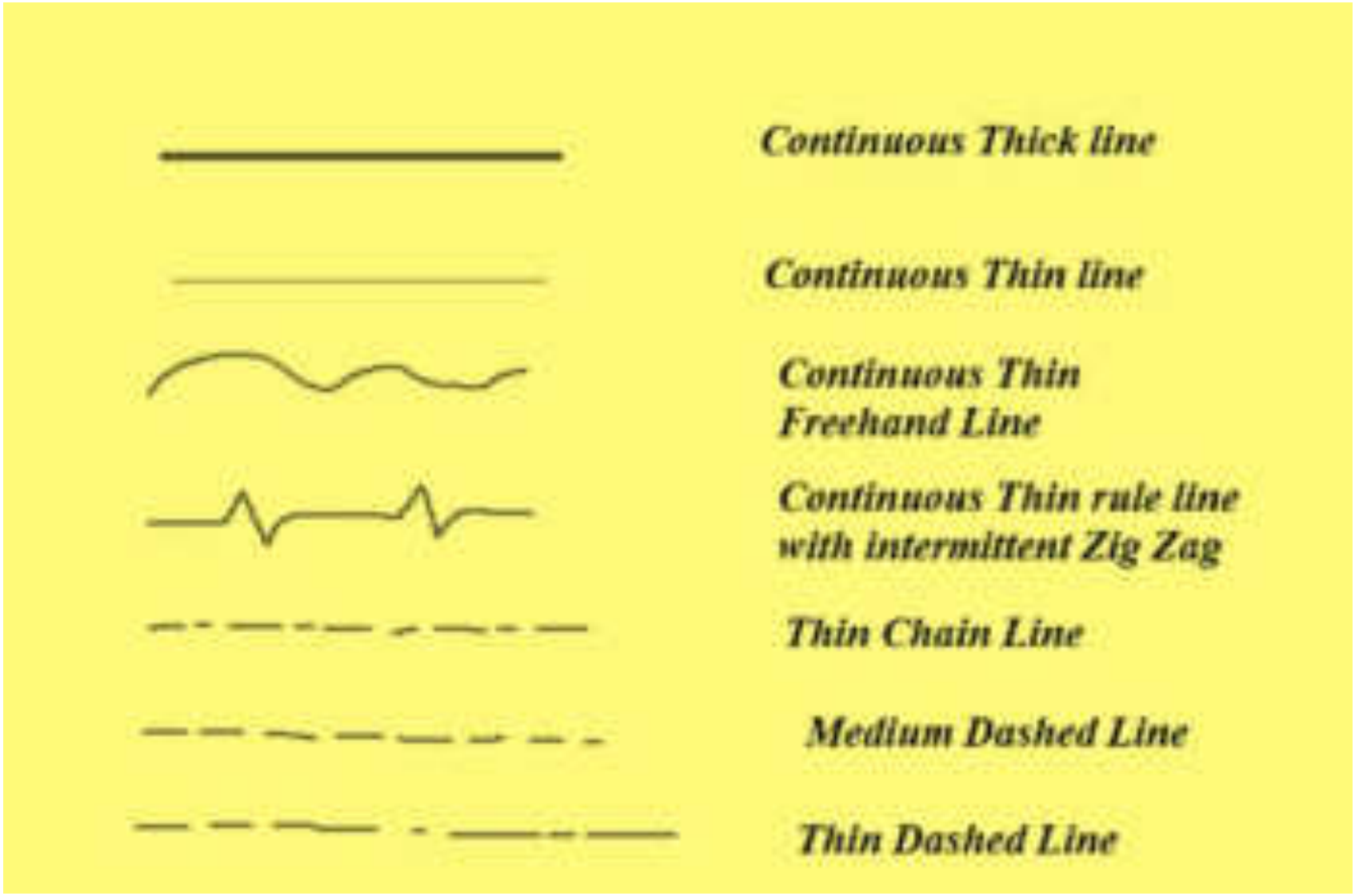
Basics of Machine Drawing

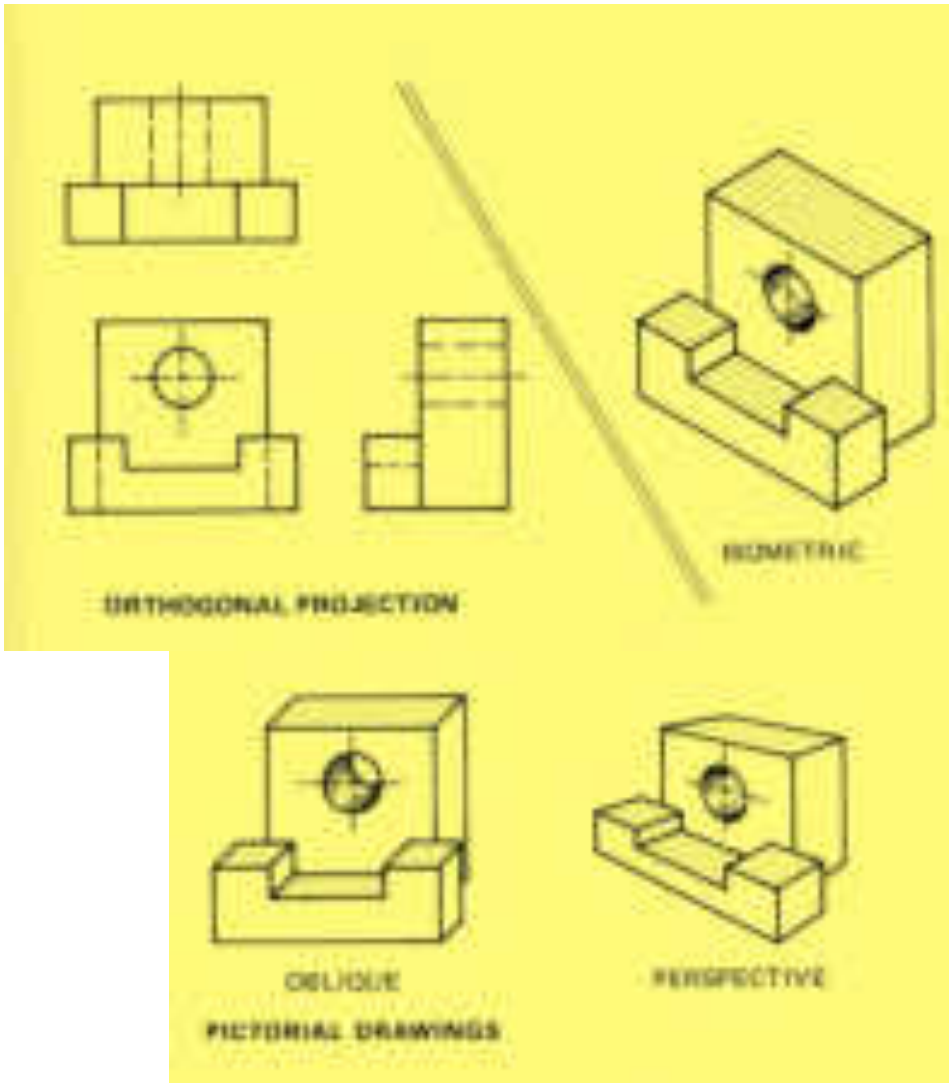
Types of Lines



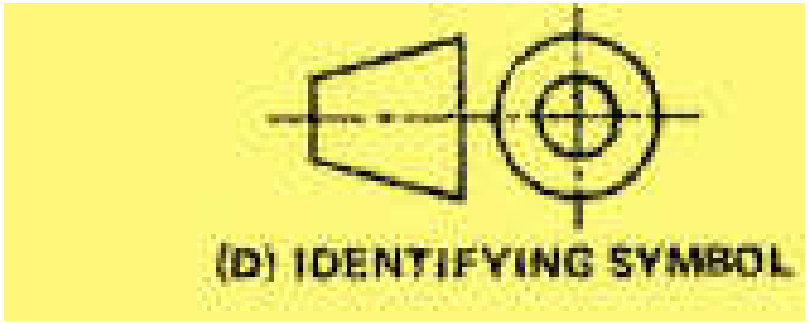
Orthographic Representation

Types of Projection

- Orthogonal Projection
  - Requires more than one view to describe an object
- Pictorial representation
  - Isometric
  - Oblique
  - Perspective



Orthographic Representation

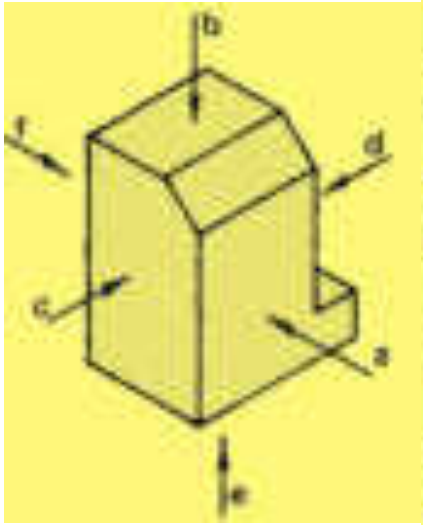


- *Uses parallel orthogonal projection to represent an object*
- *Flat, two dimensional views*
- *Views are positioned on the page according to projection method*
- *An identifying symbol next to the title block indicates which representation method is used*

Orthographic Representation

Projection Method

- First Angle Projection
- Third Angle Projection
- Reference arrows layout
- Mirrored Orthographic Representation

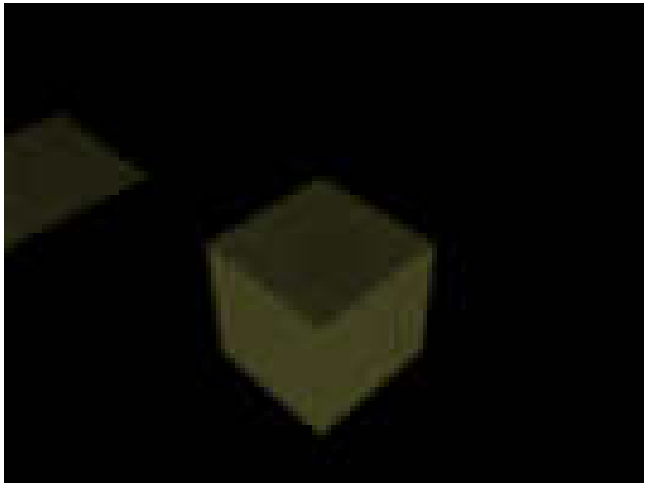


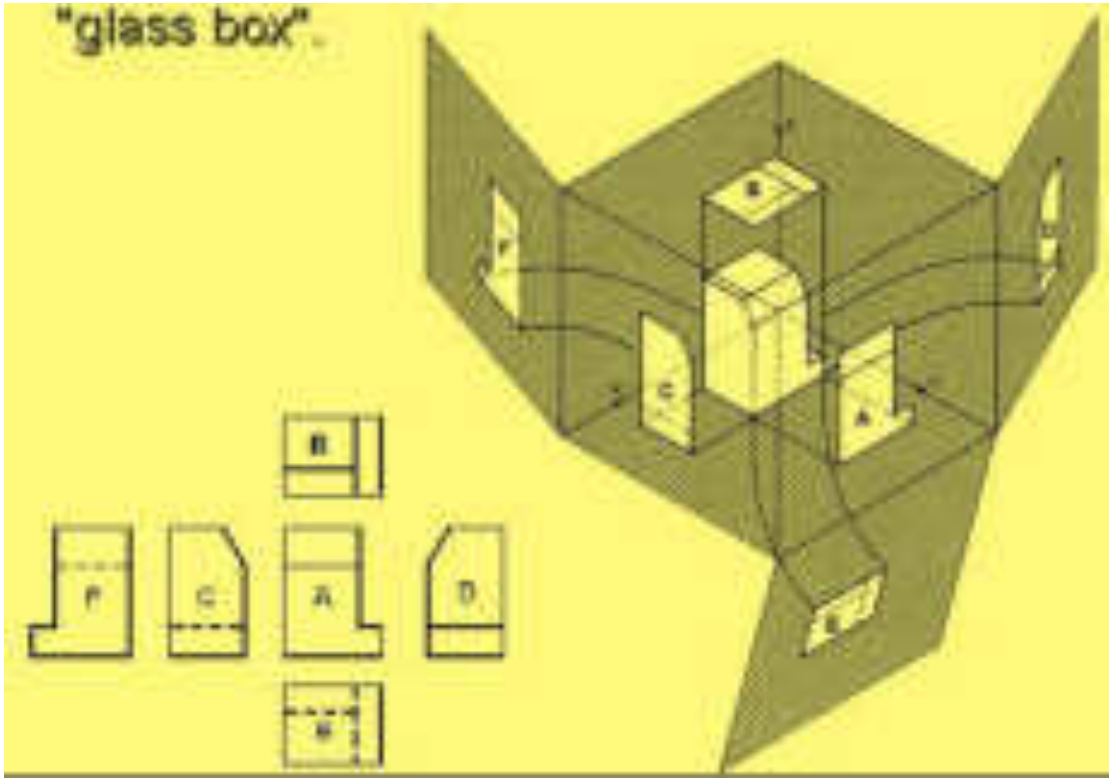
DIRECTION OF OBSERVATION		DESIGNATION OF VIEW
VIEW IN DIRECTION	VIEW FROM	
a	THE FRONT	A
b	ABOVE	B
c	THE LEFT	C
d	THE RIGHT	D
e	BELOW	E
f	THE REAR	F

Orthographic Representation

Shape Description

The observer views the object perpendicular to each of the six sides of the box.

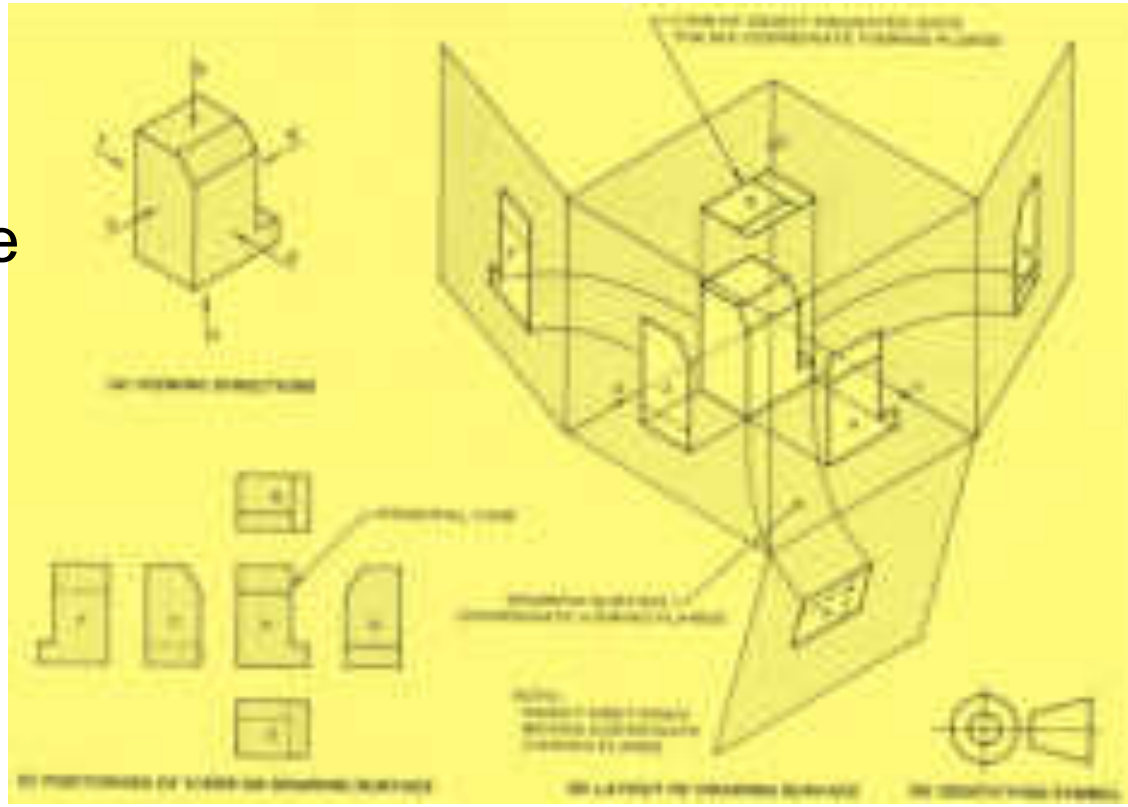




Orthographic Representation

Third angle projection

- The object to be represented appears behind the coordinate viewing planes on which the object is orthogonally projected



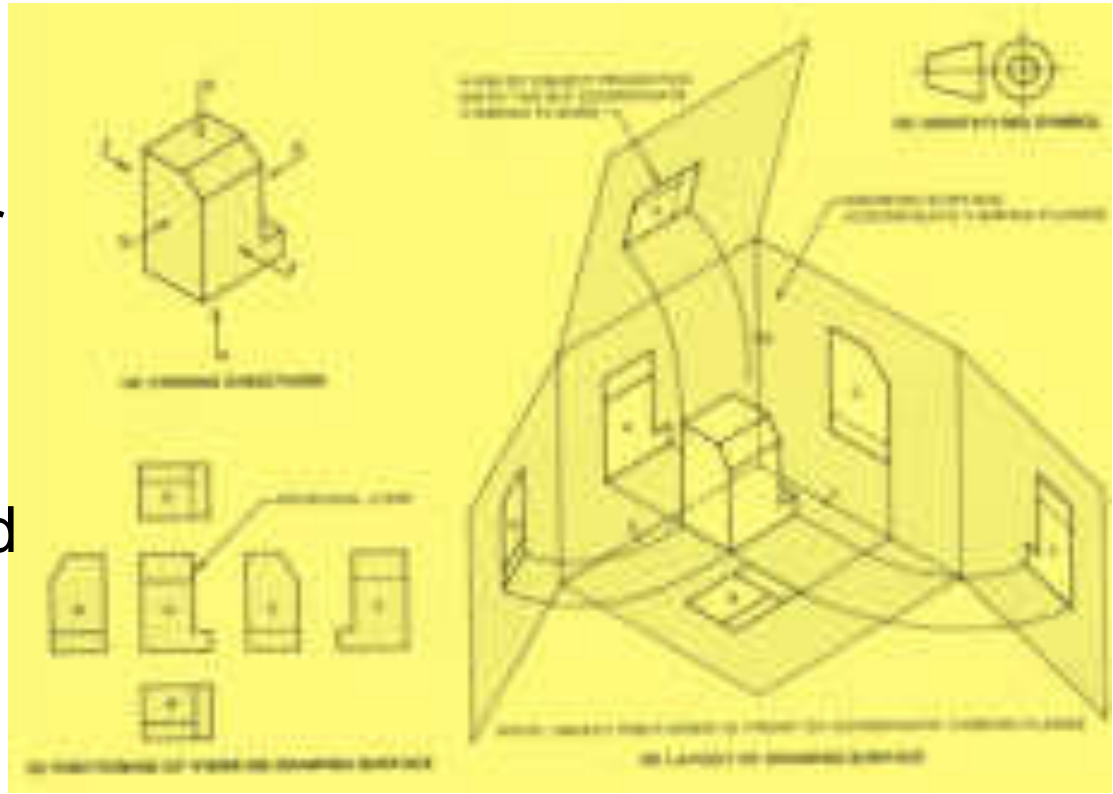
- Identifying symbol

- The most commonly used method in the US and Canada

Orthographic Representation

First angle projection

- The object to be represented appears between the observer and the coordinate viewing planes on which the object is orthogonally projected



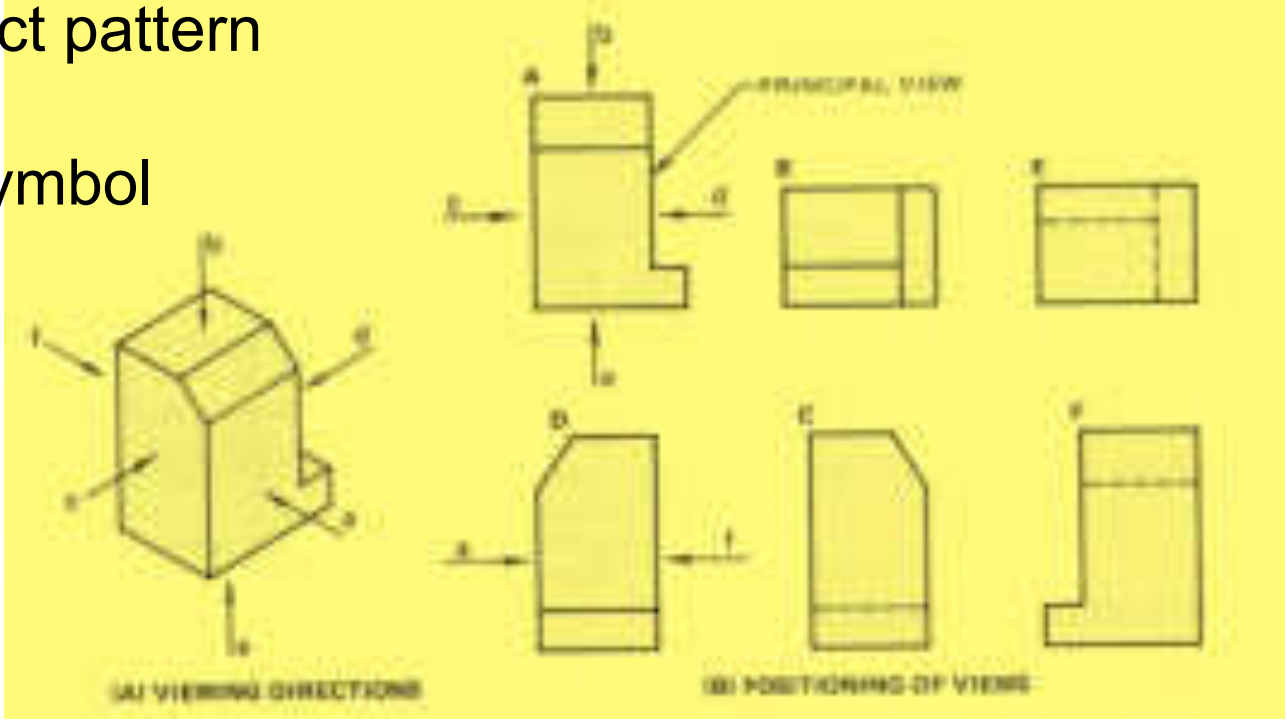
- Identifying symbol

- The most commonly used method in Europe and Asia

Orthographic Representation

Reference arrows layout

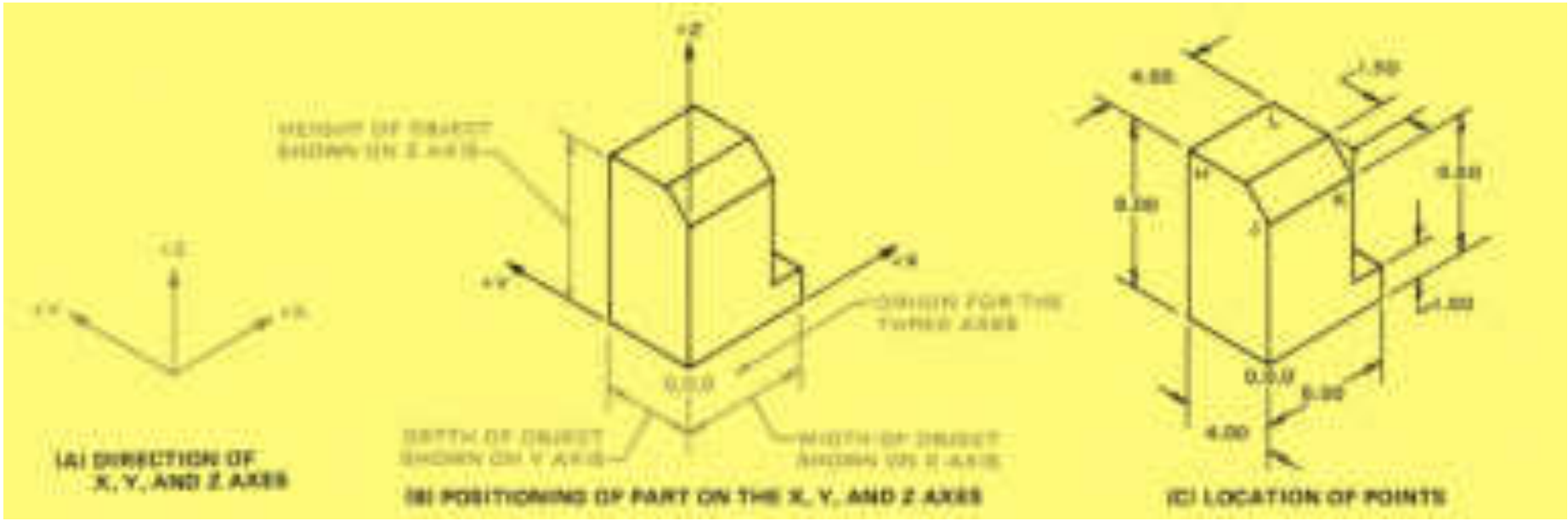
- Permits various views to be freely positioned
- Used when it is advantageous not to position views according to strict pattern
- No identifying symbol needed
- Each view identified by a letter.



