$B_7$** |
| C  | Continuous thin freehand | Limits of partial or interrupted views- **$C_1$** |
| D  | Continuous thin straight with Zig-Zags | |
| E  | Dashed thick | Hidden outlines- **$E_1$**<br>Hidden edges- **$E_2$** |
| F  | Dashed thin | Hidden outlines- **$F_1$**<br>Hidden edges- **$F_2$** |

# LINES

G  Chain thin

Center lines- **$G_1$**
Lines of Symmetry - **$G_2$**
Trajectories- **$G_3$**

H  Chain thin, thick at ends and change of direction

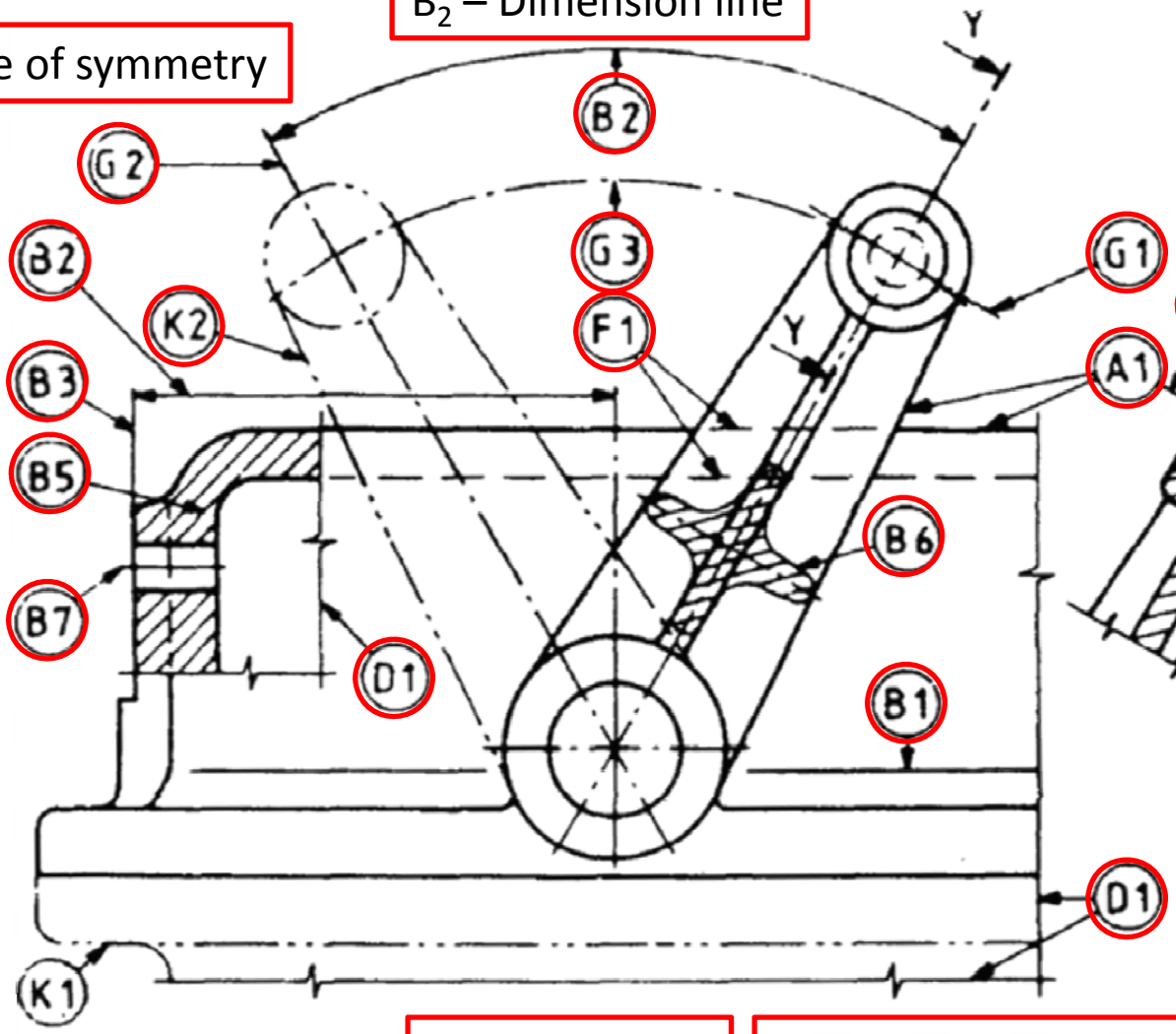
Cutting planes - **$H_1$**

J  Chain thick

Indication of lines and surfaces to which a special requirement applies - **$J_1$**