Orthographic Representation

Location of points

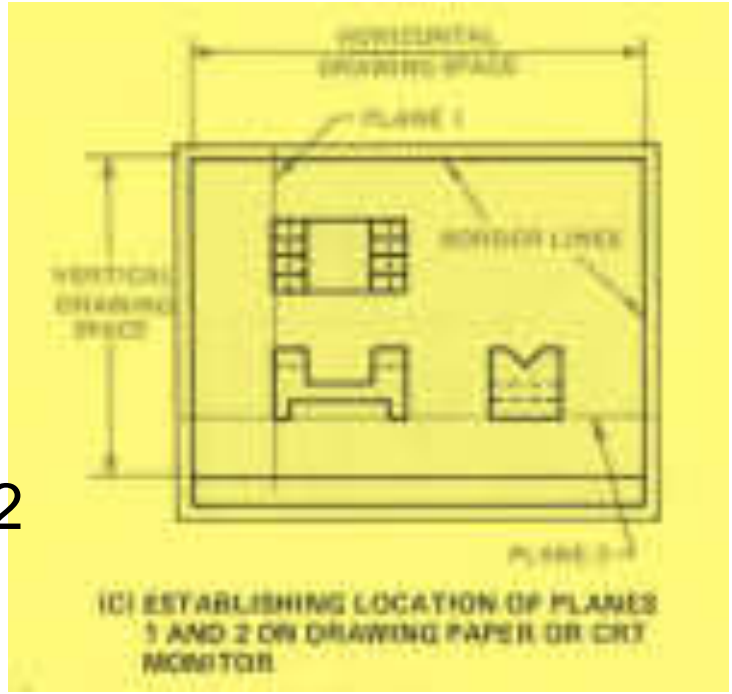
- X axis represents width
- Y axis represents depth
- Z axis represents height
- Origin (0,0,0) can be any convenient place in drawing
- The coordinates for HJKL are shown



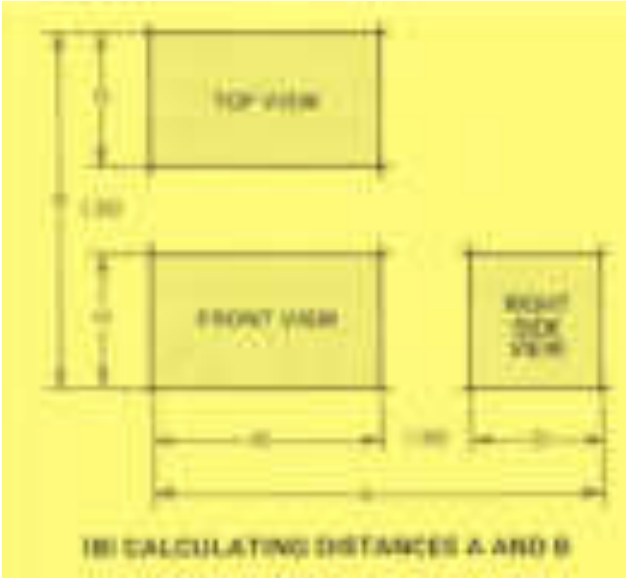
Arrangement of Views

Balancing drawing on paper

- Drafter must anticipate space required
- Draw the views so that they are balanced on the drawing paper
- Avoid crowding or excessive space
- See page 92 for details



(C) ESTABLISHING LOCATION OF PLANES 1 AND 2 ON DRAWING PAPER OR CRT MONITOR

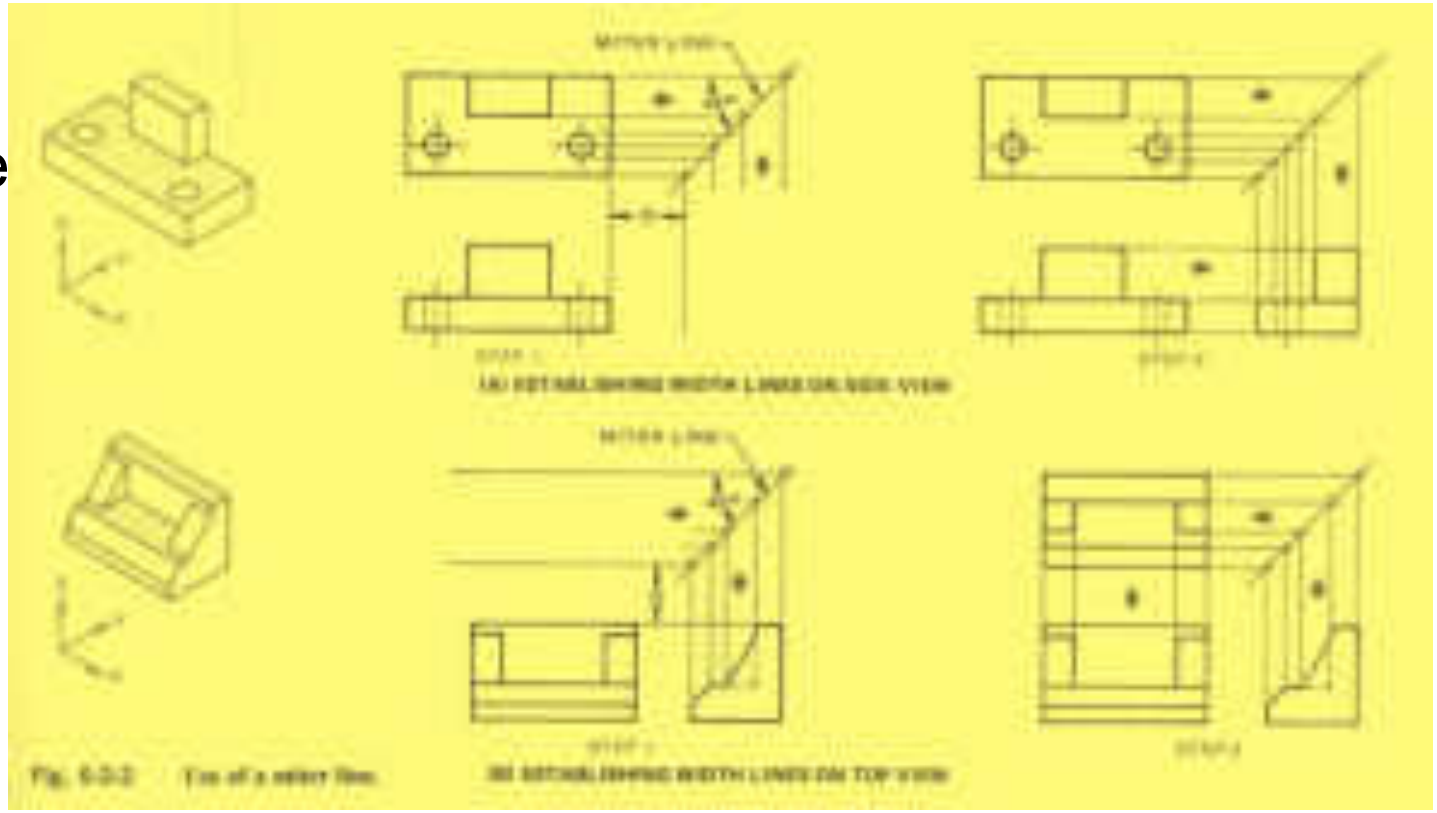


(B) CALCULATING DISTANCES A AND B

Arrangement of Views

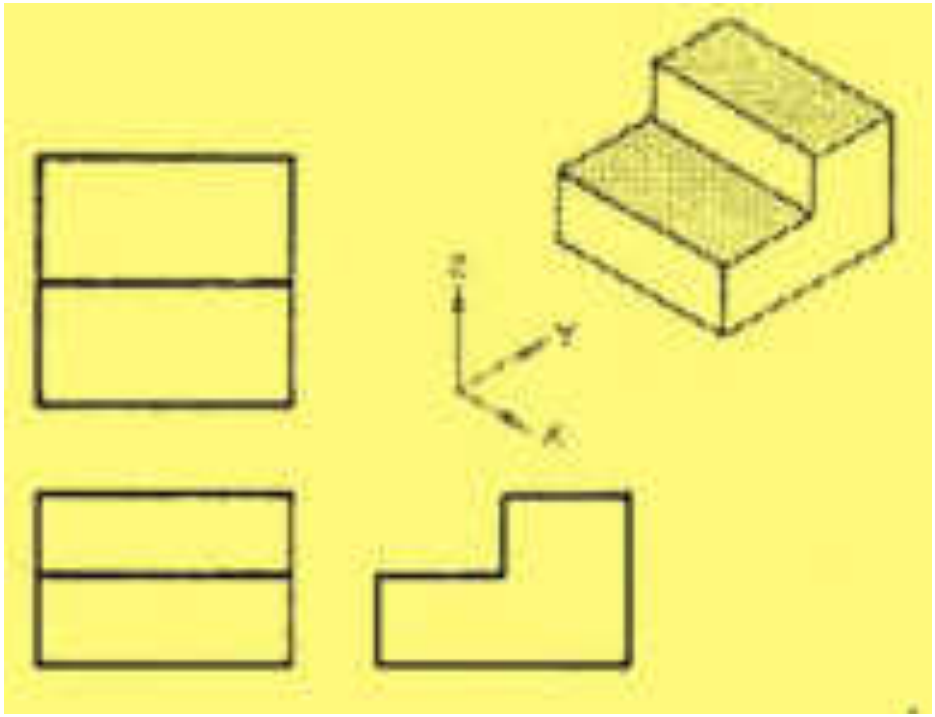
Use of Miter Lines

- 1. Given the TV & FV, project lines to the right of the TV
- 2. Establish how far (from FV) the SV is to be drawn (D)
- 3. Construct the miter line at 45° to the horizontal

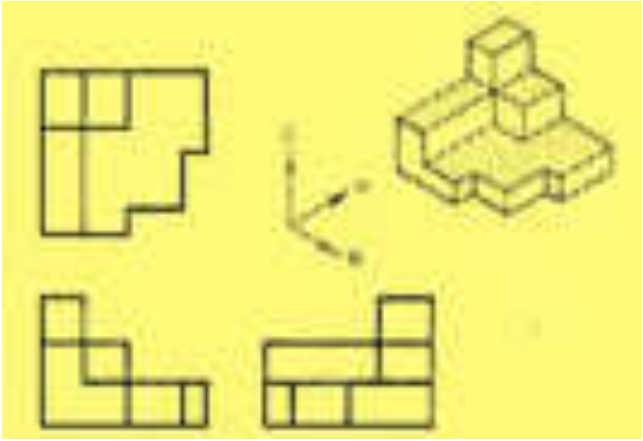


Parallel surfaces

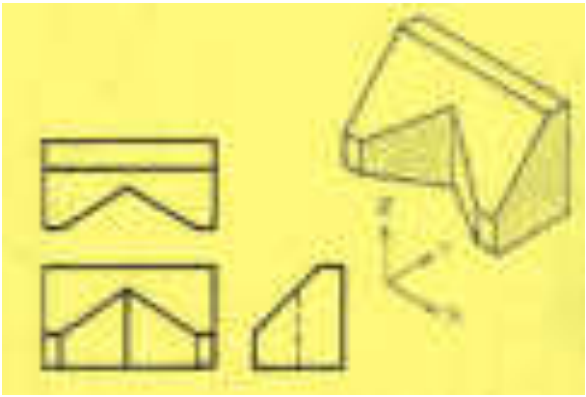
- Parallel surfaces appear parallel to the viewing plane, with and without hidden features
- It will appear as a surface in one view and lines in the other views
- The length of the lines in other views are same as is in the surface view

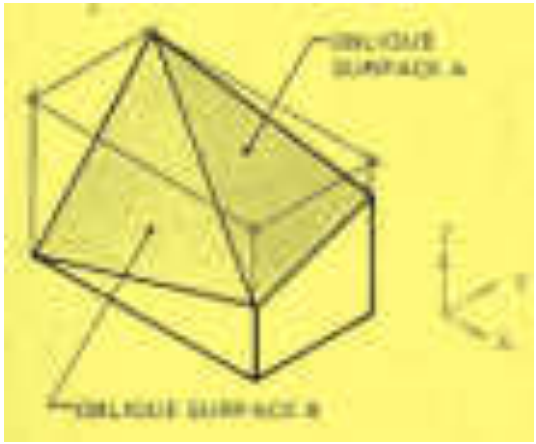


Types of Flat Surfaces



- Parallel surfaces that appear parallel to the viewing plane, with and without hidden features
- Inclined surfaces that appear inclined in one plane and parallel to the other two principal reference planes
- Oblique surfaces that appear inclined in all three reference planes

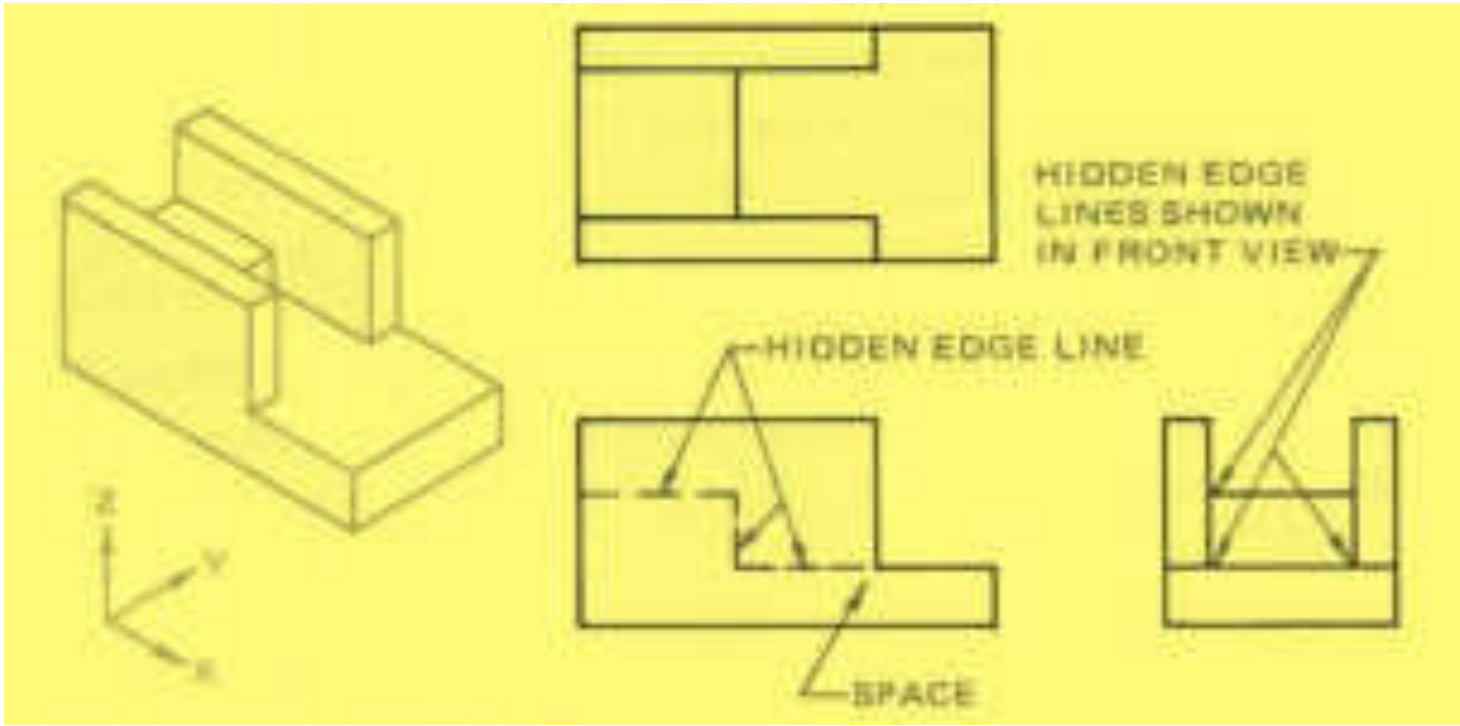




Hidden surfaces and edges

Hidden Lines

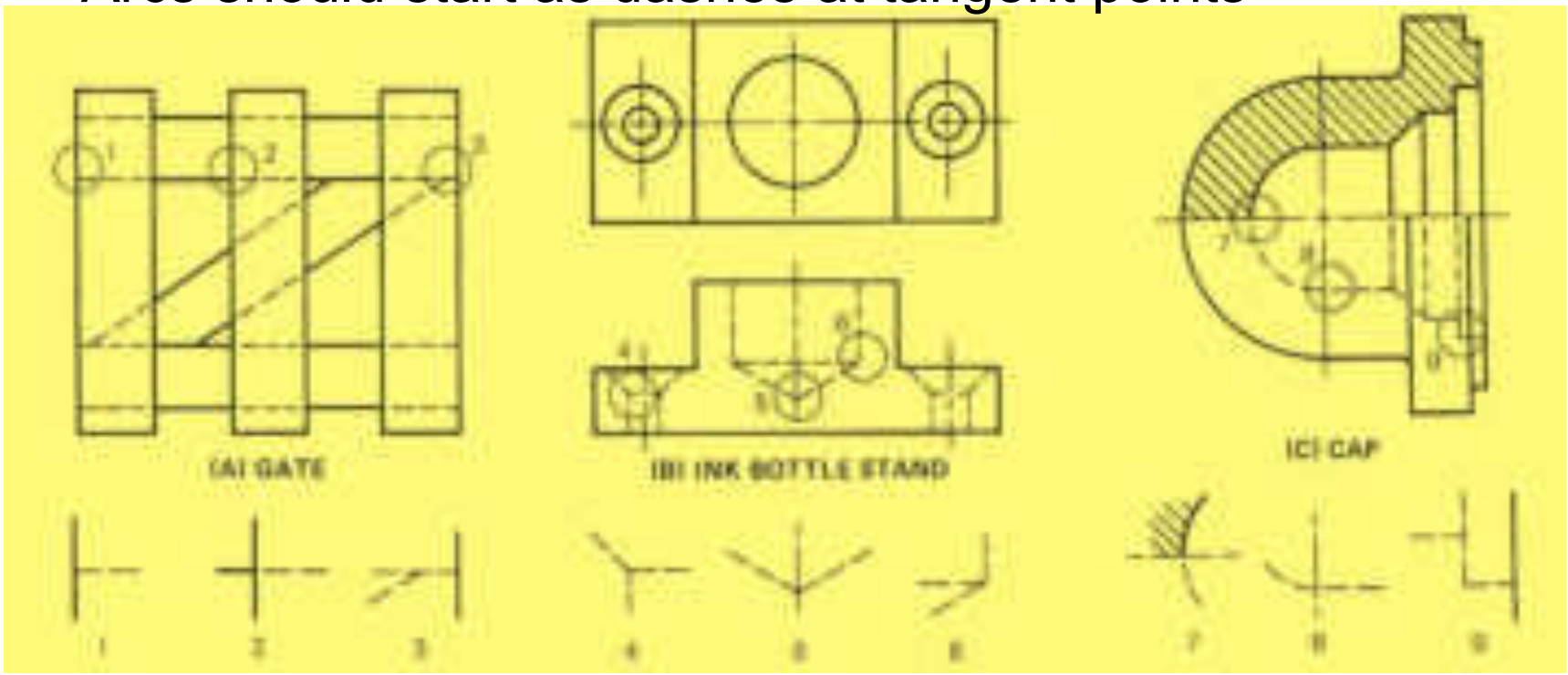
- Consist of short, evenly spaced dashes
- Represent edges that cannot be seen from outside
- Lines must begin and end with a dash except when it will be seen as an extension of a visible line



Hidden surfaces and edges

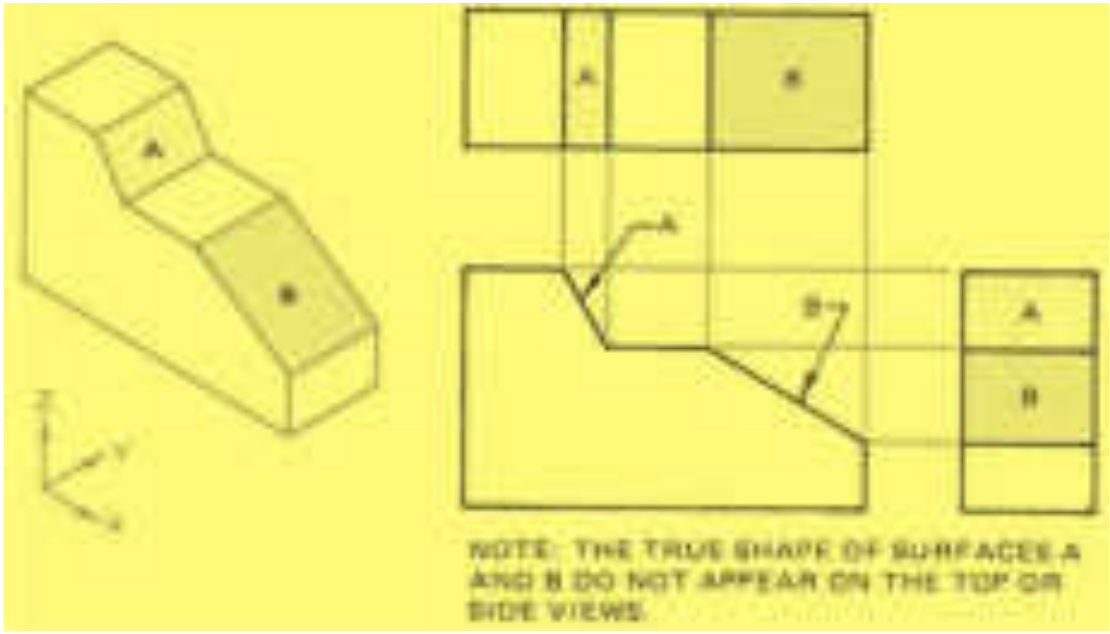
Application of hidden lines

- Lines must begin and end with a dash except when it will be seen as an extension of a visible line
- Dashes should join at corners
- Arcs should start as dashes at tangent points



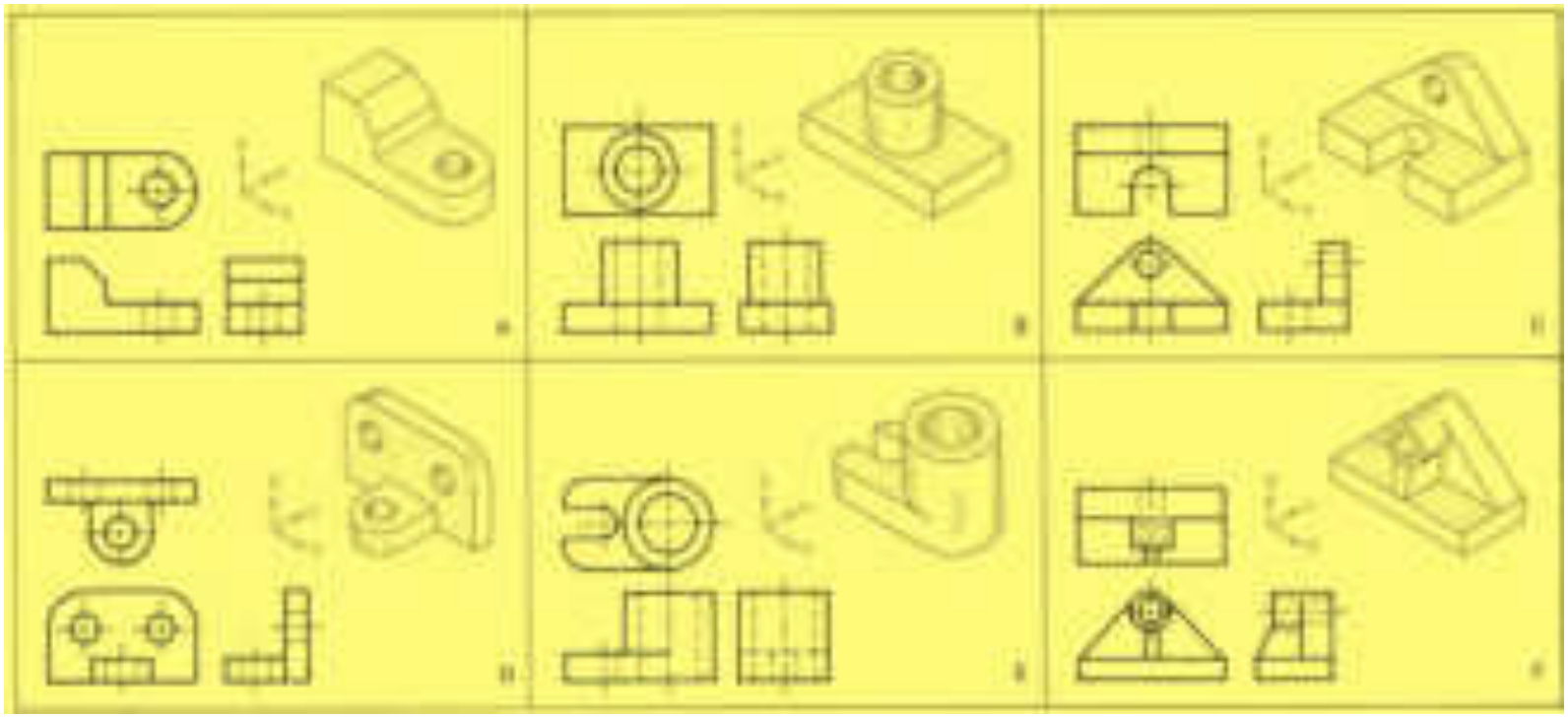
Inclined Surfaces

- Inclined surfaces that appear inclined in one plane and parallel to the other two principal reference planes
- It is seen as a distorted surface in two views and appear as line in one view
- A & B appear as shortened in TV & RSV, but the TL of the surface is seen as Lines in FV
- True shape ?



Circular Features

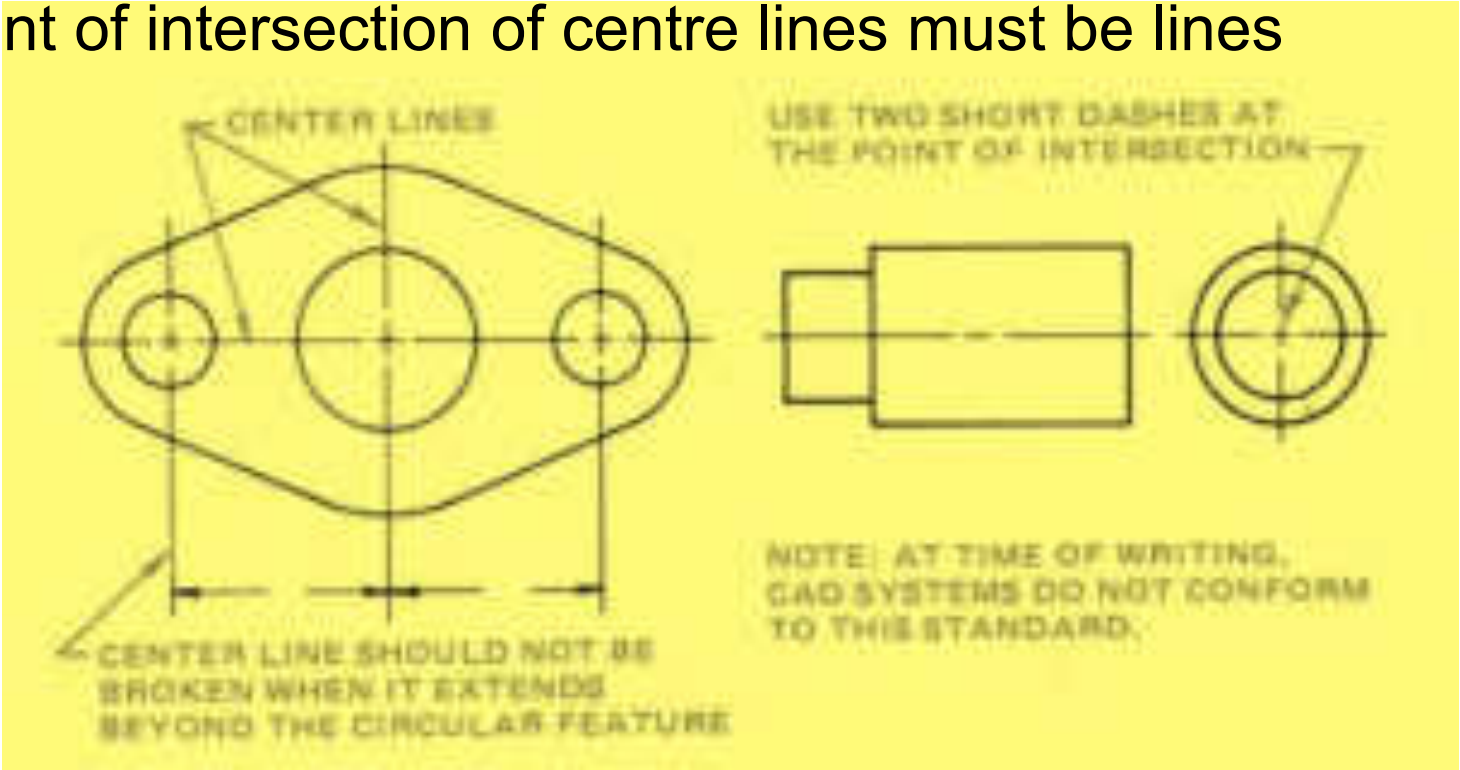
- Appear circular in only one view
- No line shown, when curved surface joins flat surface
- Hidden circles, shown as hidden lines
- Use of centre lines



Circular Features

Center line applications

- Thin broken line (alternative long and short dashes)
- To locate centre of circles or cylinders
- Lines should project beyond the outline of the referred part
- Point of intersection of centre lines must be lines



Oblique Surfaces

- Oblique surfaces that appear inclined in all three reference planes
- Not perpendicular to any principal plane
- Appear as surface in all 3 views but never in true shape
- How many Auxiliary Views are required to find the TS of oblique surface?

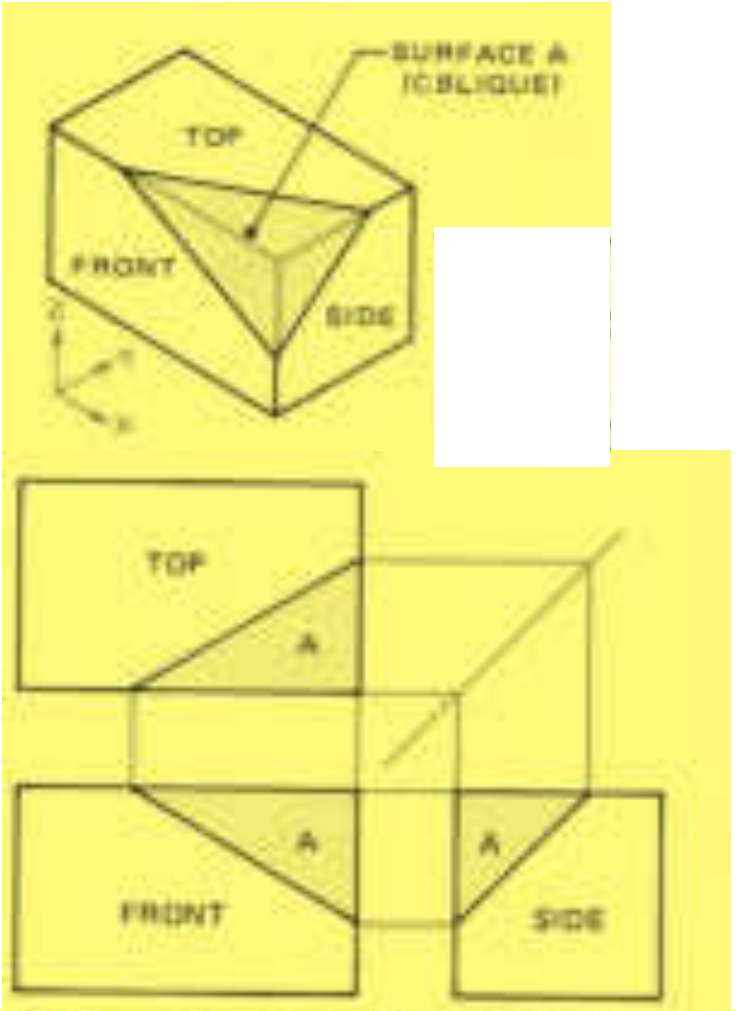


Fig. 5-7-1 Oblique surface is not its true shape in any of the three views.

One and two view drawings

View selection

- Best describe the object to be shown
- Minimum number of views to describe object
- for simple parts, one or two views often enough
- Avoid views with more hidden lines

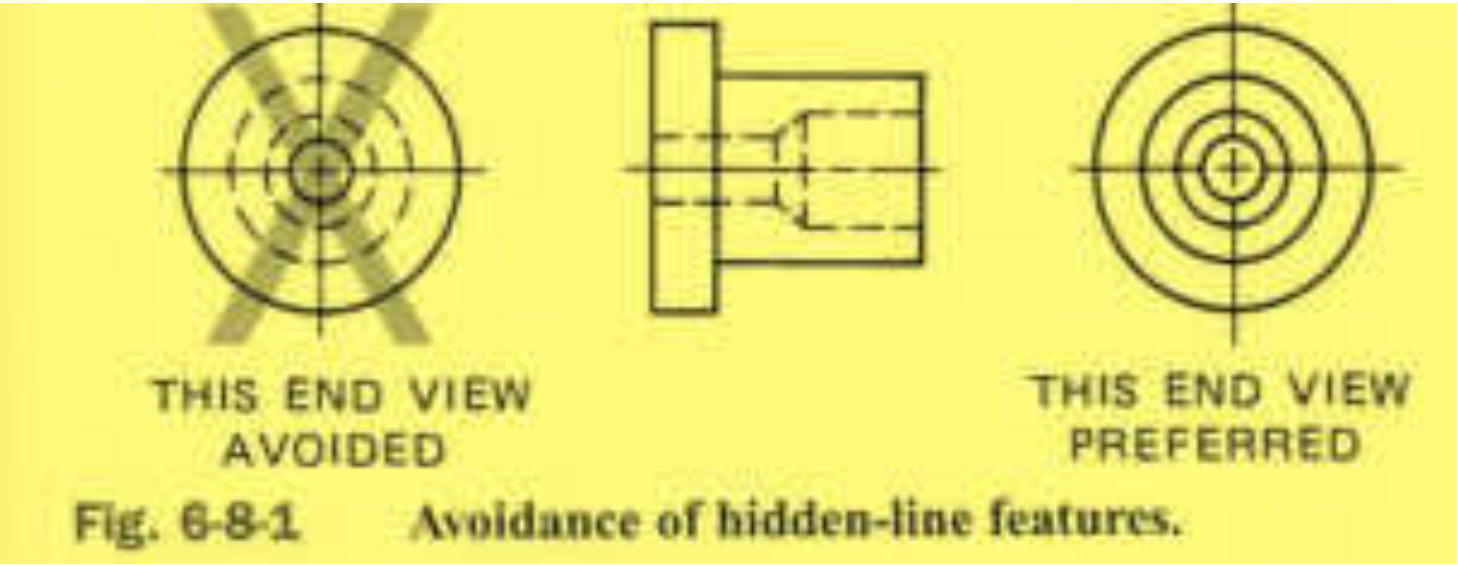
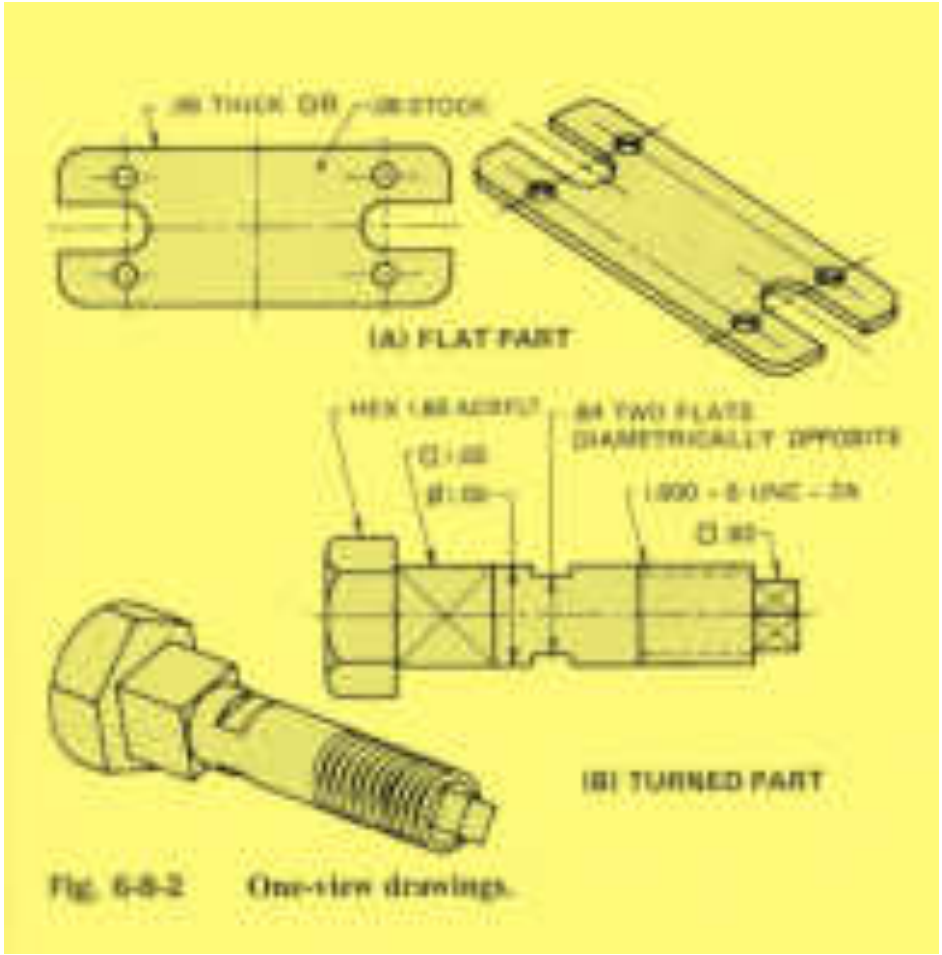


Fig. 6-8-1 Avoidance of hidden-line features.

One and two view drawings

One View drawing

- Third dim (thickness) expressed as note or symbols
- Abbreviations such as HEX ACRFLT, DIA, or ϕ
- Square sections can be indicated by crossed lines on diagonal
- Used even when the surface is parallel or inclined to the drawing plane



One and two view drawings

Two View drawing

- When cylindrical features have keyway, end view is required to shown them
- Usually drafters use two views only to define a part
- For cylindrical surfaces, if three views are drawn, any 2 of them will be identical

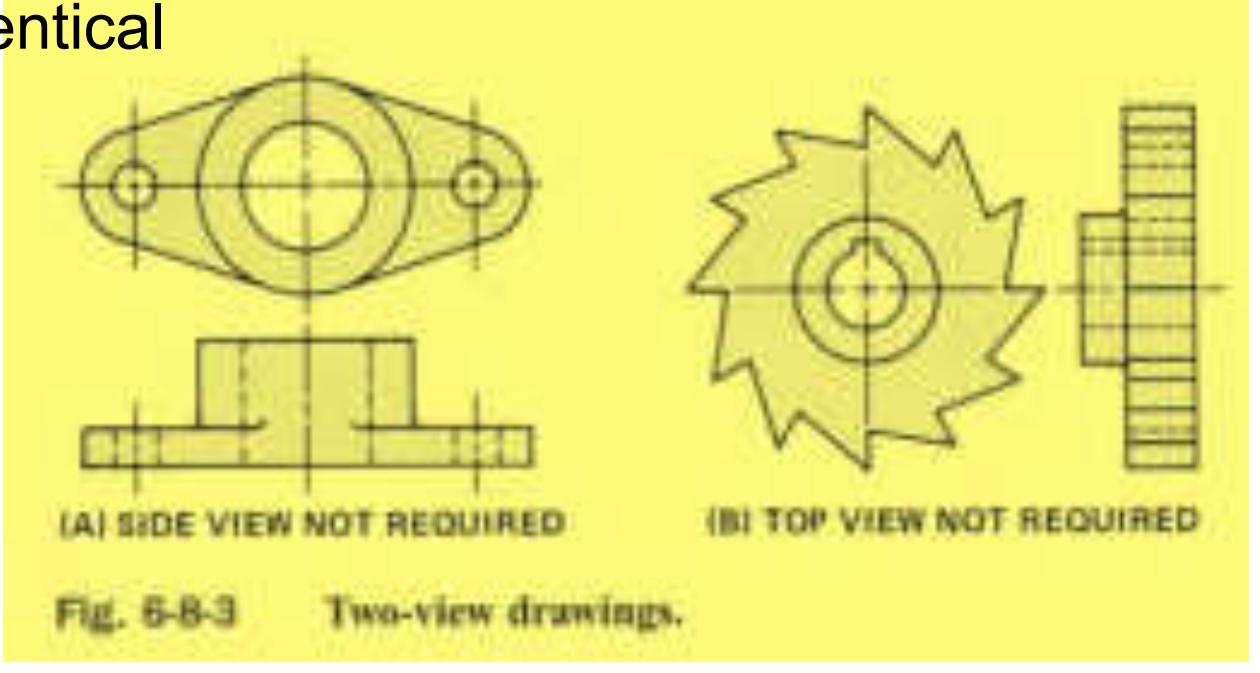


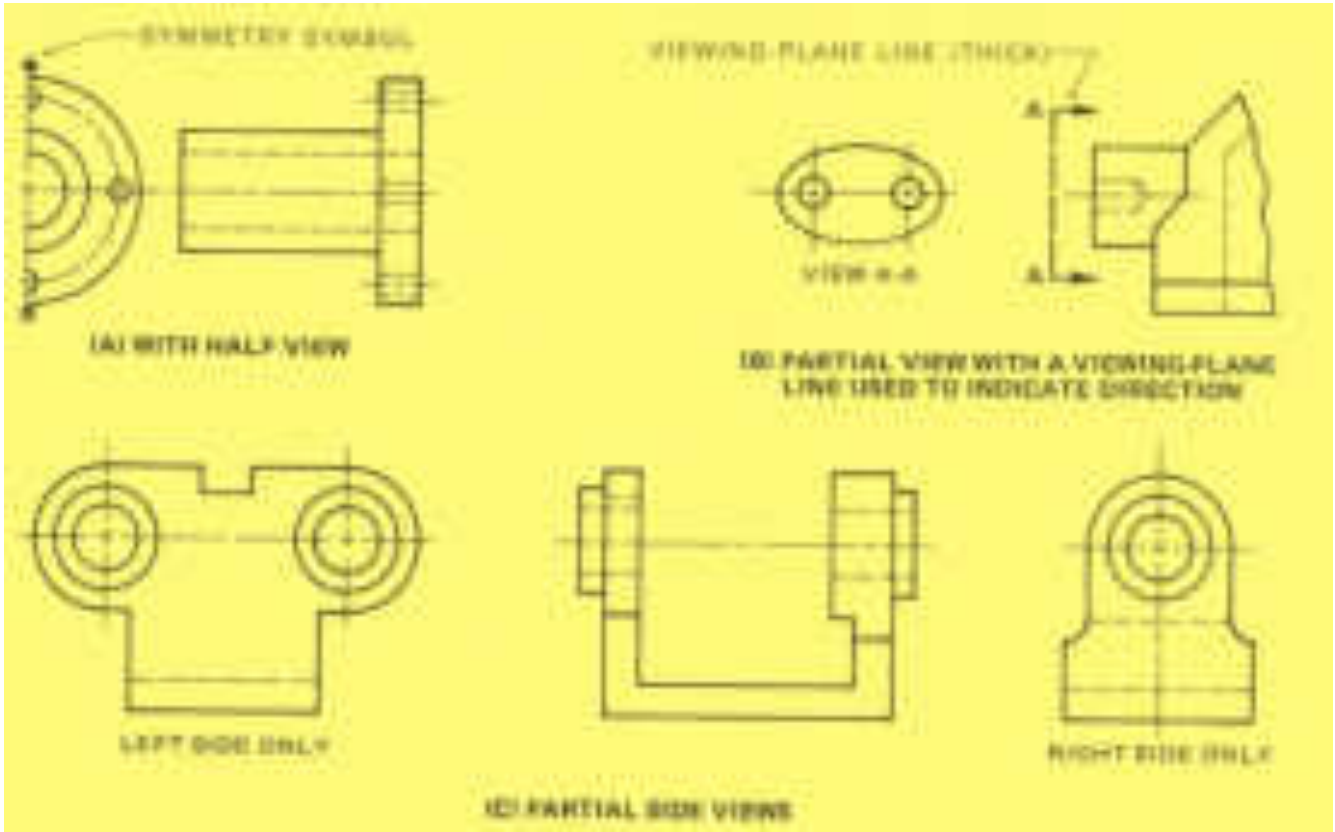
Fig. 6-8-3 Two-view drawings.

Special views

Partial views

- A symmetrical object can usually be adequately shown using a half view and symmetry symbol

- For complex shapes, side views sometimes maybe sometimes partial



Special views

Enlarged views

- Required to show particular feature with greater details, in a complex drawing
- Oriented in the same manner as in view
- If rotated, must show details of angle, direction etc..

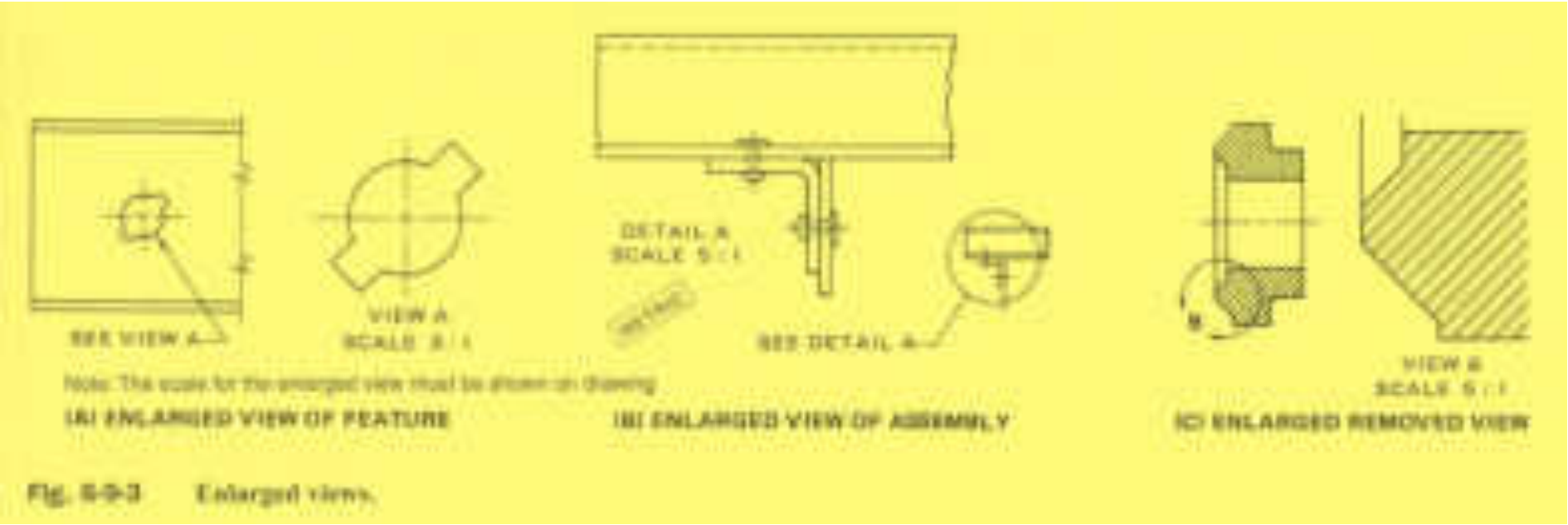


Fig. 6-93 Enlarged views.

Conventional representation

- Simplify representation of common features
- Mainly for improving clarity and reducing drafting time
- Clarity, more important than speed

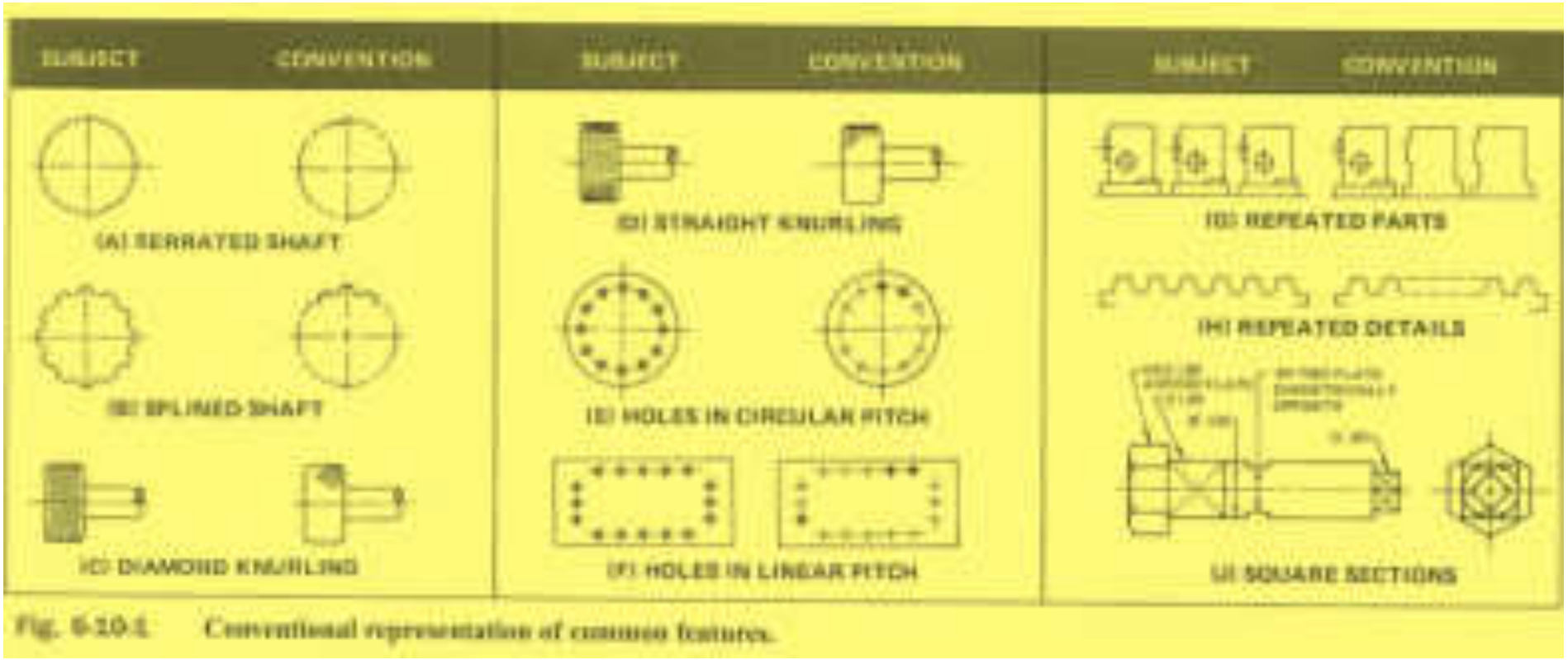
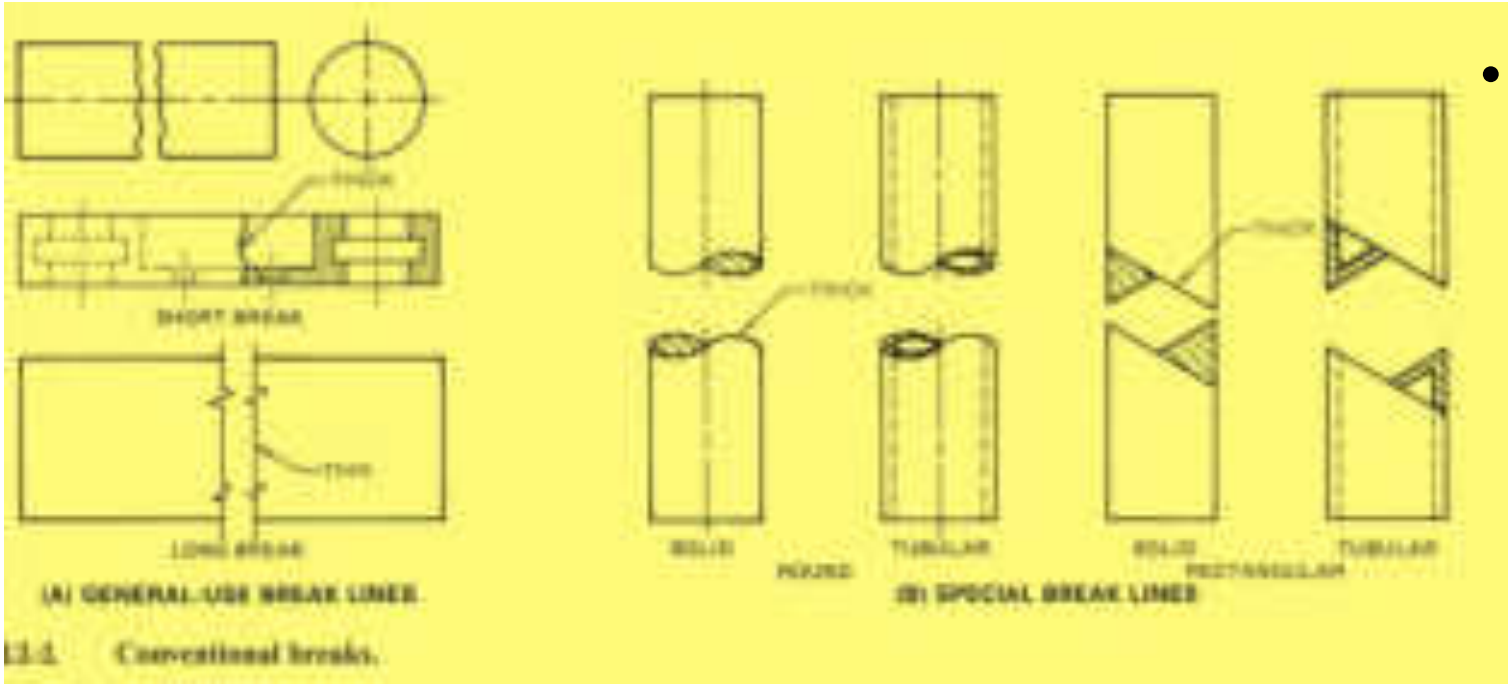


Fig. 6.10.1 Conventional representation of common features.

Conventional breaks

- Long simple parts (shafts, pipes etc) can be shown using conventional breaks
- True length must be shown in dimension
- Short breaks are free hand thick lines, while long breaks are thin line with some zig zags



- Special break lines are used to show the shape of features

Materials of construction

- Symbols are used in sectional views to indicate materials
- Symbols for concrete, wood, and transparent materials may be used for outside views

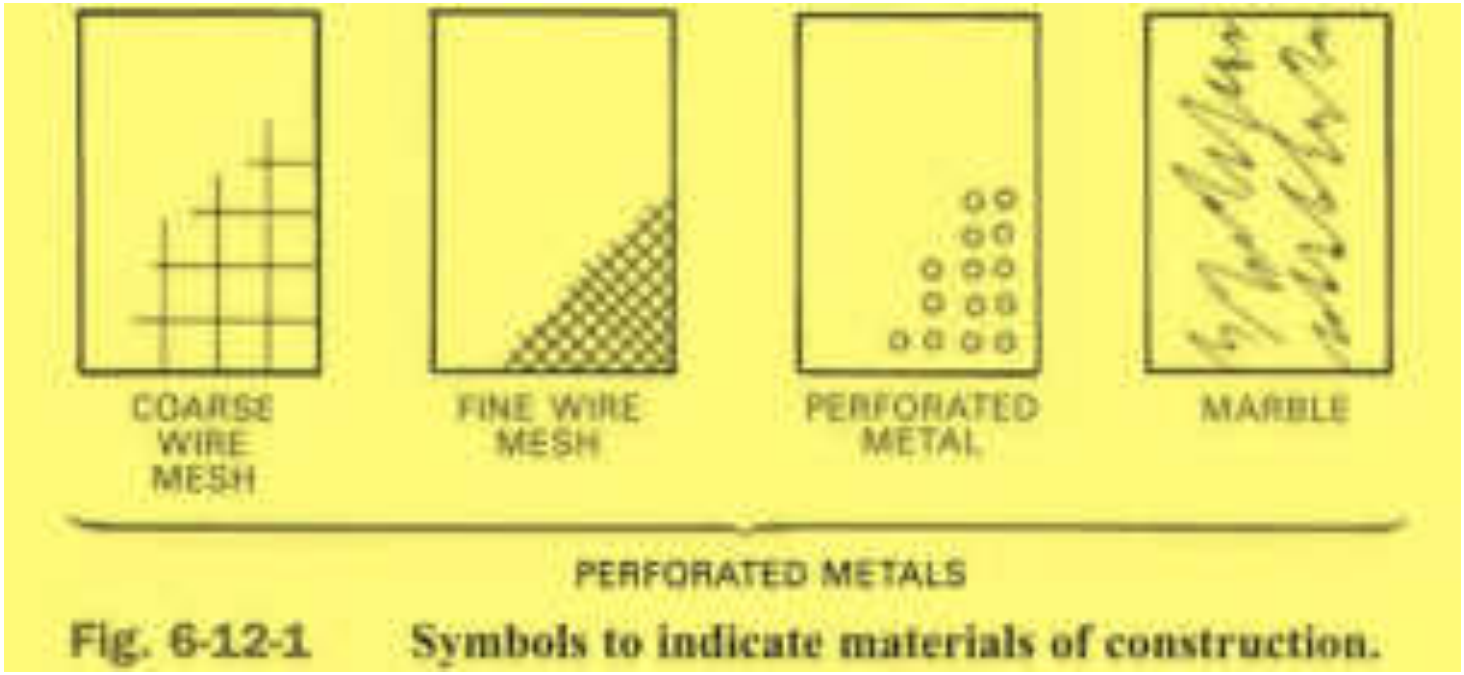


Fig. 6-12-1 Symbols to indicate materials of construction.

Cylindrical intersections

- Conventional representation for intersecting rectangular and circular contours
- Intersecting rectangular and circular contours shown conventionally, unless large
- Same convention can be used for two cylindrical intersections

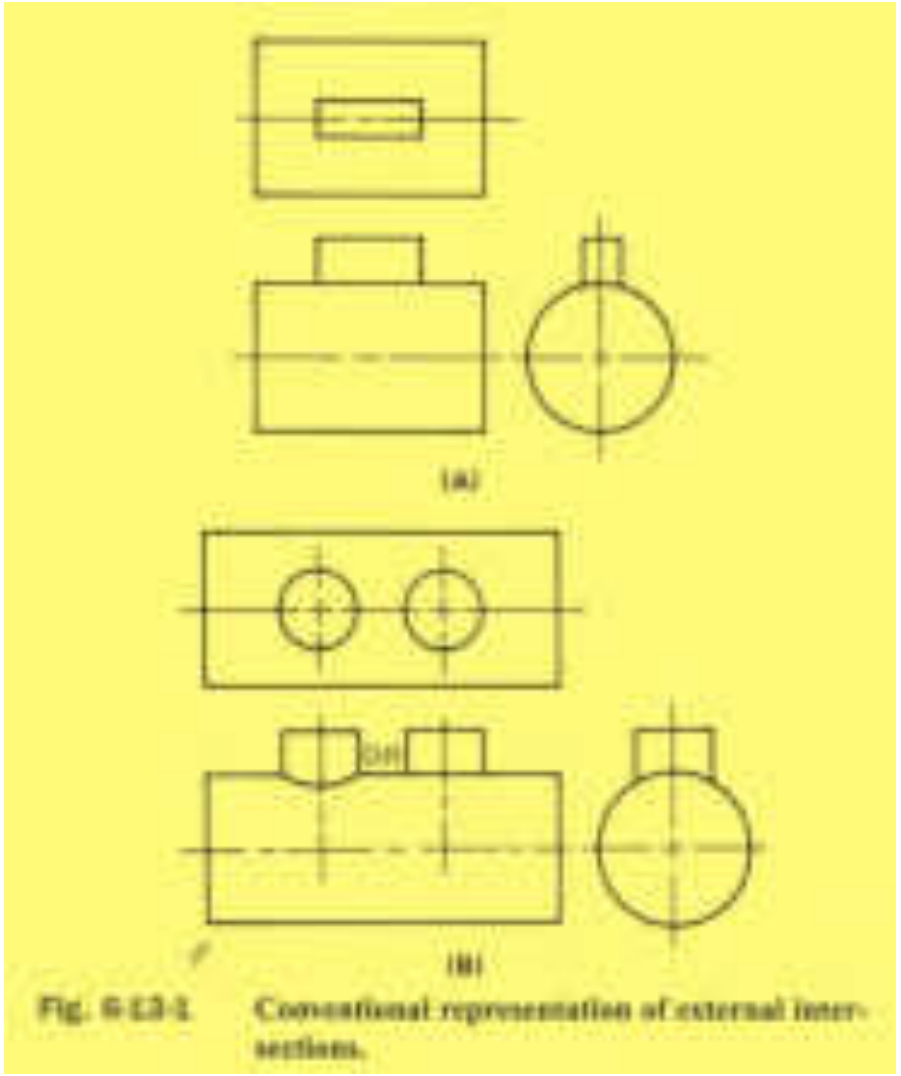


Fig. 6·13·1 Conventional representation of external intersections.