K  Chain thin double dashed

Outlines of adjacent parts- **$K_1$**
Alternative and extreme positions of movable parts- **$K_2$**
Centroidal lines- **$K_3$**
Initial outlines prior to forming - **$K_4$**
Parts situated in front of cutting plane- **$K_5$**




$B_2$ – Dimension line

$G_2$ – Line of symmetry

$A_1$ – Visible outline

$G_1$ – Center line

$B_4$ – Leader line

$G_1$ – Center line

$B_1$ – Imaginary lines of intersection

$G_3$ – Trajectory

$F_1$ – Hidden outlines

$B_3$ – Projection line

$B_7$ – Short center line

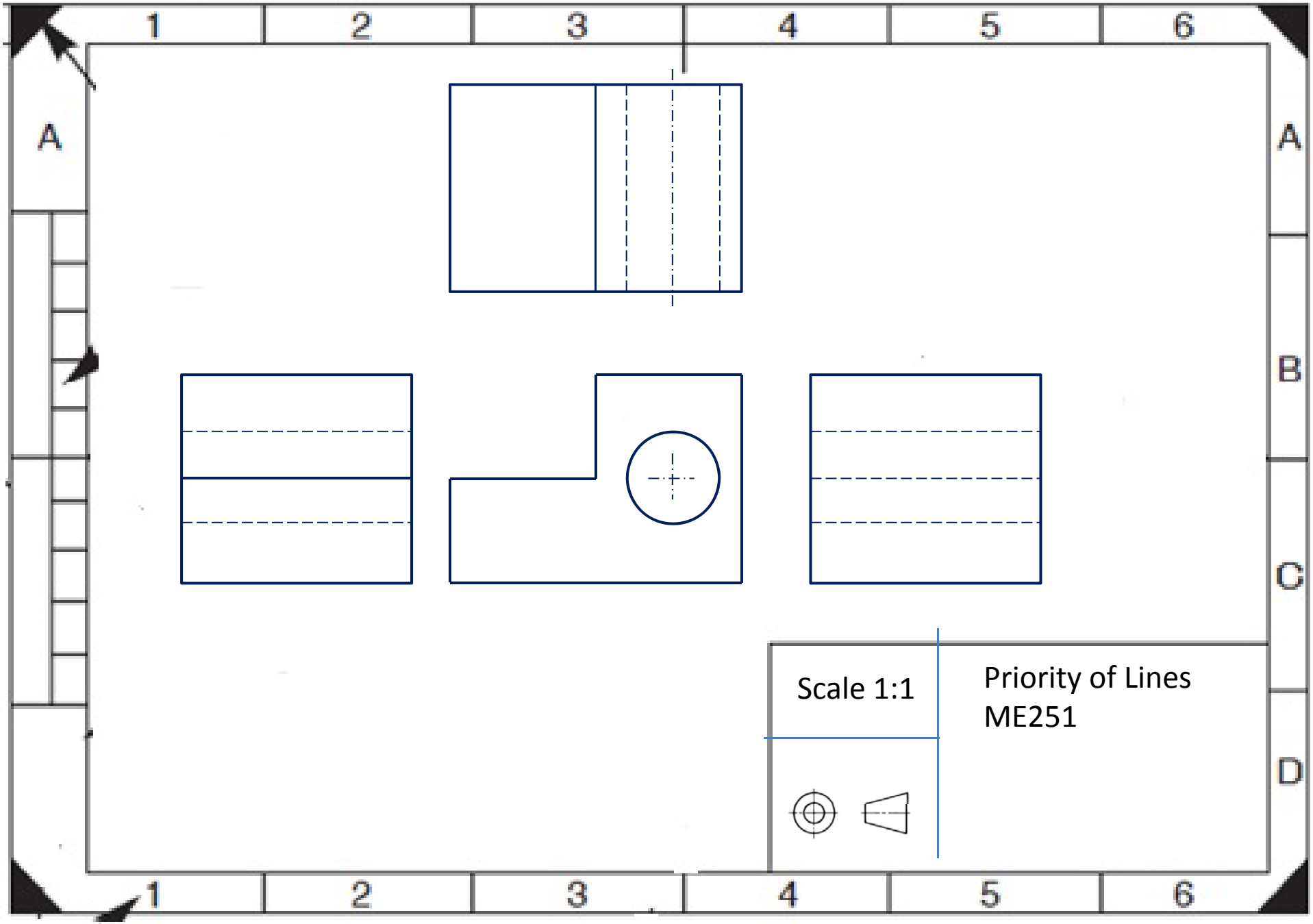
$B_5$ – Hatching

$K_2$ – Extreme position

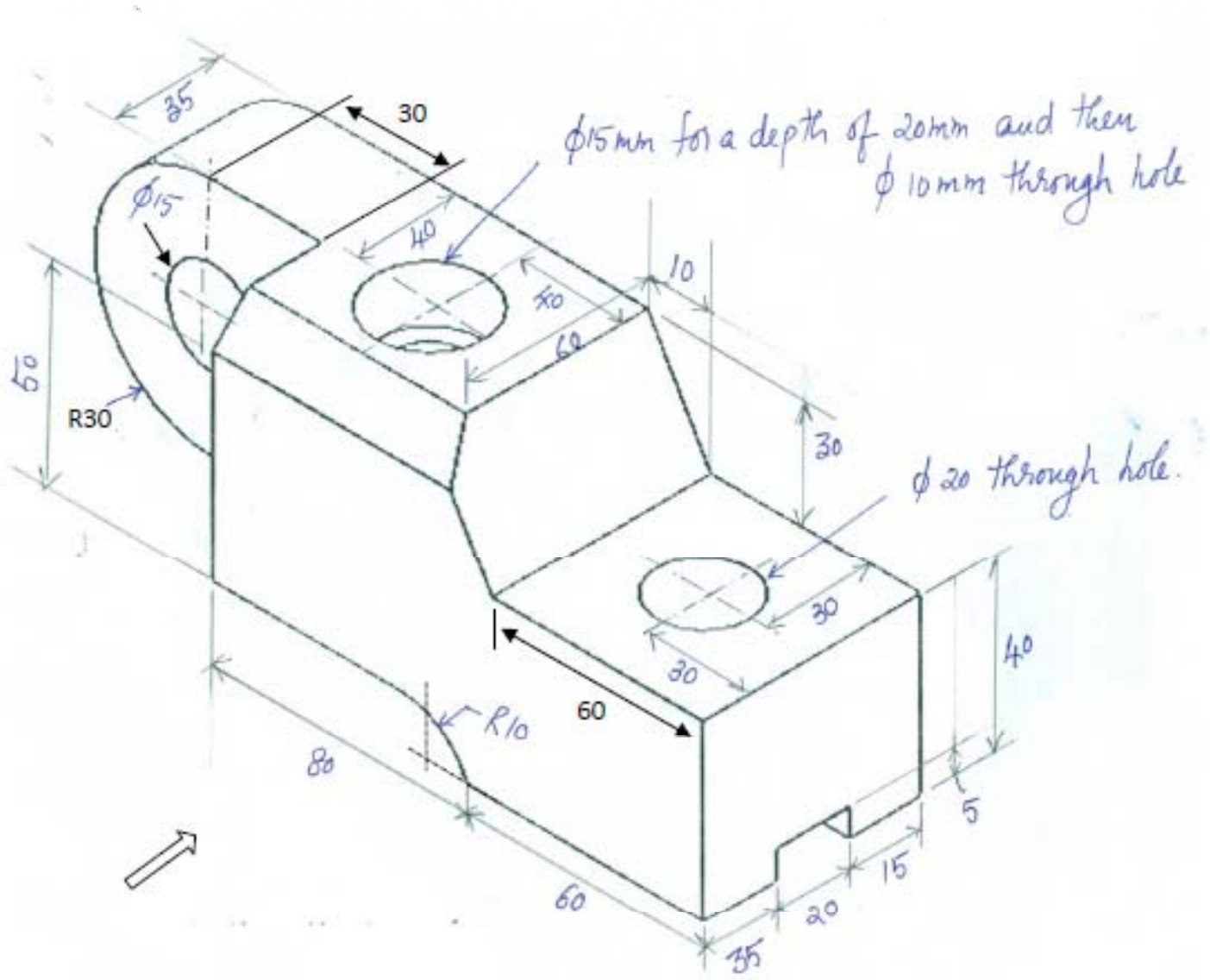
$B_6$ – Outline of revolved section

# LINES

- **Priority**:
  - Visible outlines and edges (A)
  - Hidden outlined and edges (B)
  - Cutting planes
  - Centerlines and lines of symmetry
  - Projection lines


1
2
3
4
5
6
A
B
C
D
Scale 1:1
Priority of Lines
ME251

# Lab on Friday 30-07-2016




All dimensions in mm