Foreshortened projection

- When true projection of feature would result in confusing foreshortening, it should be rotated until it is parallel to the line of projection
- Drilled holes also need to be rotated rather than showing true distance

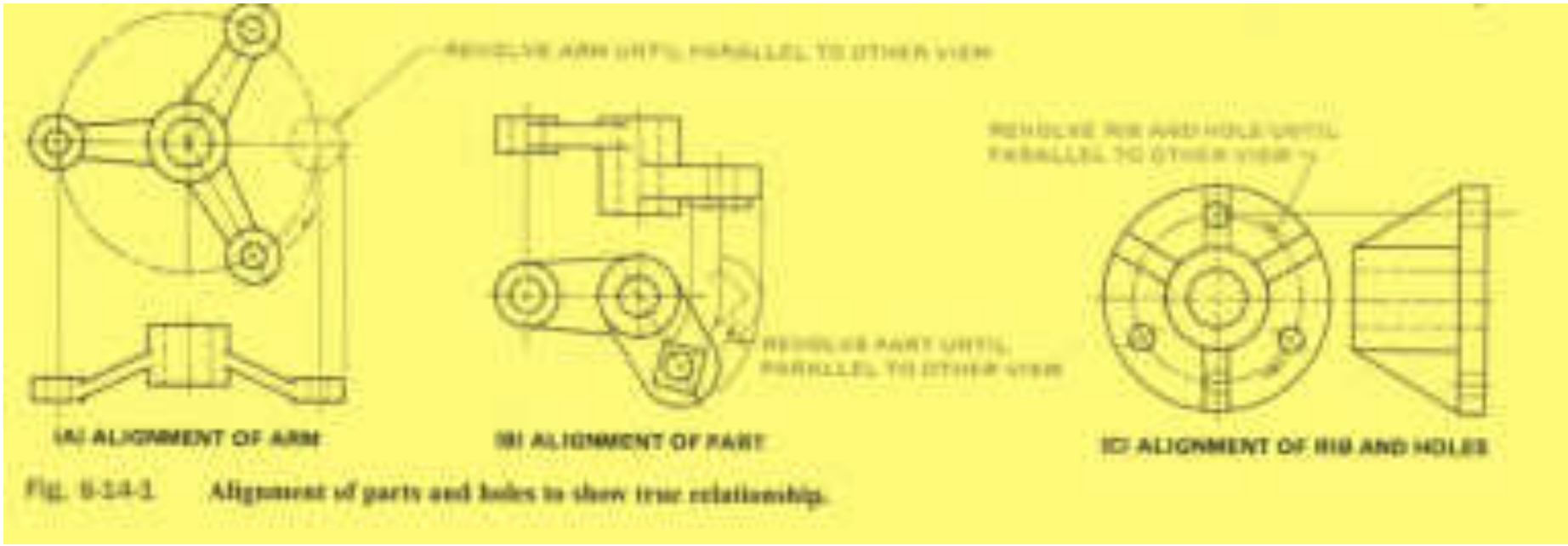
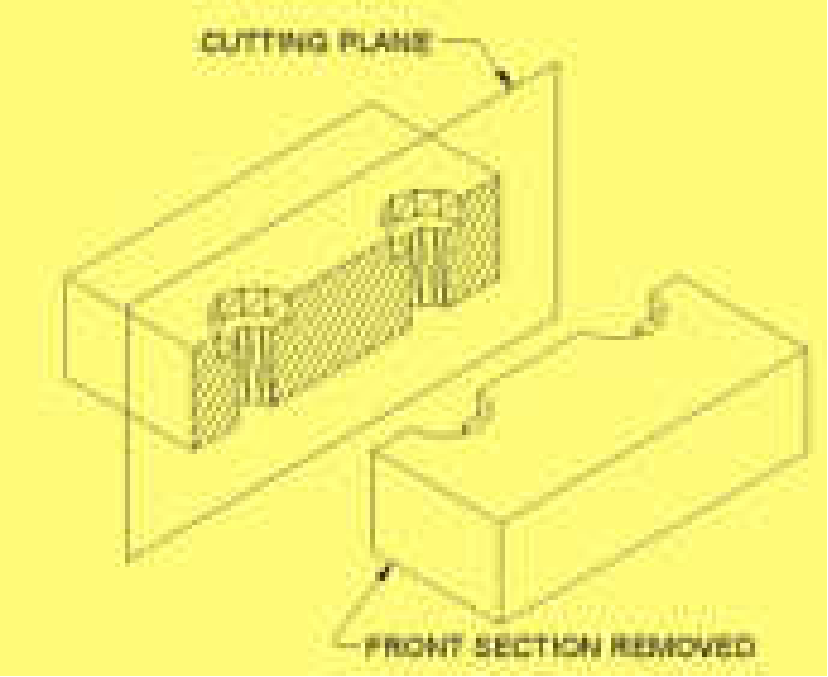


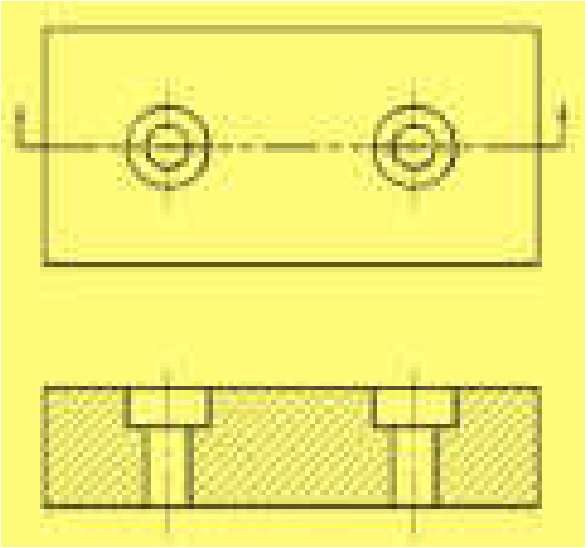
Fig. 9-14-1 Alignment of parts and holes to show true relationship.

Sectional Views

- Shows interior detail
- Describes complicated parts
- Eliminates the need for hidden lines
- Frequently replaces a regular view



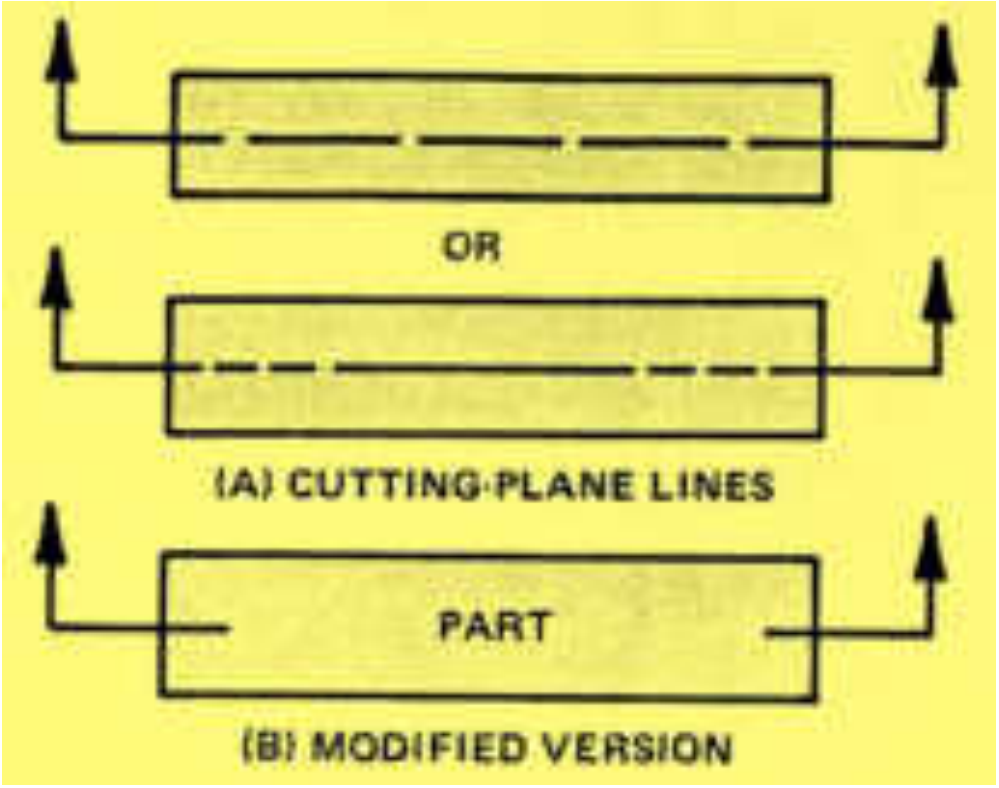
FULL SECTION



Sectional Views

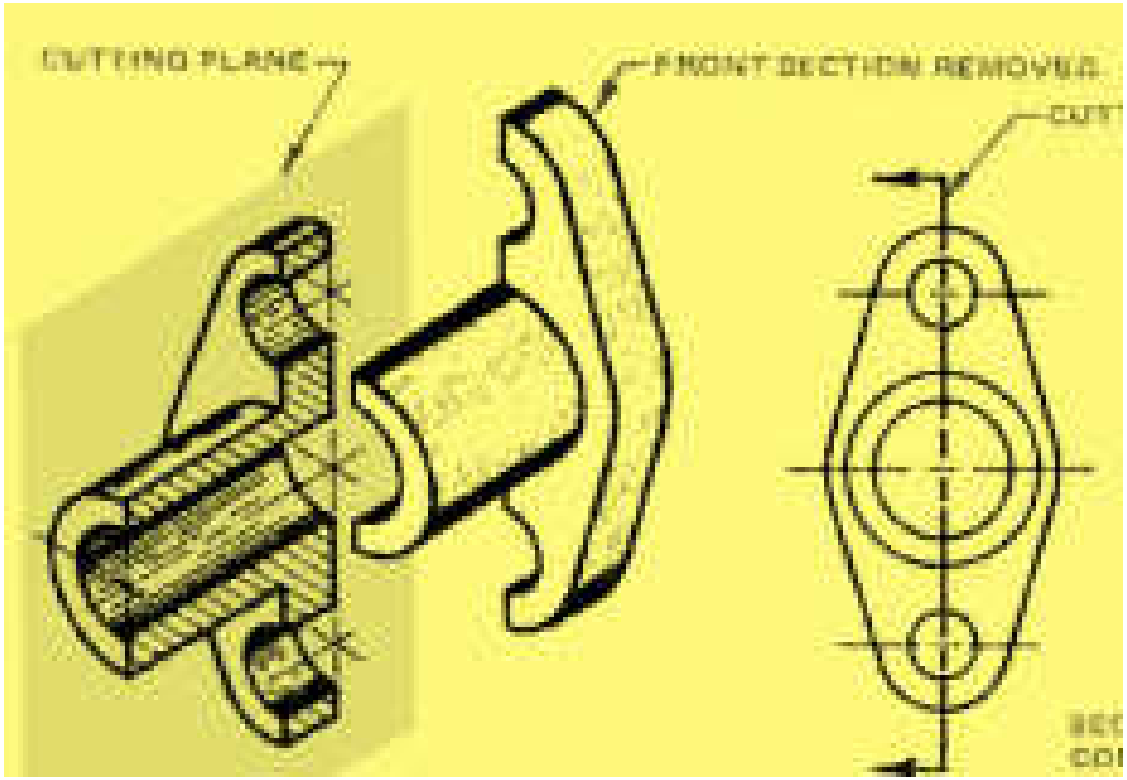
Cutting plane lines

- Shows the location of the cutting plane
- Has arrowheads to show the direction of sight



Sectional Views

Full Section

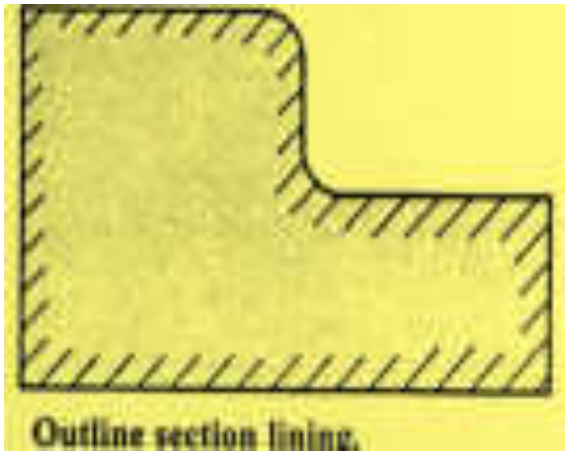


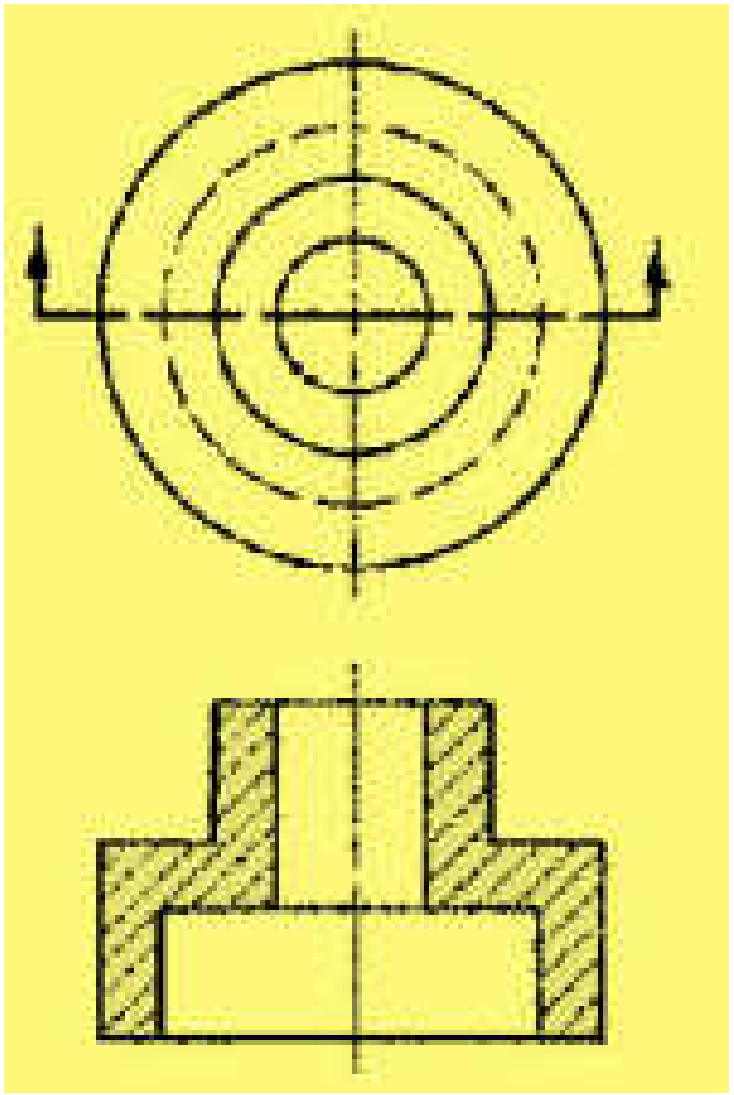
- A section view in which the cutting plane extends entirely through the object in a straight line

Sectional Views

Sectional lining

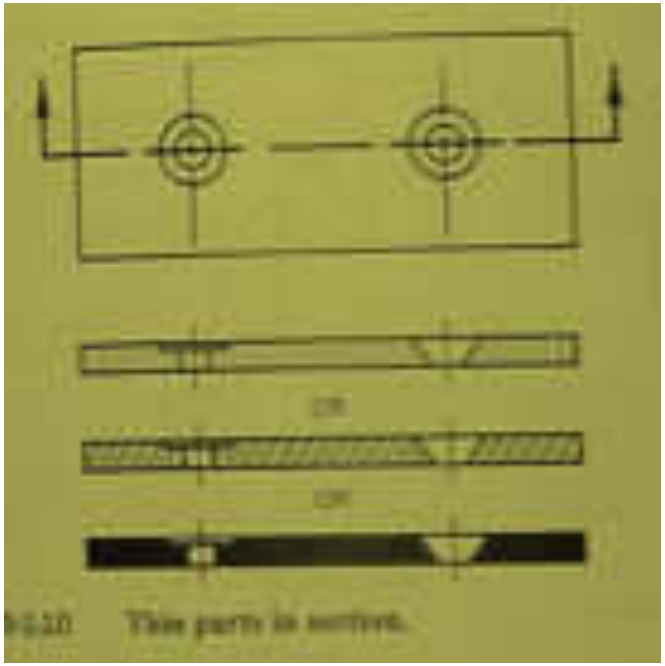
- Also called crosshatching
- Indicates surface that has been theoretically cut
- Lining symbols may indicate the material that makes up the object





Sectional Views

General Purpose Sectional lining

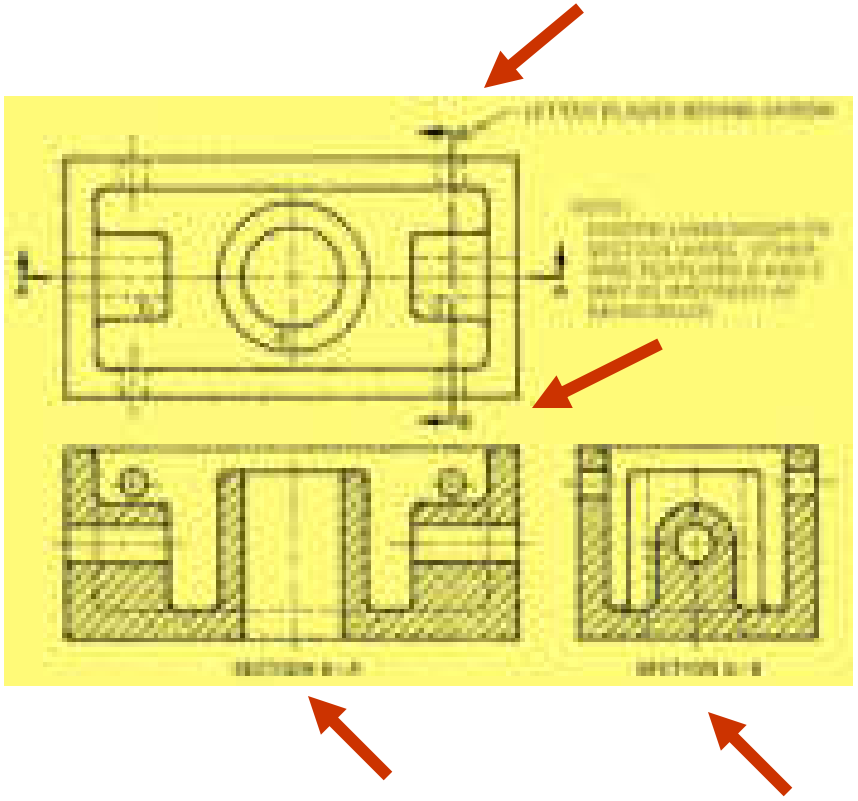


- To look for
  - Direction of section lines
  - Space for accommodating dimensions
  - Thin parts shown as thick lines

- Drawn with thin lines
- Lines are usually drawn at 45° to the object's main outline
- The same angle and direction is used for the whole "cut" surface of a part
- Large areas can be marked with section lining only around the outline

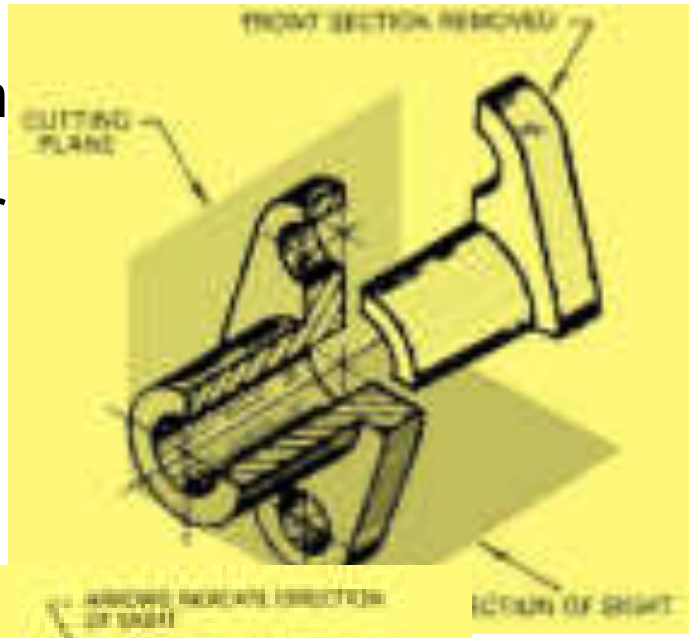
Two or more Sectional Views

- If two or more sections appear on the same drawing:
- Cutting-plane lines are identified by two identical capital letters
- Sectional view subtitles incorporate the identification letters.



Half Sections

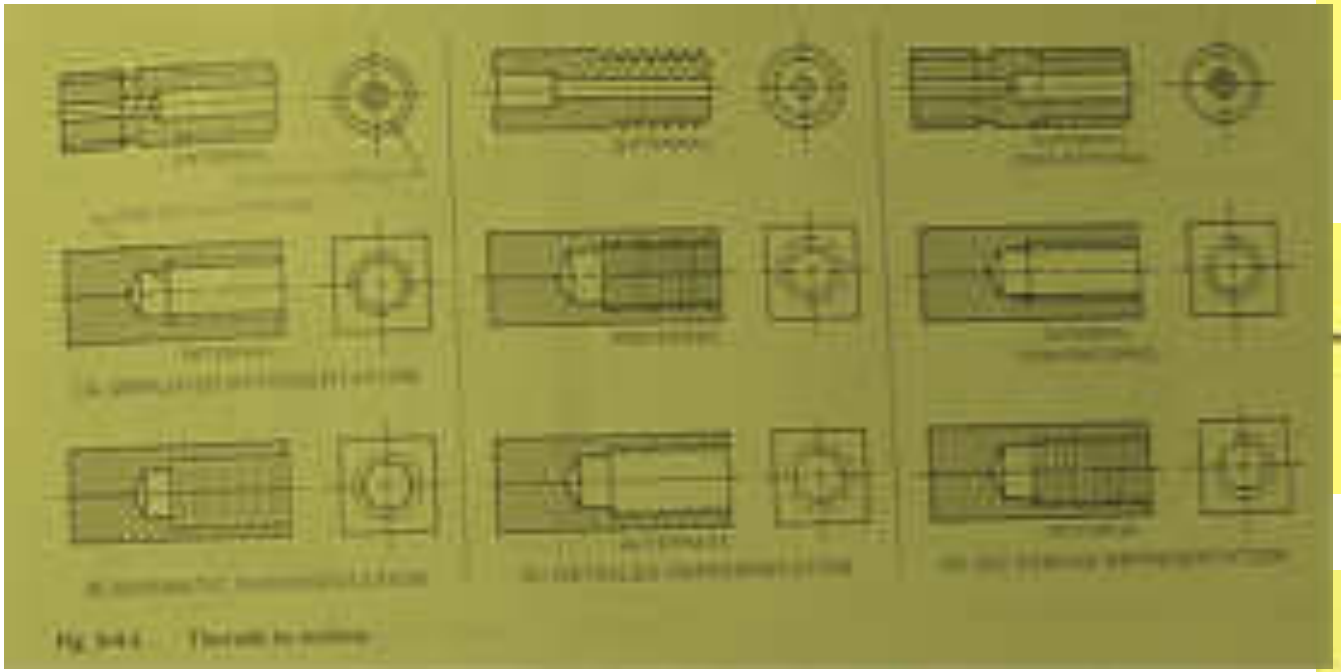
- Shows one-half of the view in section
- Has two cutting planes perpendicular to each other
- One quarter of the object is removed

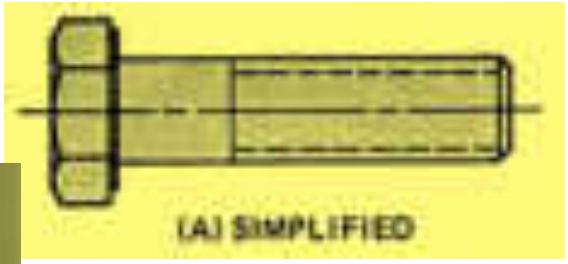


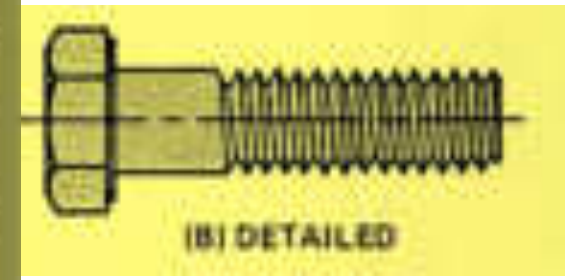
Threads in Sections

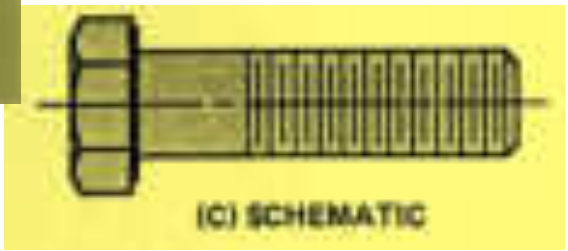
Representation of threads in drawing

- Detailed, Schematic, Simplified





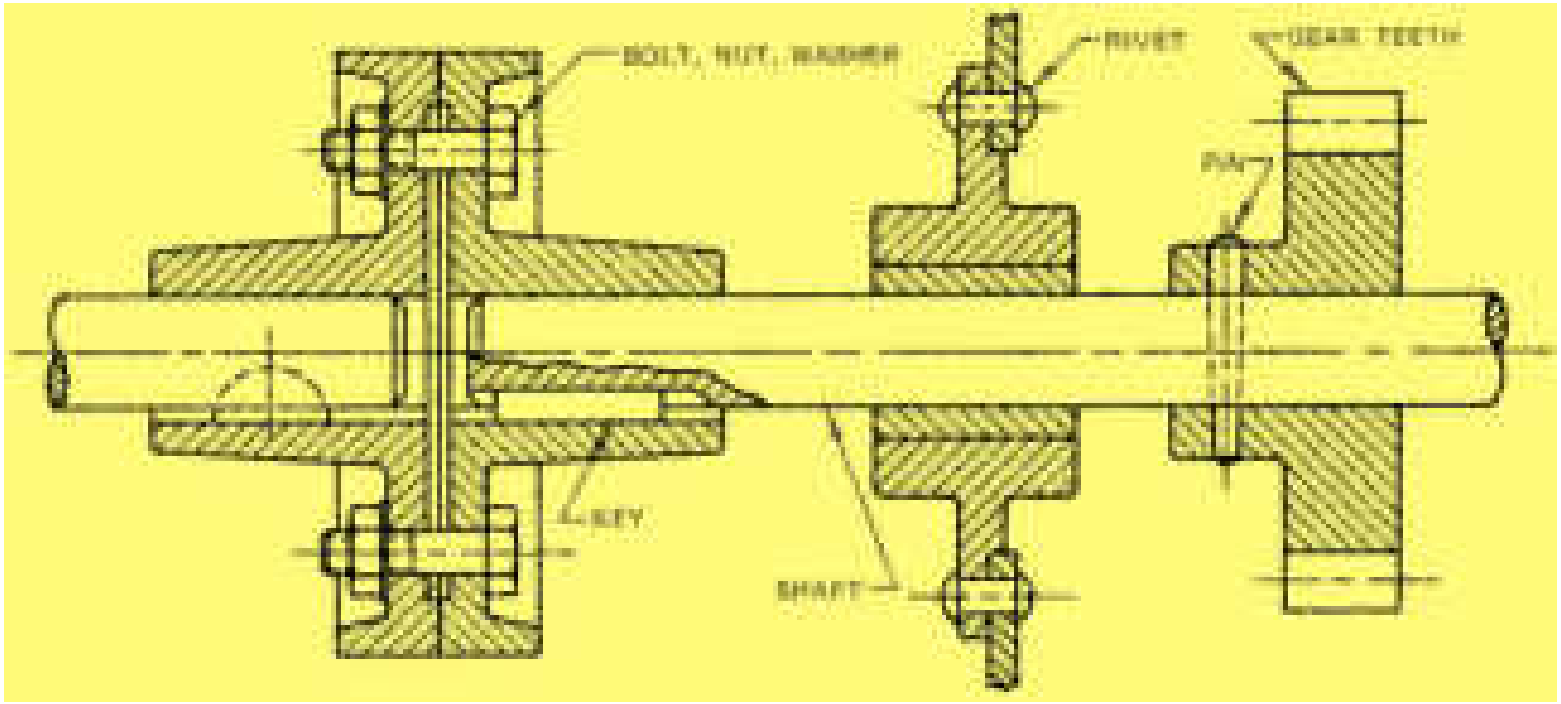




Assemblies in Sections

Sectioning in assembly drawings

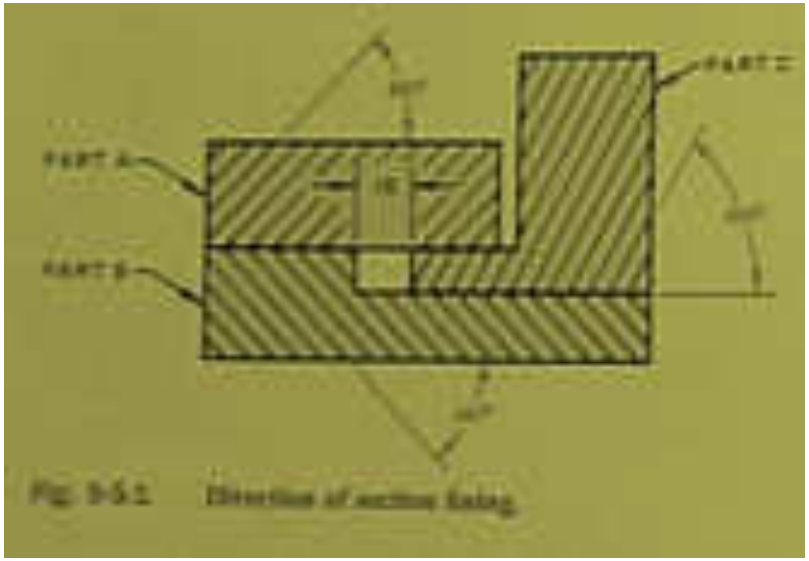
- Section lining on assembly drawings
- Shafts, Bolts, Pins, Keyseats

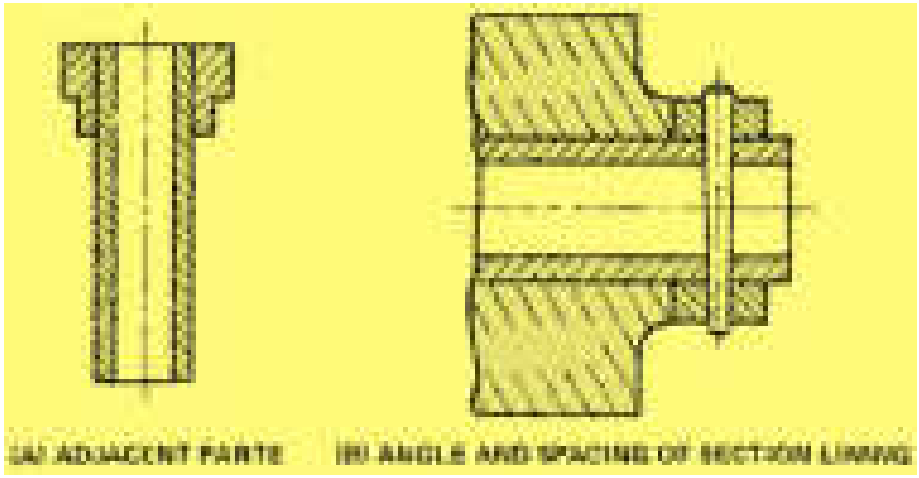


Assemblies in Sections

Section lining in assembly drawings

- Use opposite directions for section lining on adjacent parts
- For more than two parts, use lining at a different angle

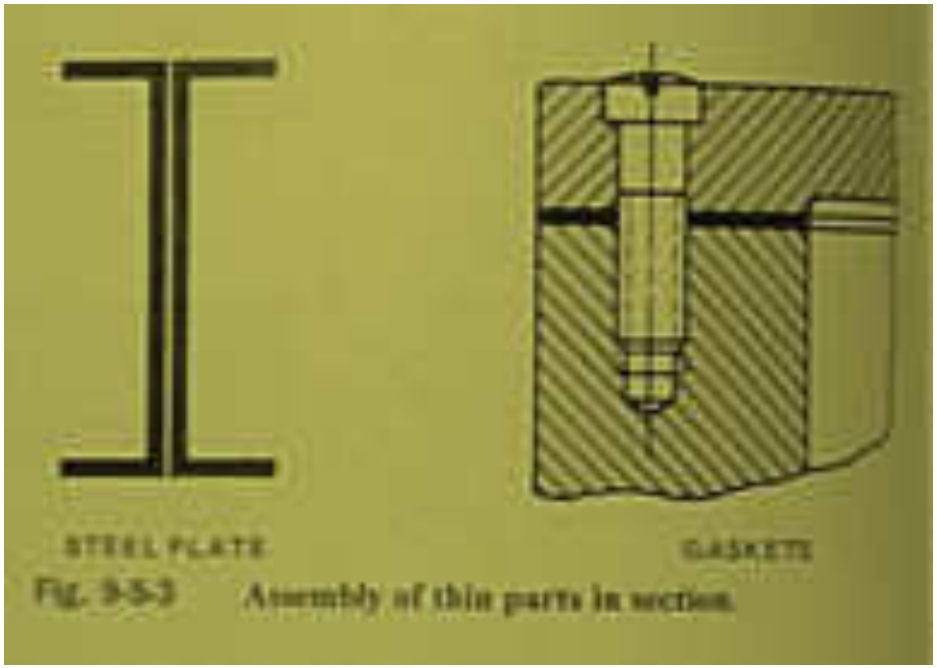




Assemblies in Sections

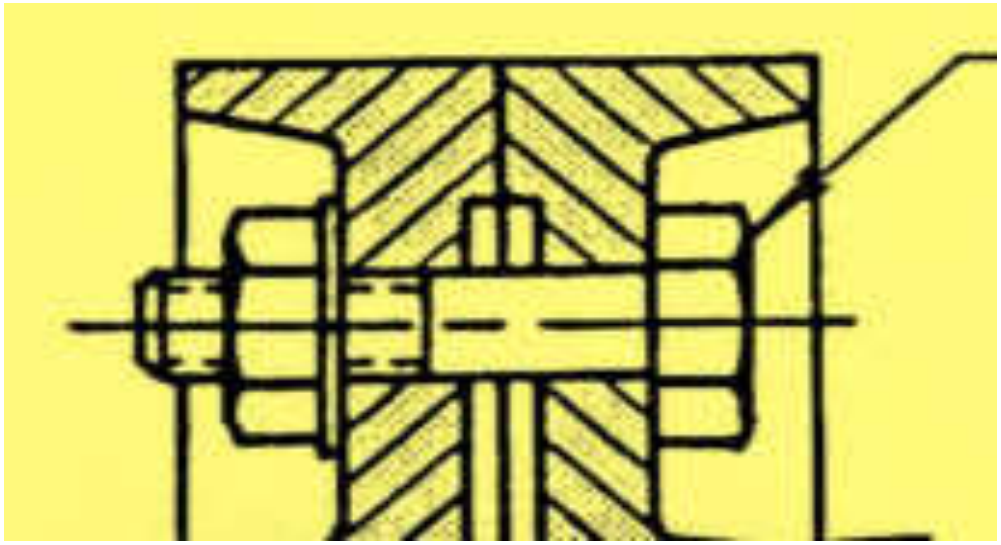
Section lining in assembly drawings

- Avoid symbolic section lining on drawings to be microformed
- If adjacent thin parts are filled in, leave space between them



Assemblies in Sections

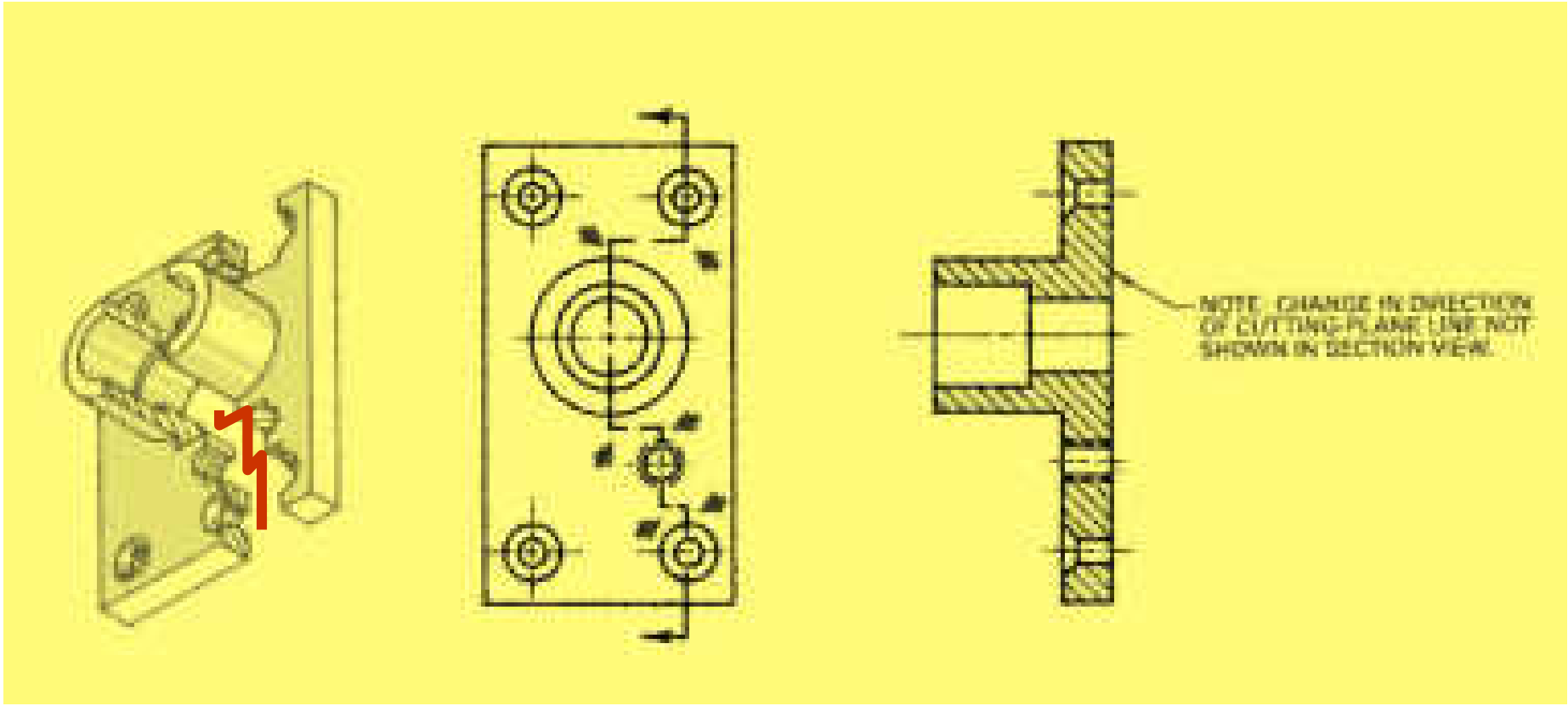
Parts generally not sectioned:



- Shafts
- Bolts
- Pins
- Keyseats
- Similar solid parts
  - A broken-out section of a shaft may be used to describe a key, keyseat, or pin.

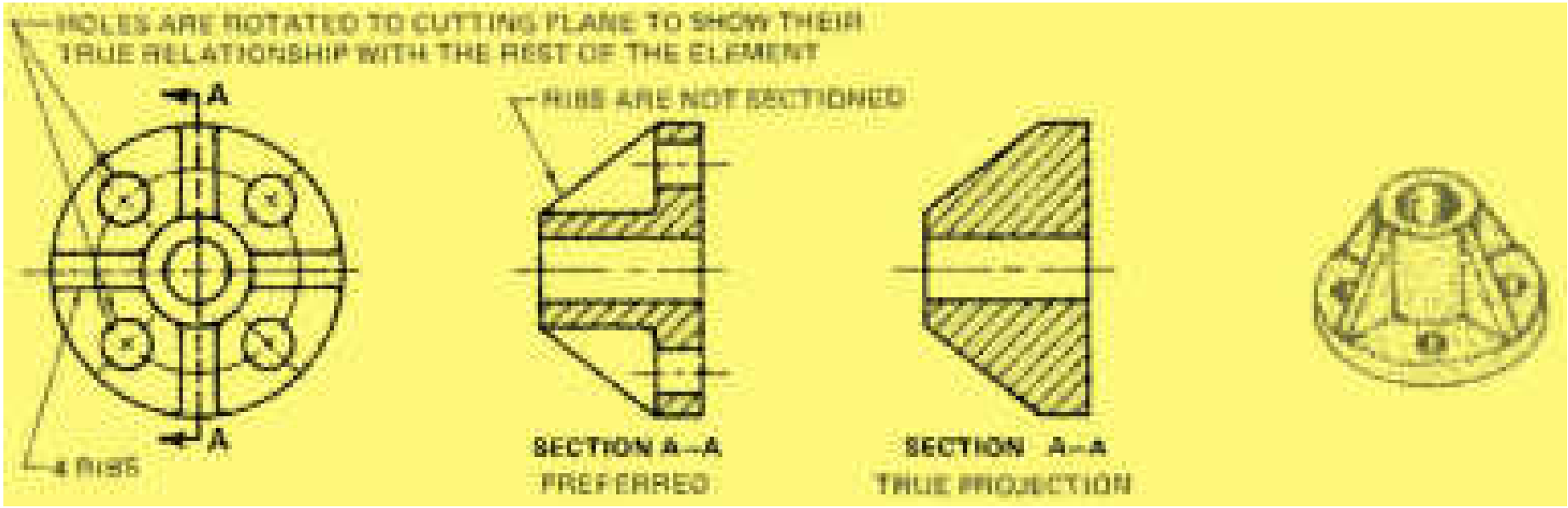
Offset Sections

- A cutting plane can be bent to include several surfaces



Ribs, Holes, and Lugs in Sections

Parts generally not sectioned:

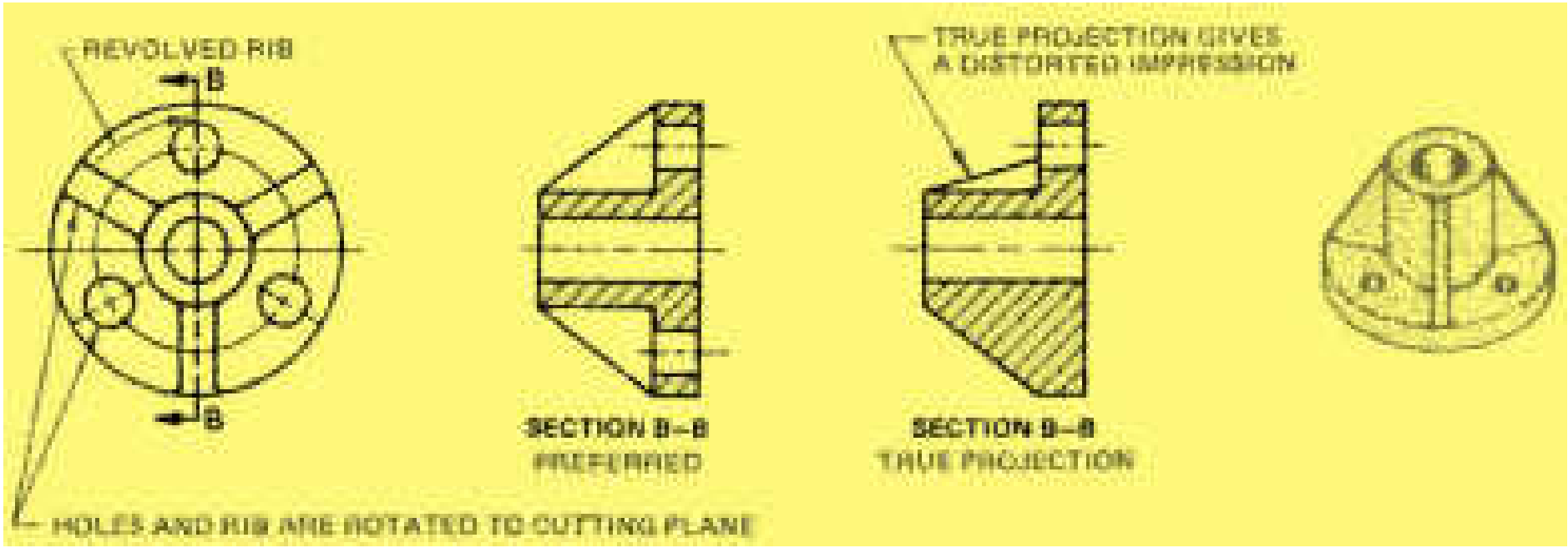


- Conventions for aligning ribs, holes and lugs in section

Ribs, Holes, and Lugs in Sections

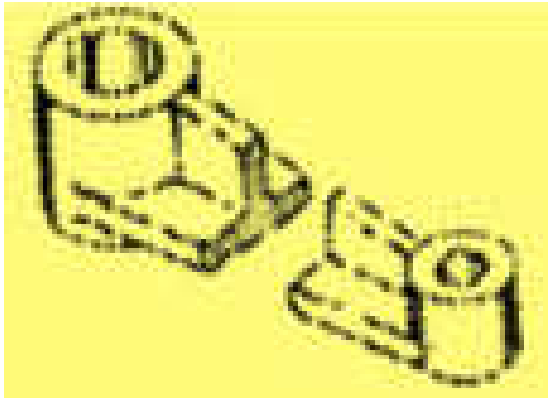
Aligning and rotating

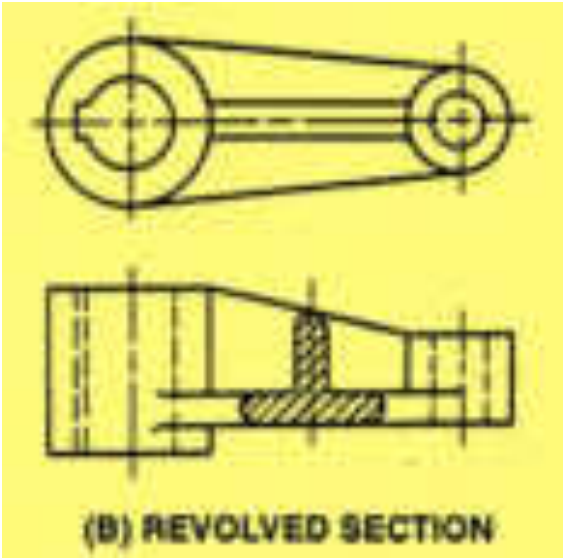
- When a true projection would be misleading, the rib, hole or lug is revolved to show its true relationship to the part

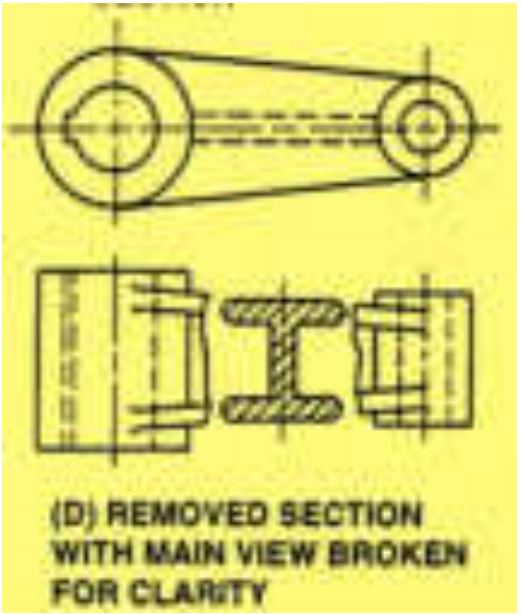


Revolved and removed Sections

- Ribs, spokes, and arms

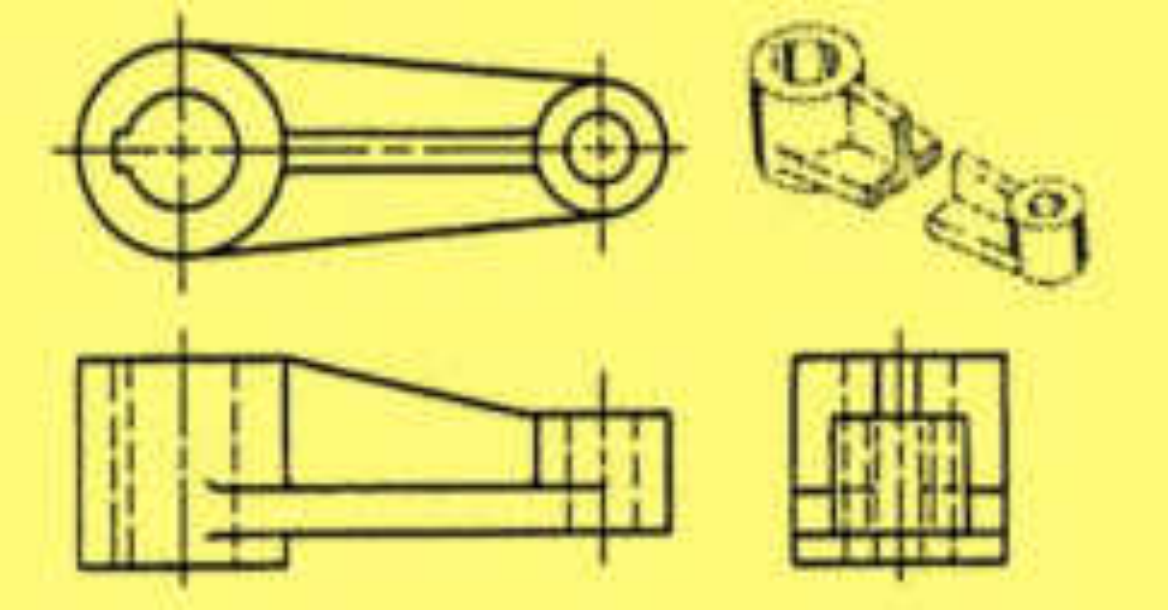






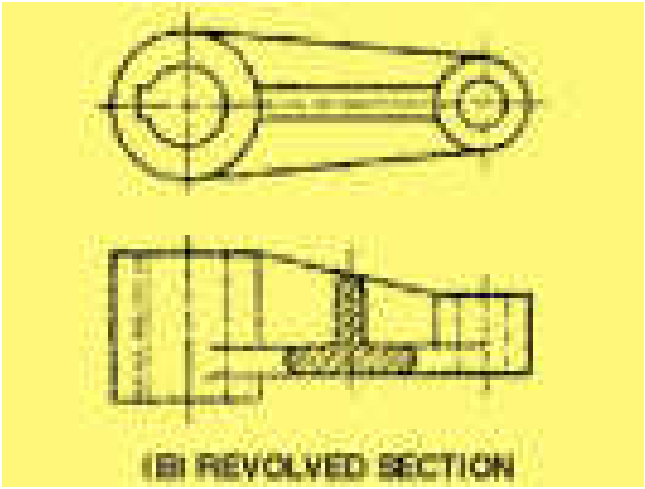
Revolved and removed Sections

- Show cross-sectional shape of ribs, spokes, or arms
  - Section is rotated 90 degrees

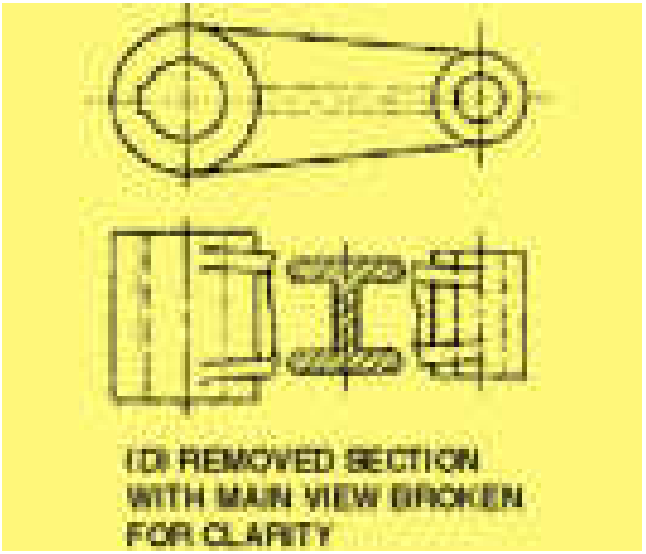


Revolved and removed Sections

- Revolved section:
  - Section may be superimposed on regular view of part
  - Regular view is broken if needed for clarity or to add dimensions

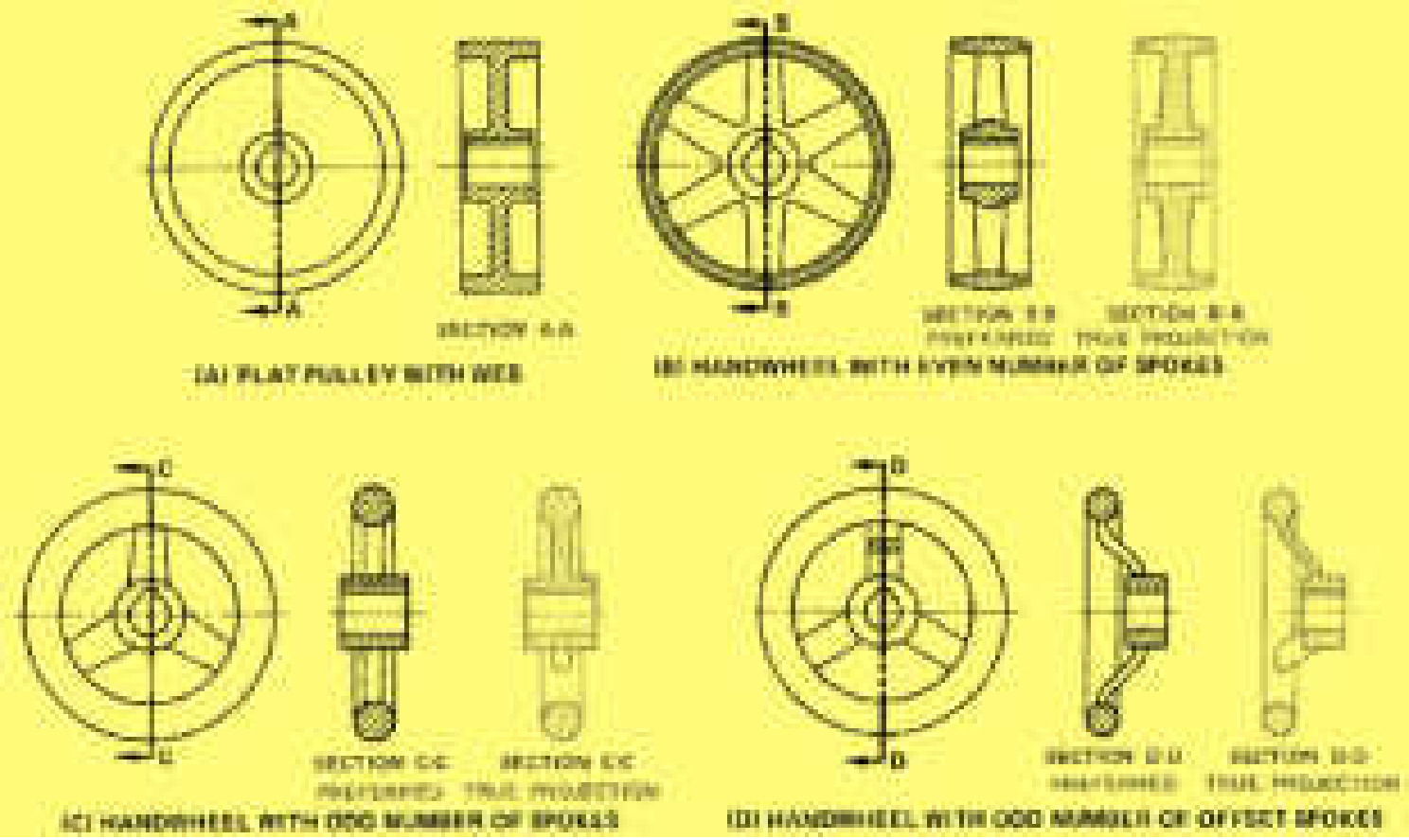


- Removed section:
  - Removed to an open area on drawing; may be enlarged



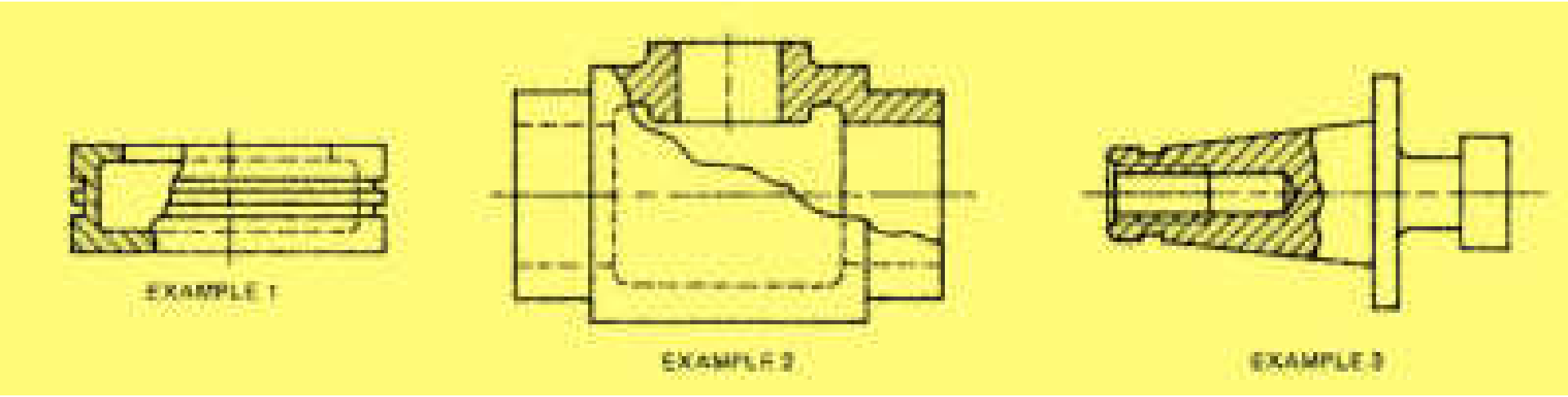
Spokes and arms in Sections

- Section lining is not drawn on parts that are
  - Not solid
  - Not continuous around the hub



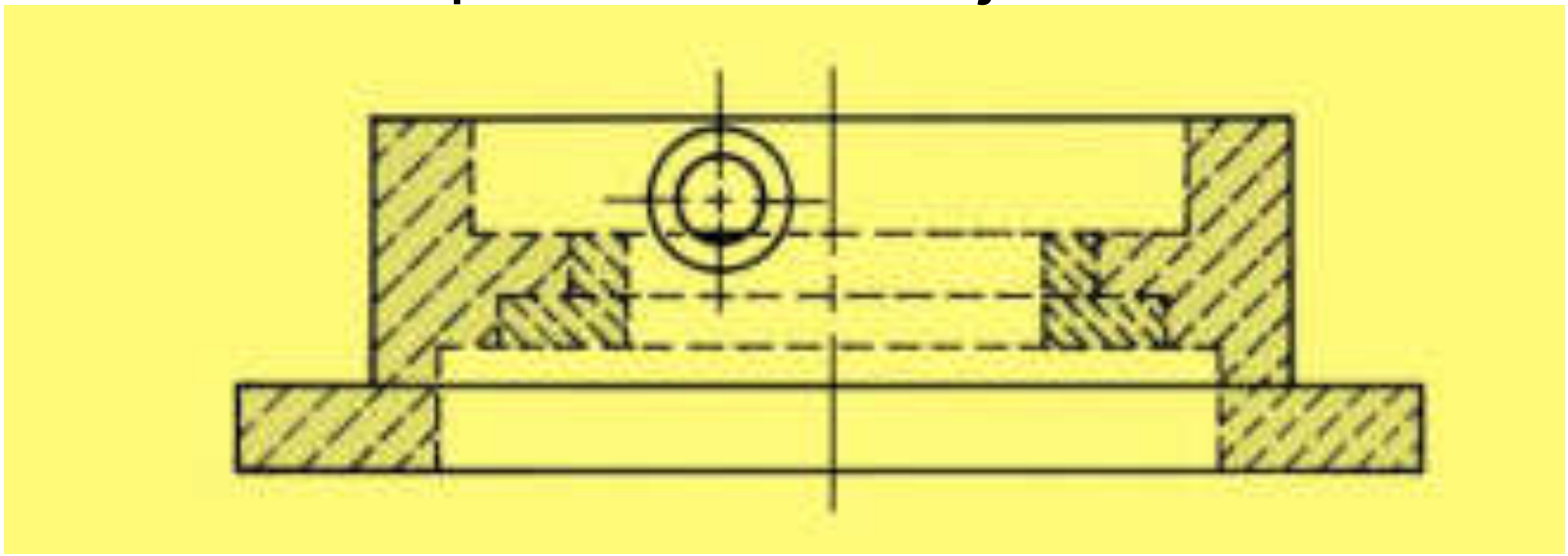
Partial or broken out Sections

- Partial sections are indicated with an irregular break line.
- A cutting-plane line is not required.



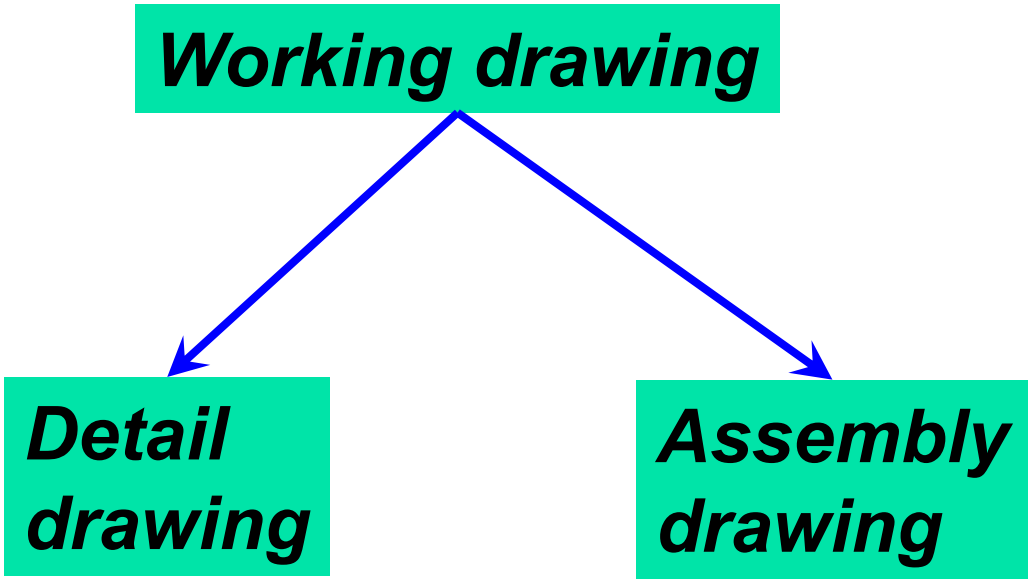
Phantom or Hidden Sections

- Used to show interior details of parts that are not symmetric, or mating parts in assembly
- A phantom section is a sectional view superimposed on a regular view
- The front portion of the object is not removed



DEFINITION

- ***Working drawing*** is a set of drawing used during the work of making a product.



DEFINITION

- ***Detail drawing*** is a ***multiview representation*** of a single part with ***dimensions and notes***.

- ***Assembly drawing*** is a drawing of various parts of a machine or structure assembled in their relative working positions.

PURPOSE

- ***Detail drawing*** conveys the ***information*** and ***instructions*** for manufacturing the part.

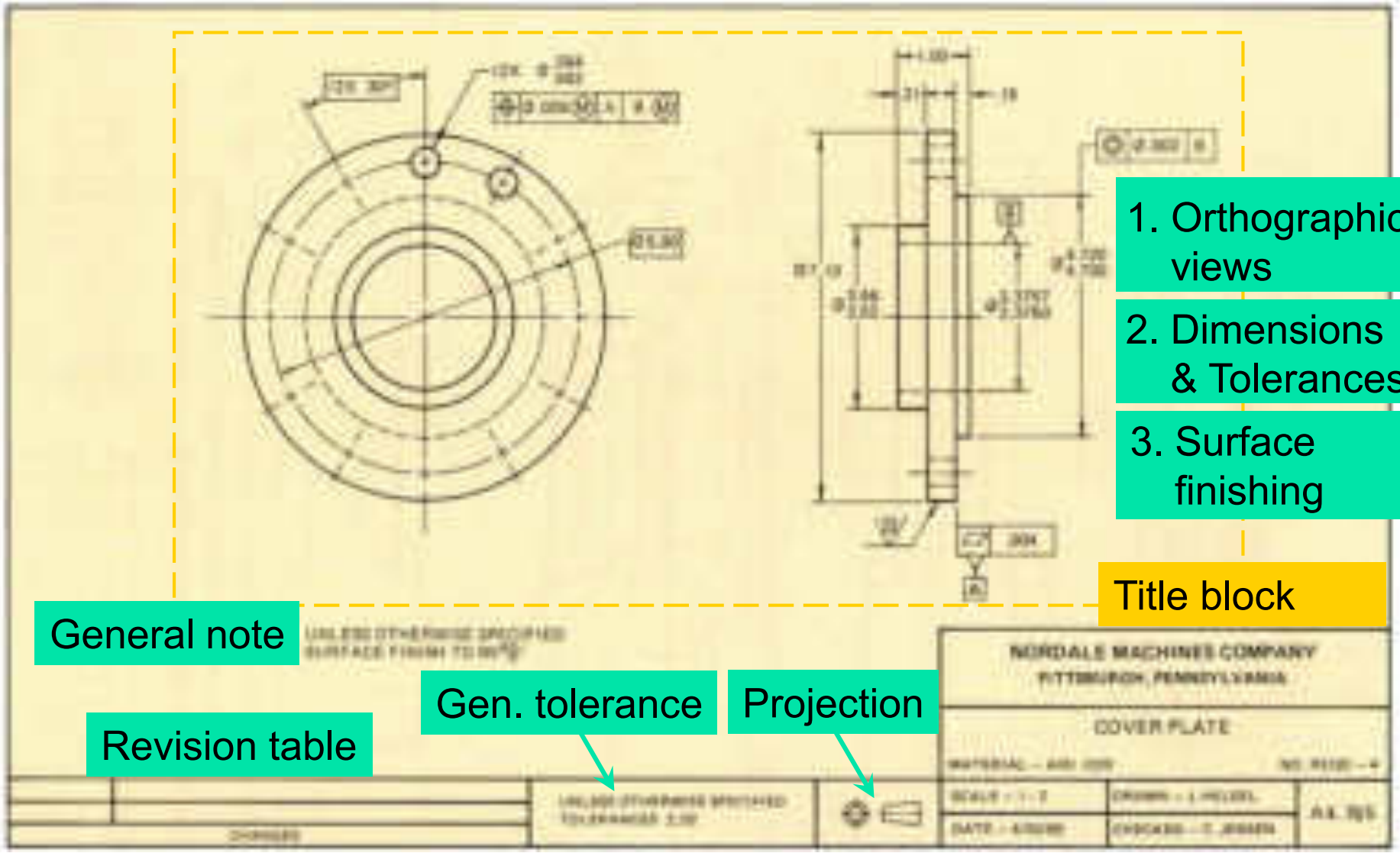
- ***Assembly drawing*** conveys

  1. completed shape of the product.
  2. overall dimensions.
  3. relative position of each part.
  4. functional relationship among various components.

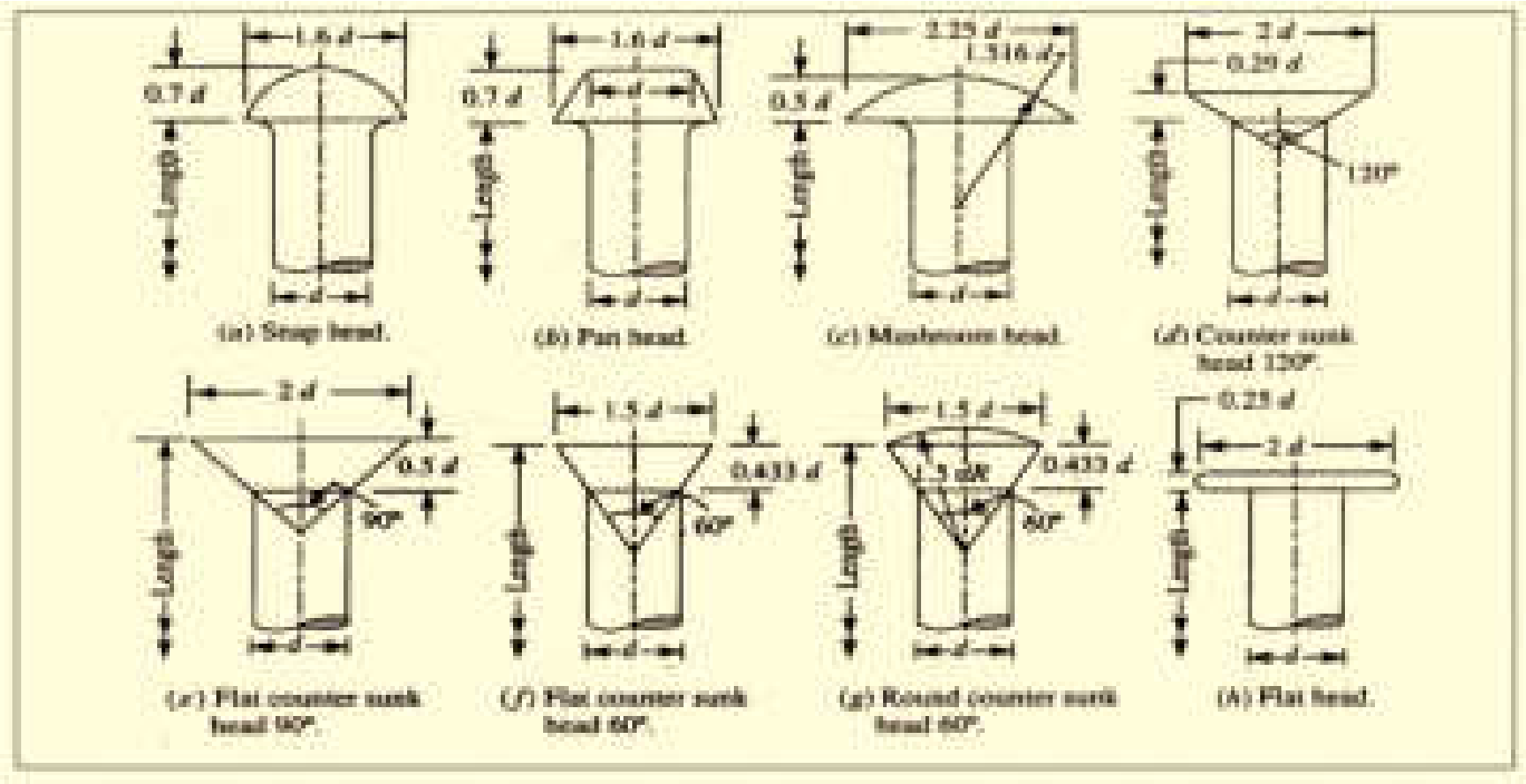
PART' S INFORMATION

Shape	❖ **Orthographic drawing** ❖ Pictorial drawing
Size	❖ **Dimensions** and Tolerances
Specifications	❖ **Part number, name, number required** ❖ **Type of material used** ❖ **General notes** ❖ Heat treatment ❖ Surface finish ❖ General tolerances

EXAMPLE : Interpreting detail drawing



Rivet heads for general purposes



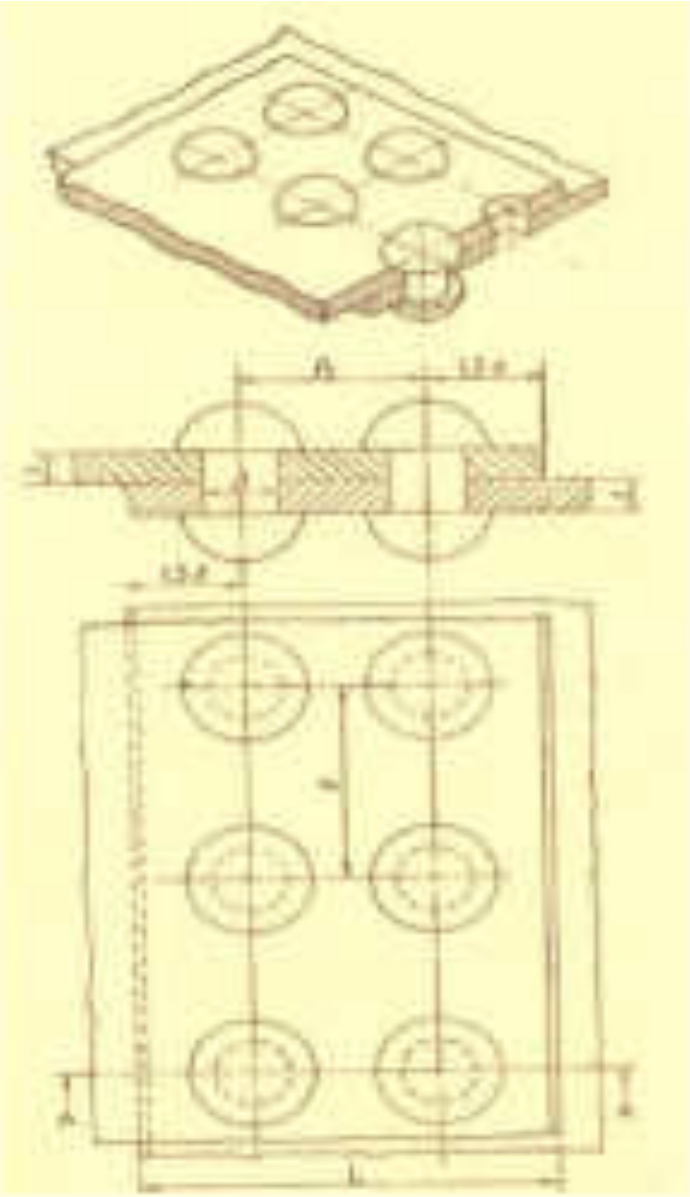


Fig.6.7. Double riveted (Chain) Lap joint

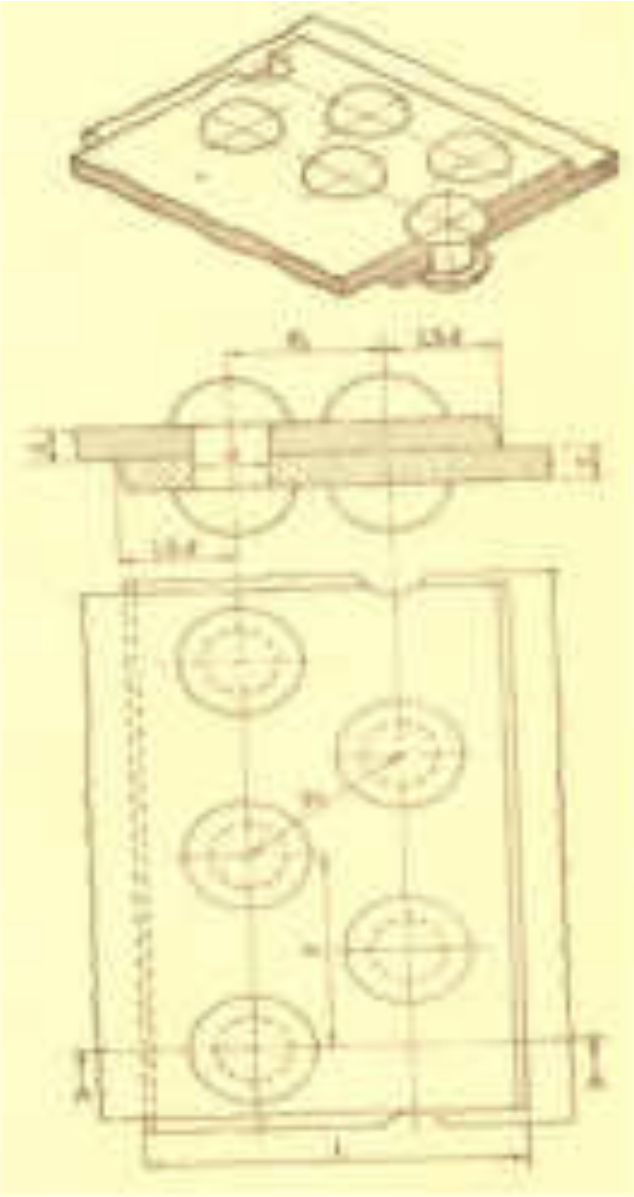


Fig.6.8.Double riveted (Zigzag) Lap joint

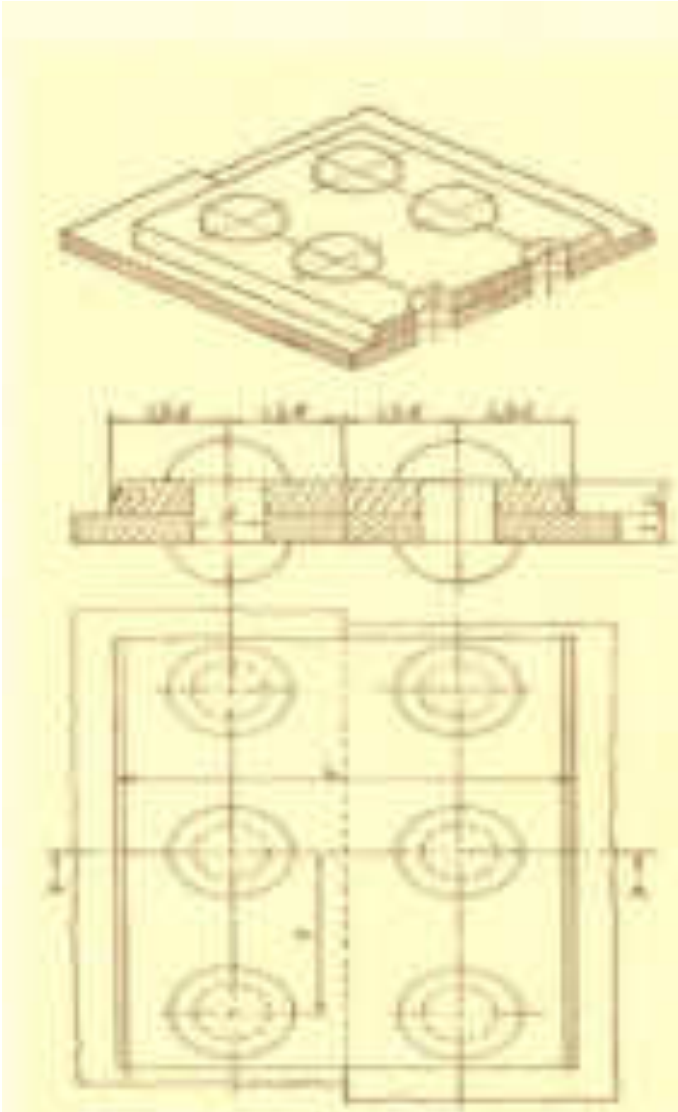


Fig.6.8. Single riveted (single strap) Butt joint

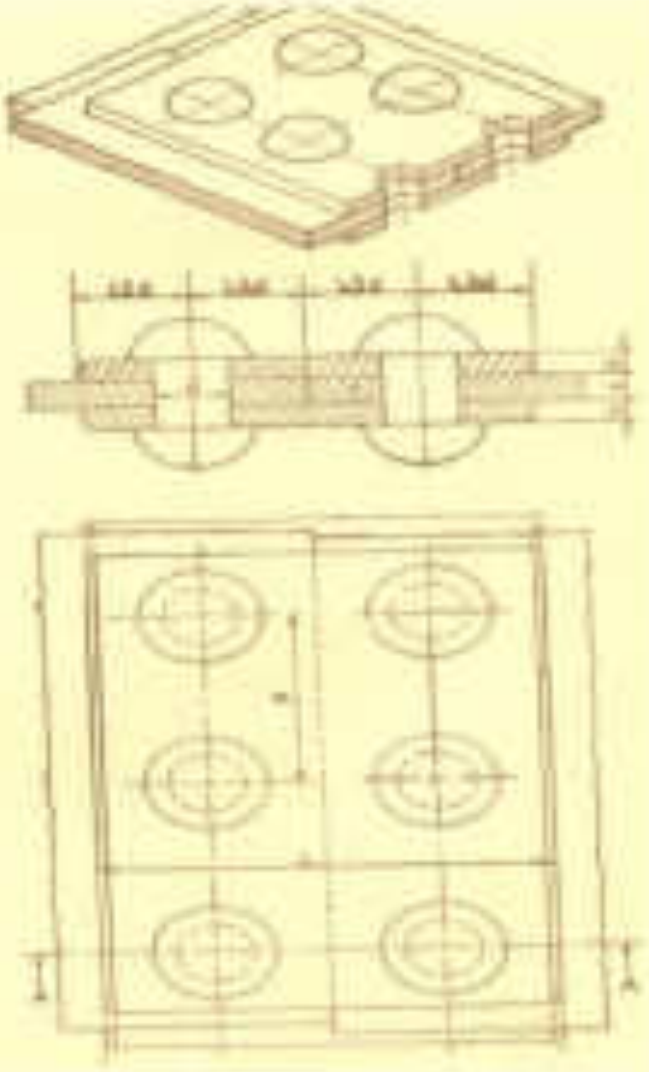


Fig.6.9. Single riveted (Double strap) Butt joint

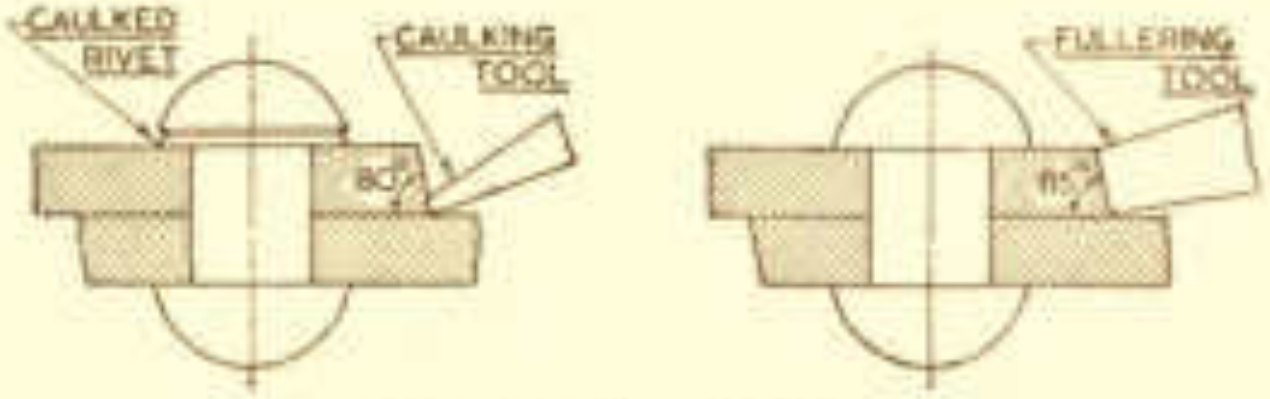


Fig.6.6.Caulking and Fullering

Form of weld	Illustration	BS symbol
Butt weld between flanged plates (the flanges being melted down completely)		
Square butt weld		
Single-V butt weld		
Single-bevel butt weld		
Single-V butt weld with broad root face		
Single-bevel butt weld with broad root face		
Single-U butt weld		
Single-J butt weld		
Backing or sealing run		
Fillet weld		
Plug weld (circular or elongated hole, completely filled)		
Spot weld (resistance or arc welding) or projection		

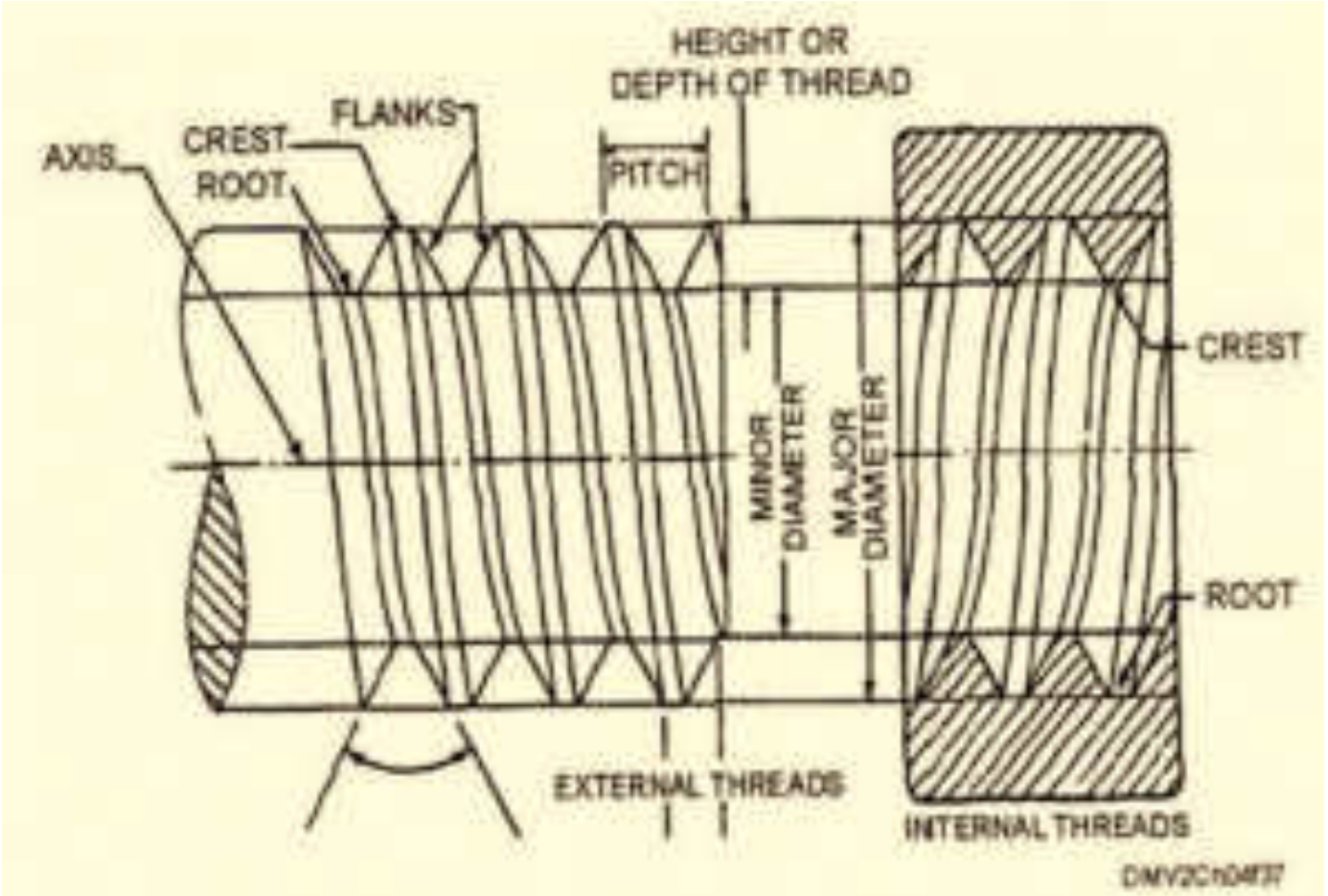
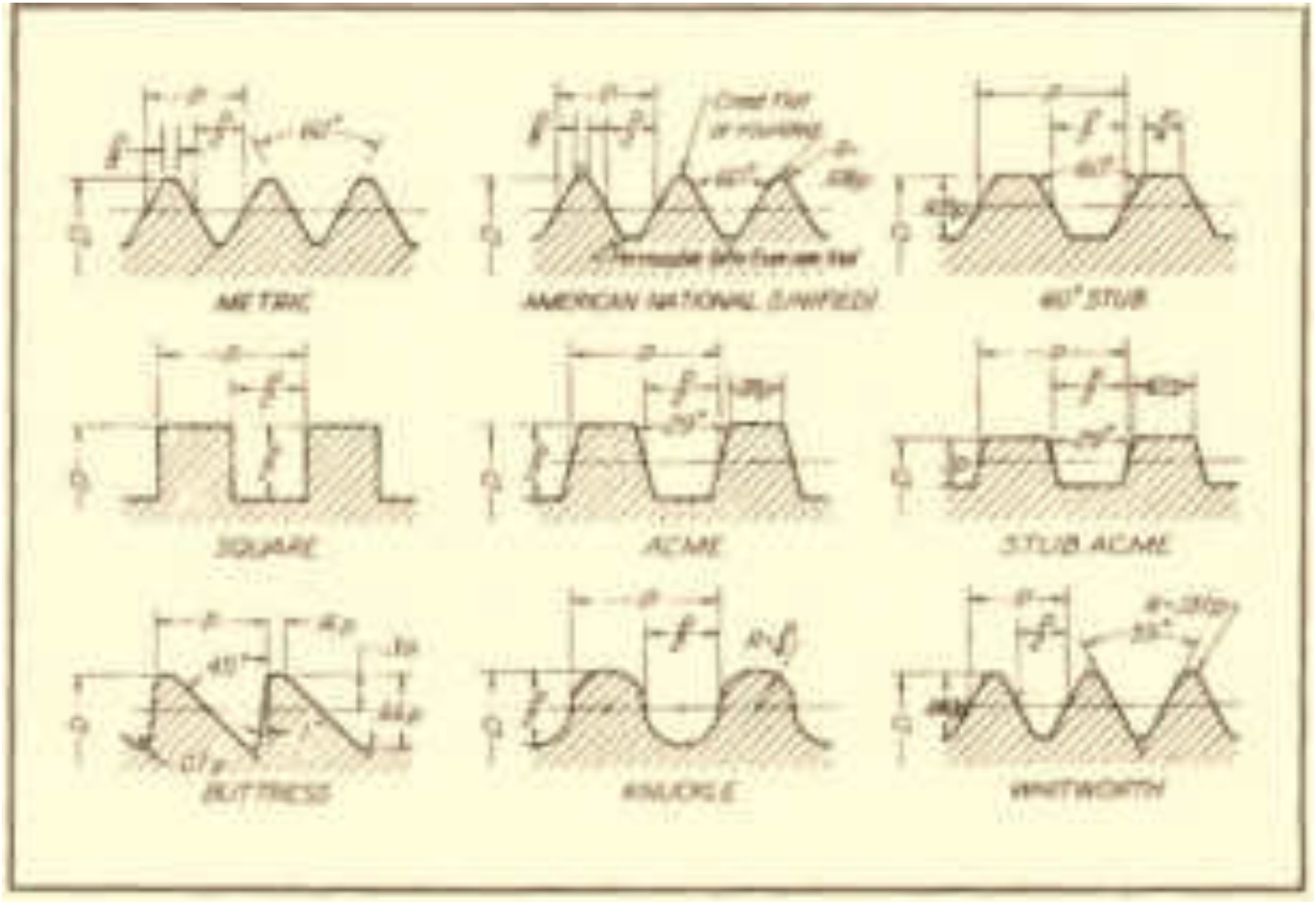
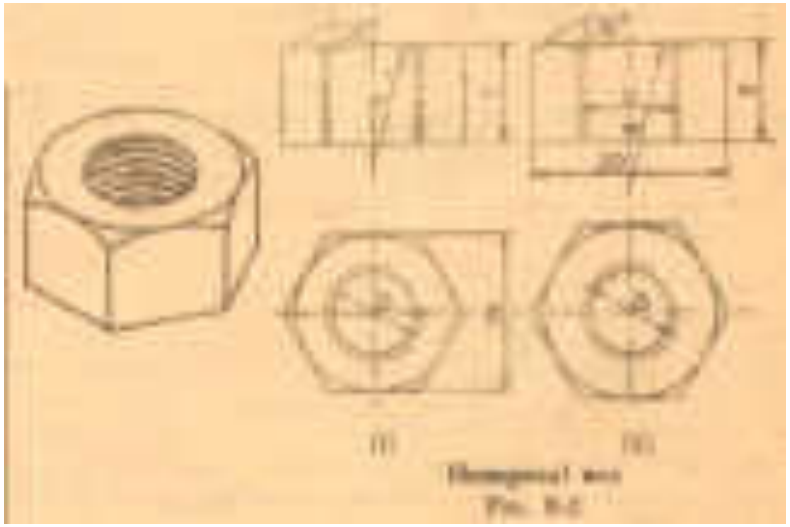
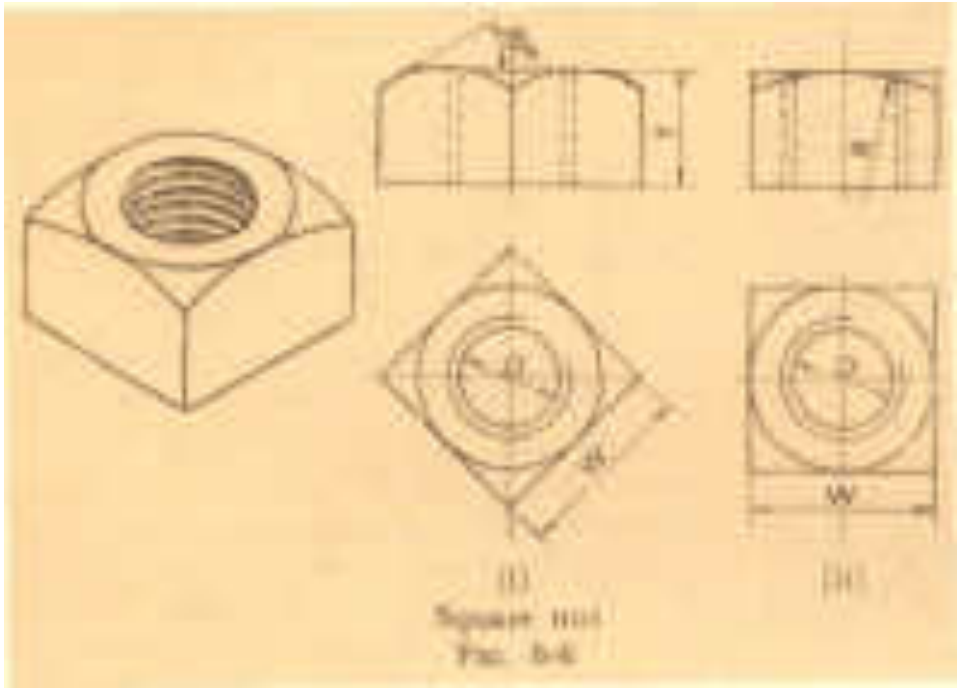


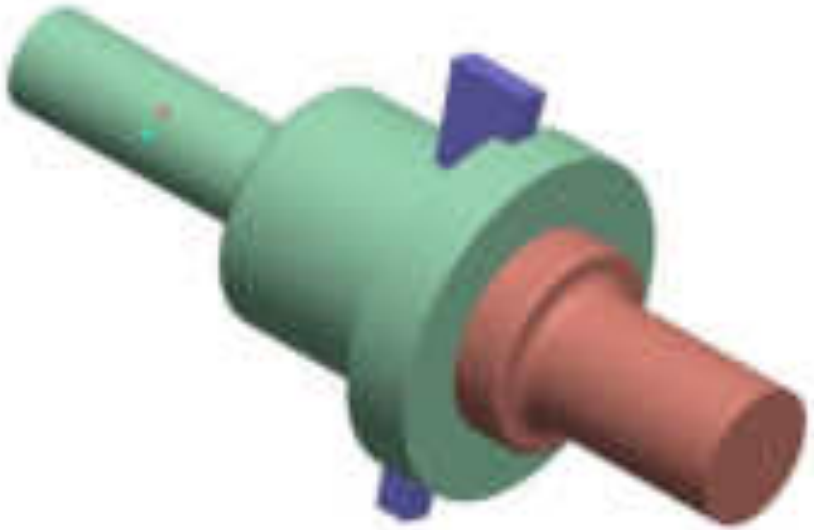
Fig. 7.1. Thread Nomenclature (Ref.2)


METRIC
AMERICAN NATIONAL (UNIFIED)
60° STUB
SQUARE
ACME
STUB ACME
BUTTRESS
KNUCKLE
WHITWORTH

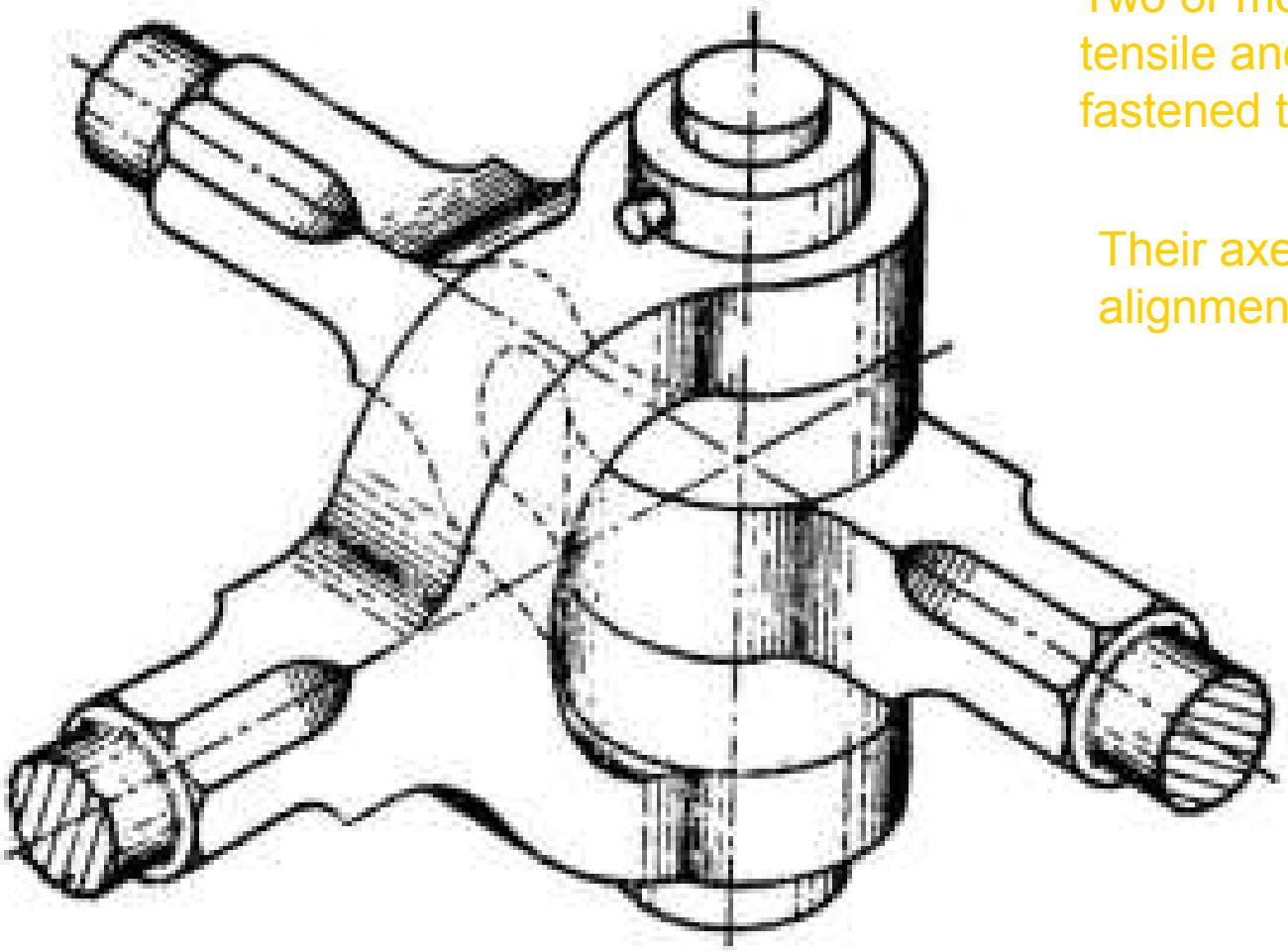



W

Cotter Joint



Knuckle joint



Two or more rods subjected to tensile and compressive forces are fastened together

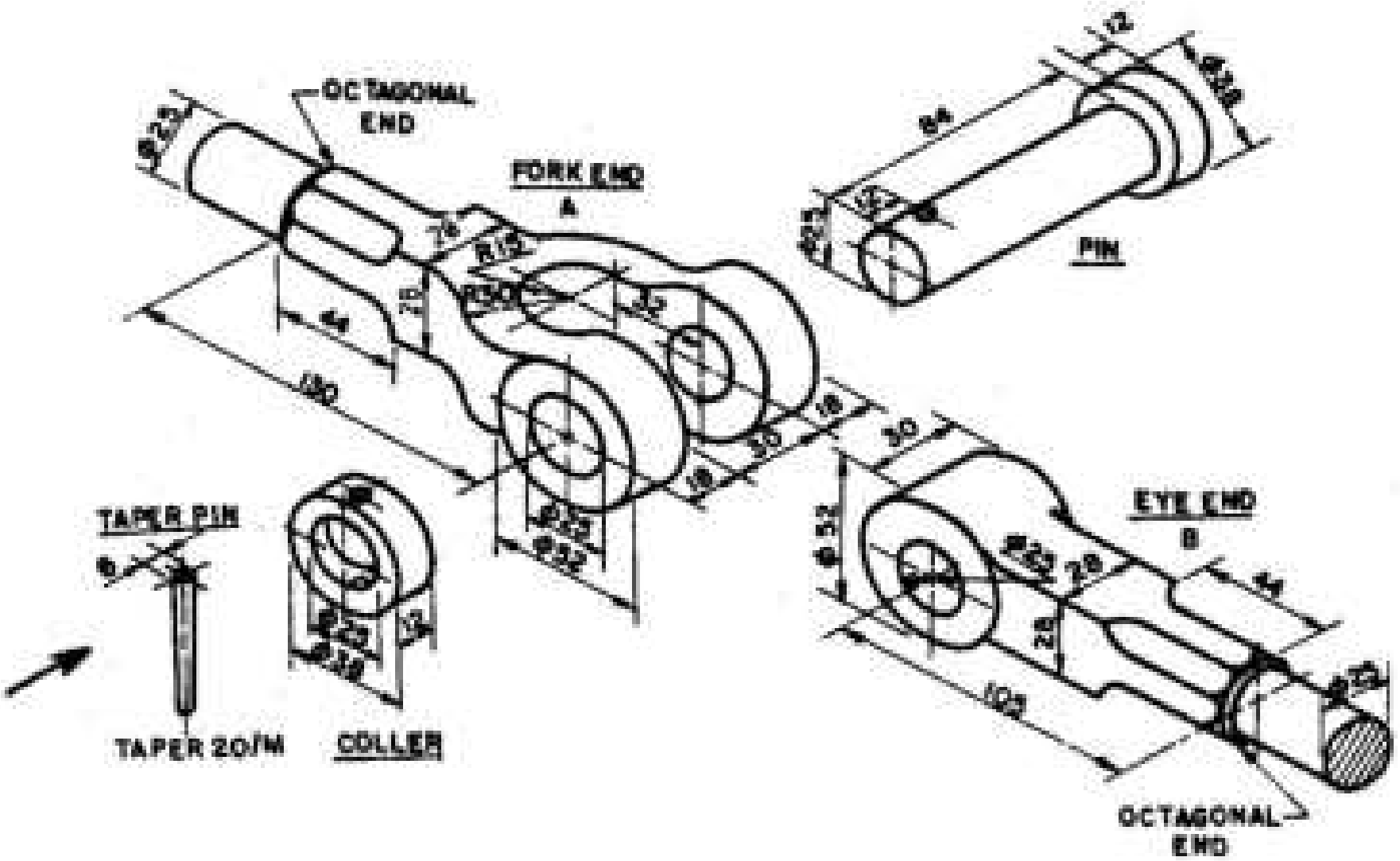
Their axes are not in alignments but meet in a point

The joint allows a small angular moment of one rod relative to another

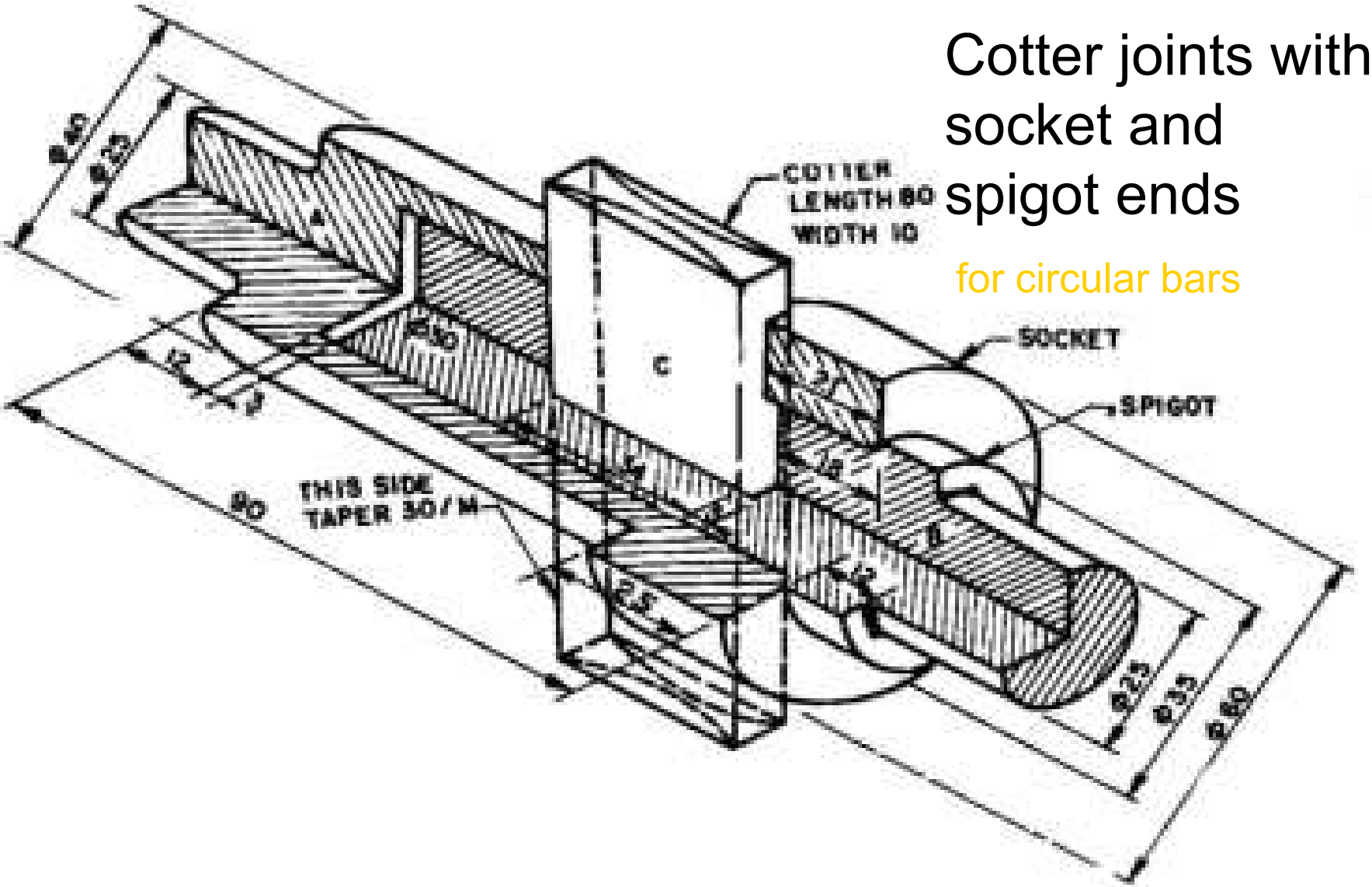
It can be easily connected and disconnected

Applications: Elevator chains, valve rods, etc

Knuckle joint



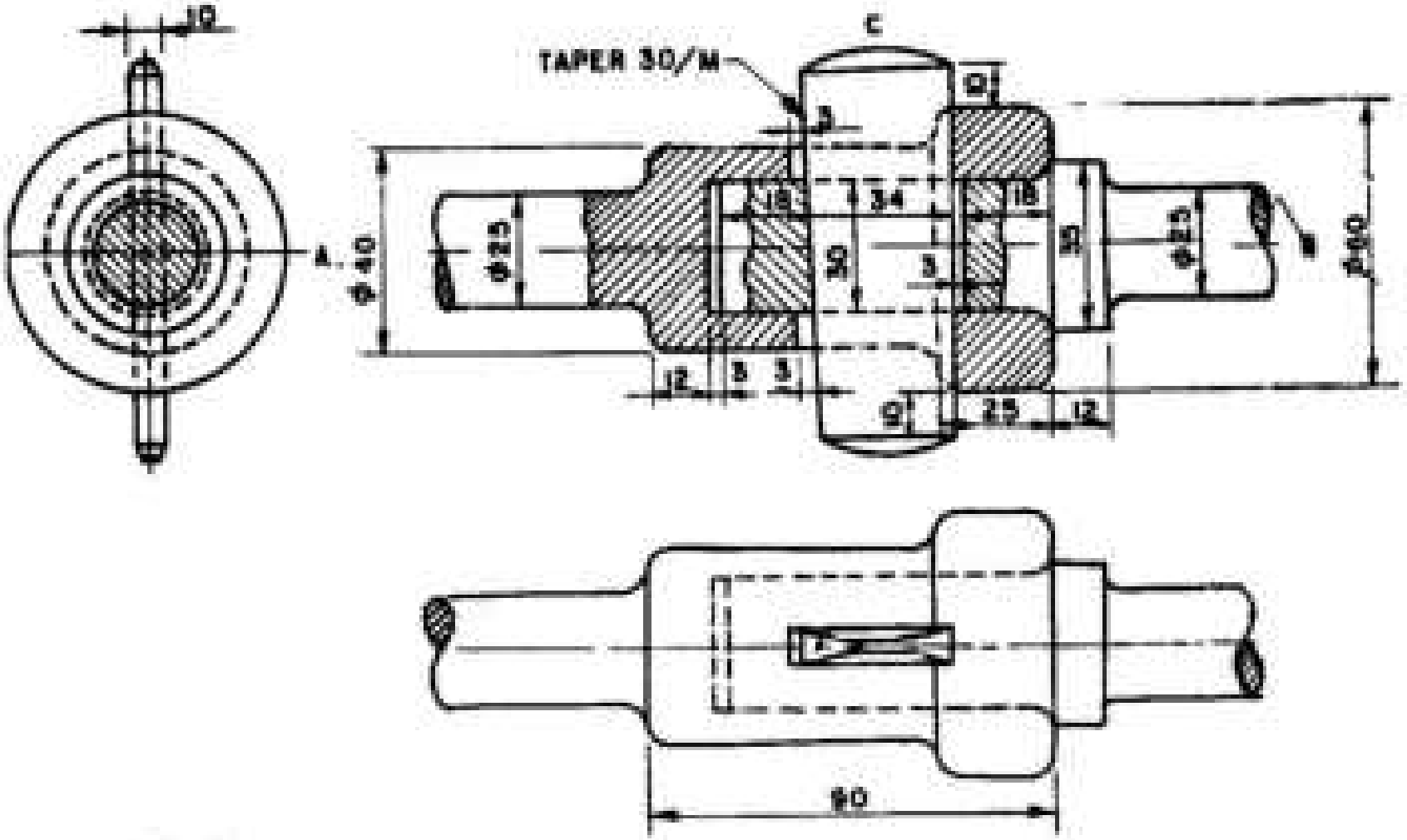
Cotter joint



Cotter joints with socket and spigot ends

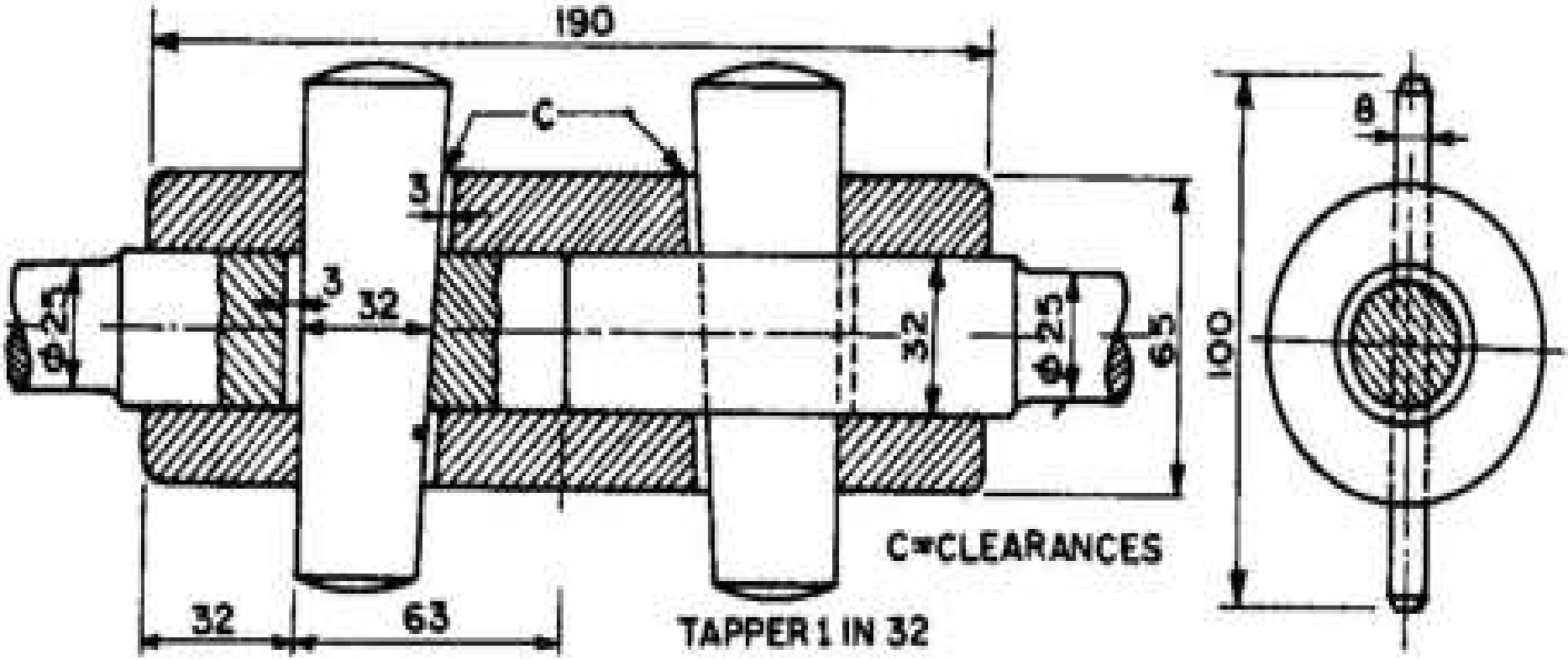
for circular bars

Cotter joint



Sleeve and cotter joint

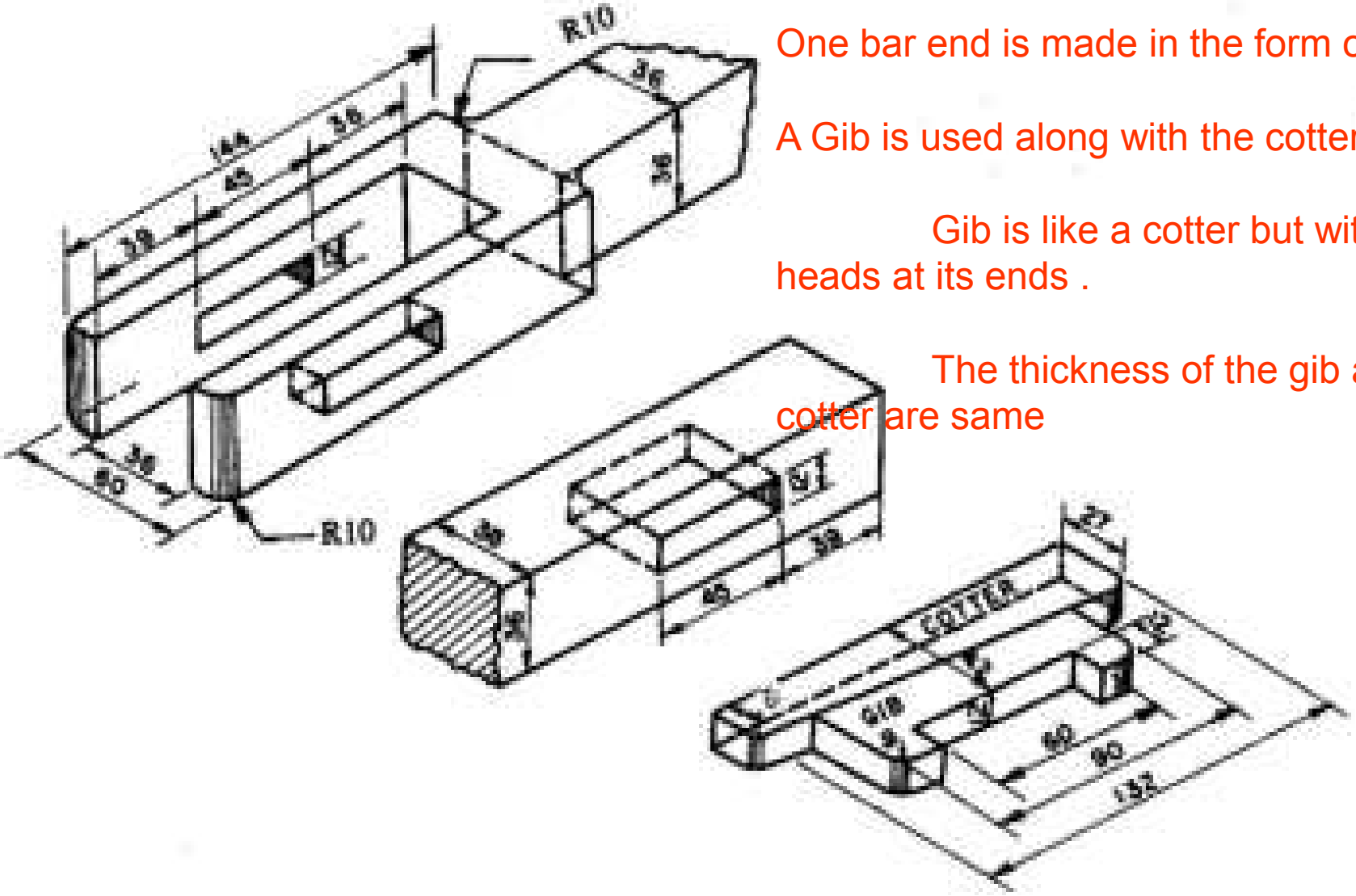
For circular rods



The enlarged ends of the rods butt against each other with a common sleeve over them

•The rod ends are enlarged to take care of the weakening effect caused by slots

Gib and cotter joint for rectangular rods



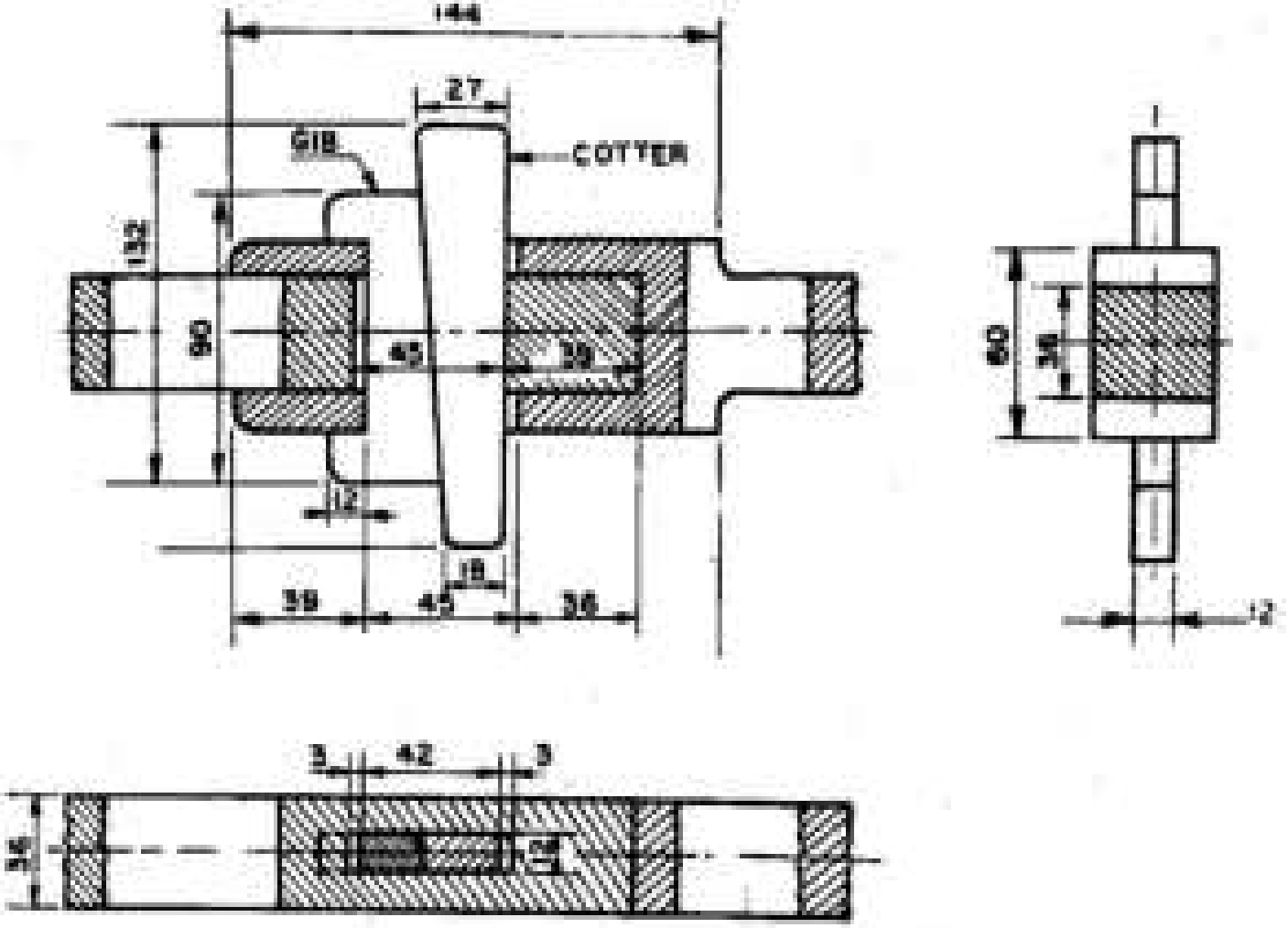
One bar end is made in the form of a strap

A Gib is used along with the cotter.

Gib is like a cotter but with two gib heads at its ends .

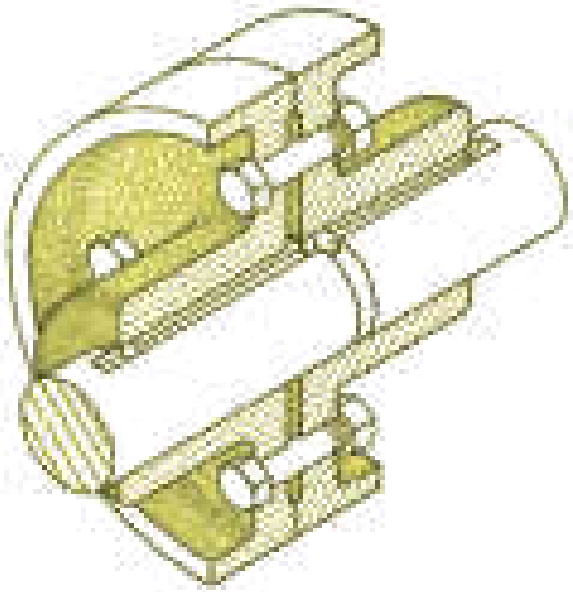
The thickness of the gib and cotter are same

Gib and cotter joint or rectangular rods

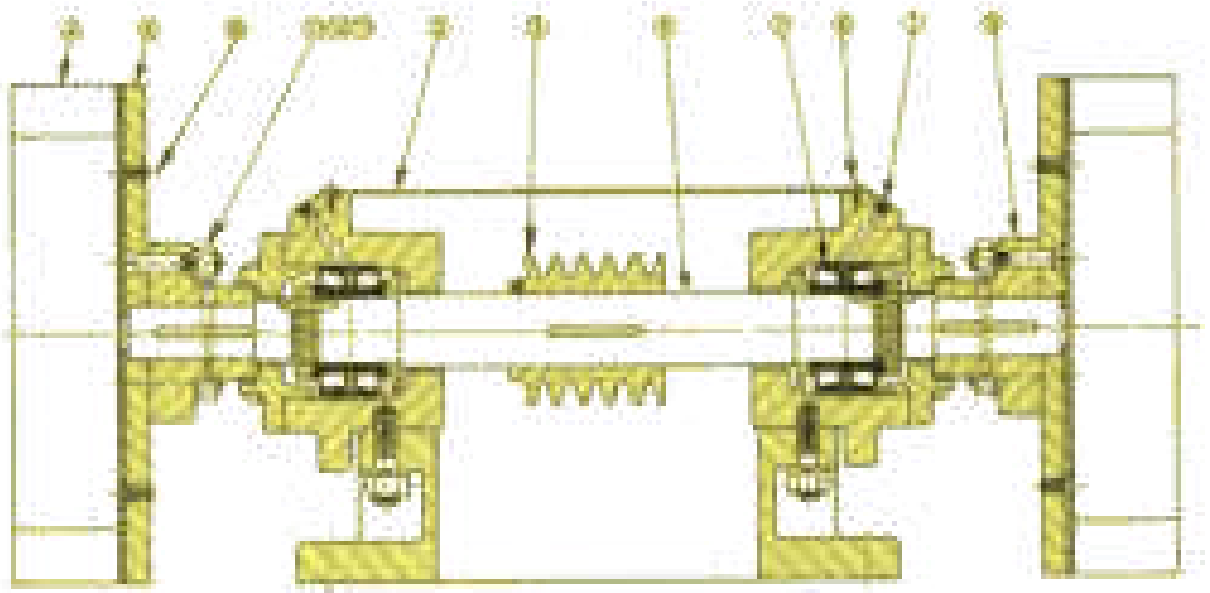


2. GENERAL ASSEMBLY

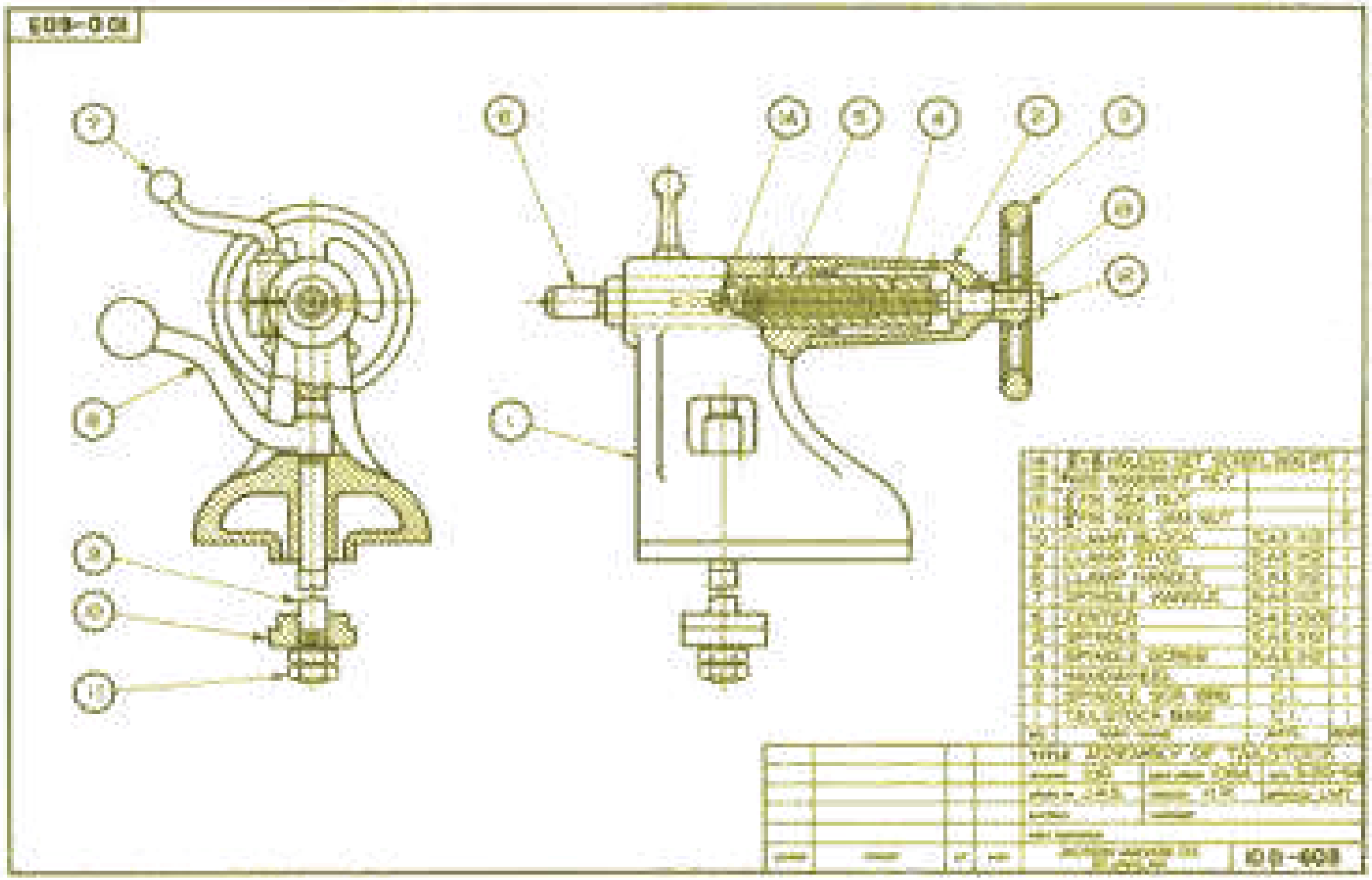
Pictorial

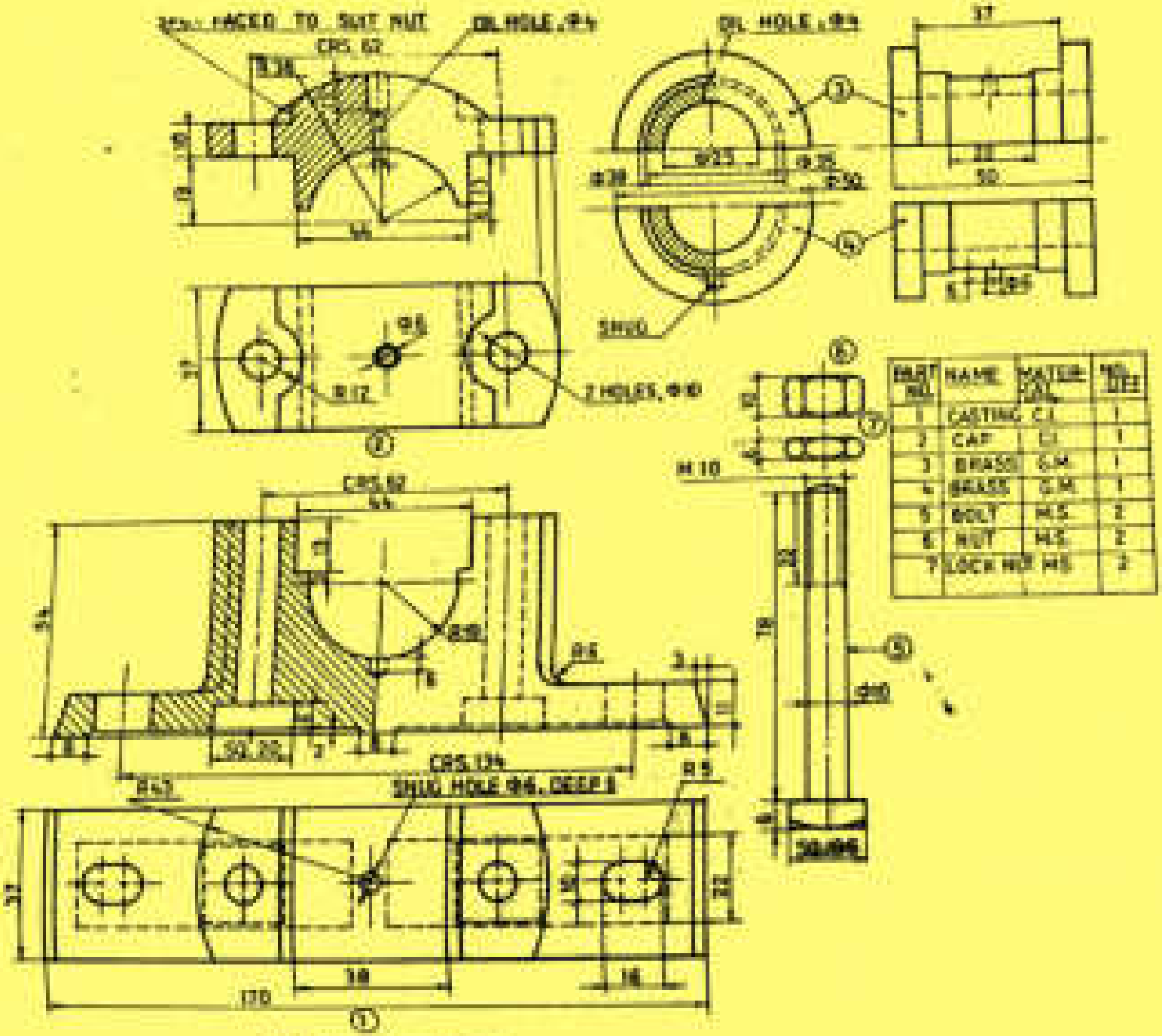


Orthographic



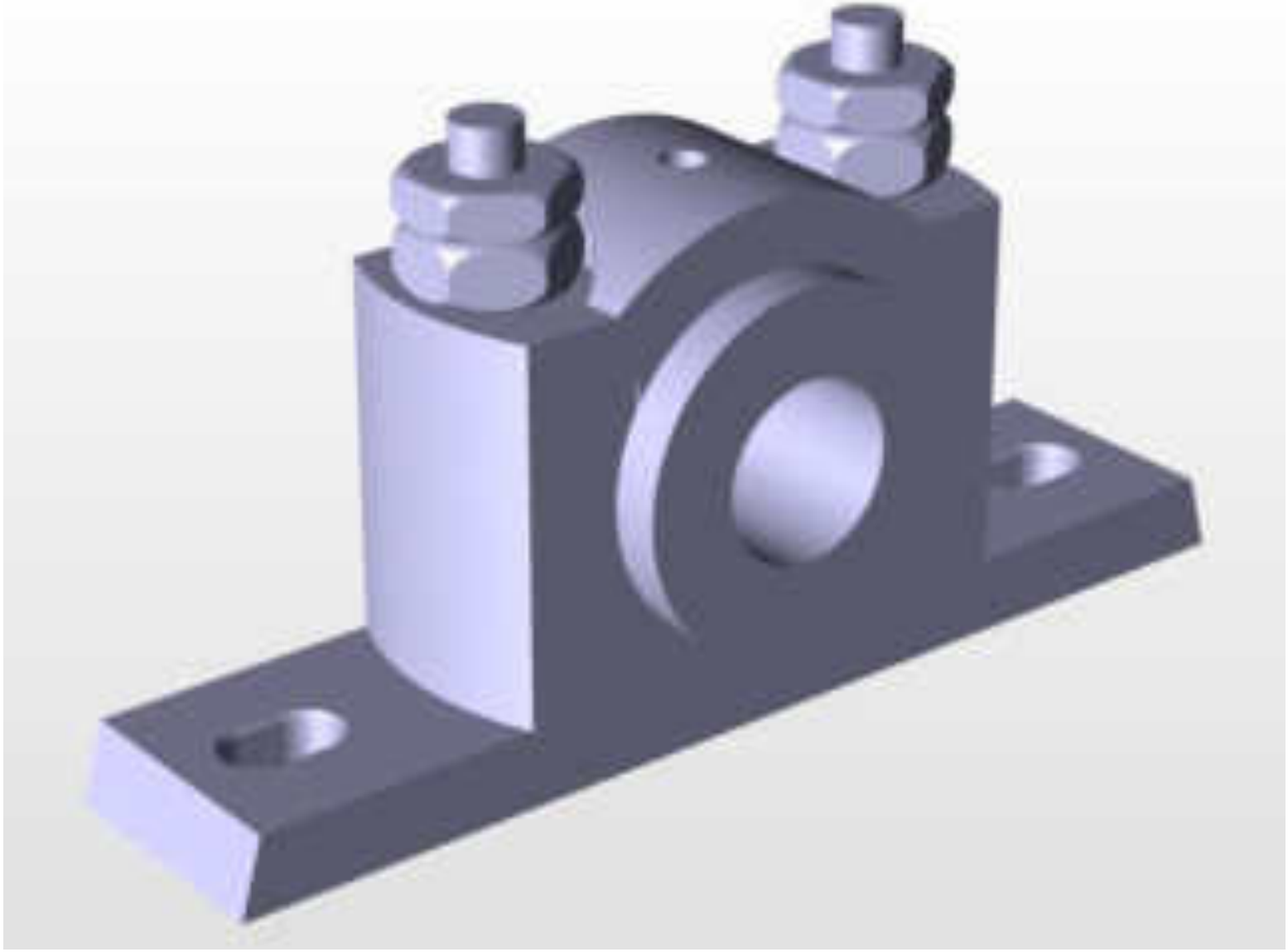
2. GENERAL ASSEMBLY





PART NO.	NAME	MATERIAL	NO. OFF
	CASTING	C.I.	1
3	CAP	C.I.	1
3	BRASS	G.M.	1
4	BRASS	G.M.	1
5	BOLT	M.S.	2
6	NUT	M.S.	2
7	LOCK NUT	M.S.	2

Fig 1: Details of Plummer Block




BLOW OFF COCK

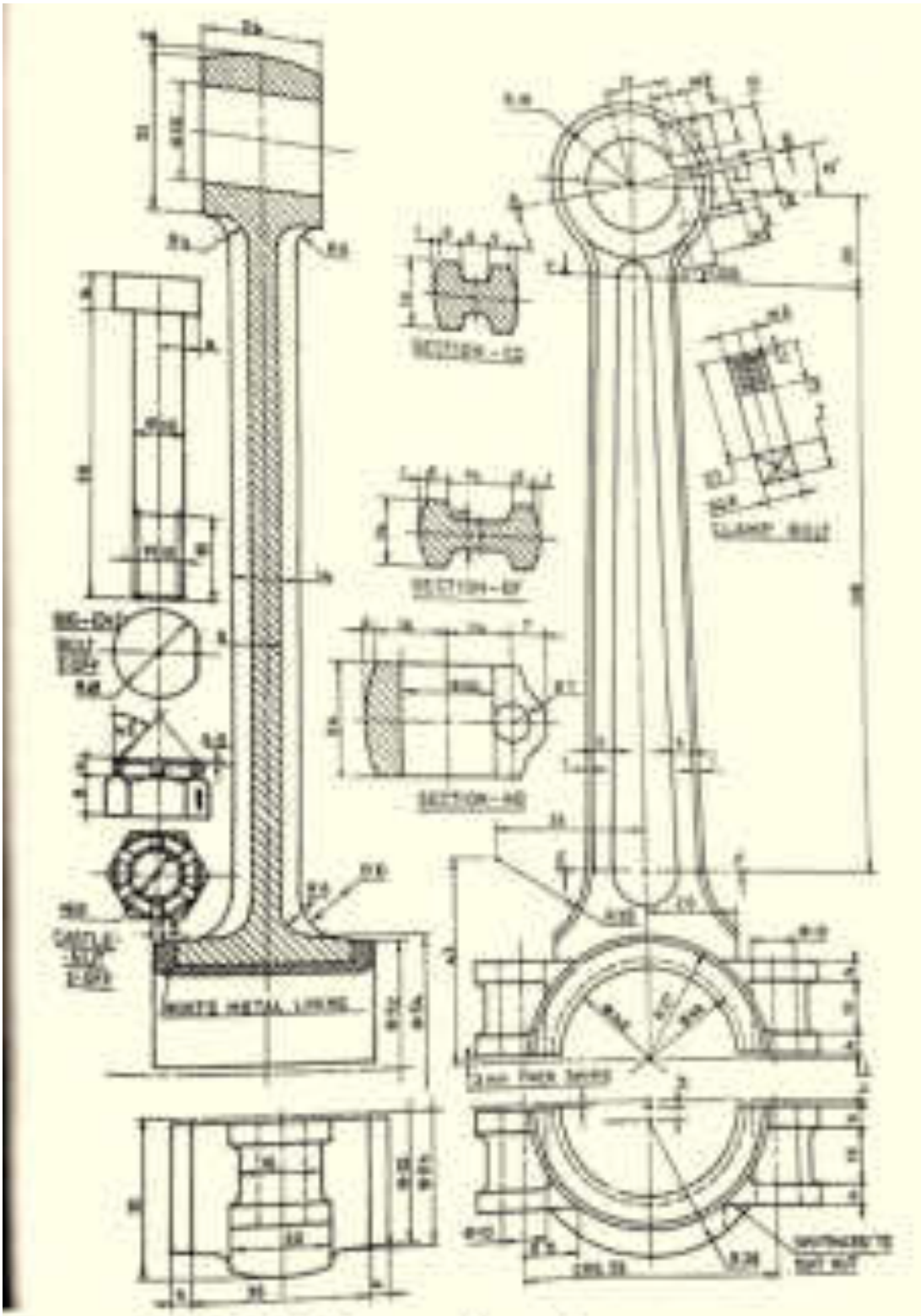
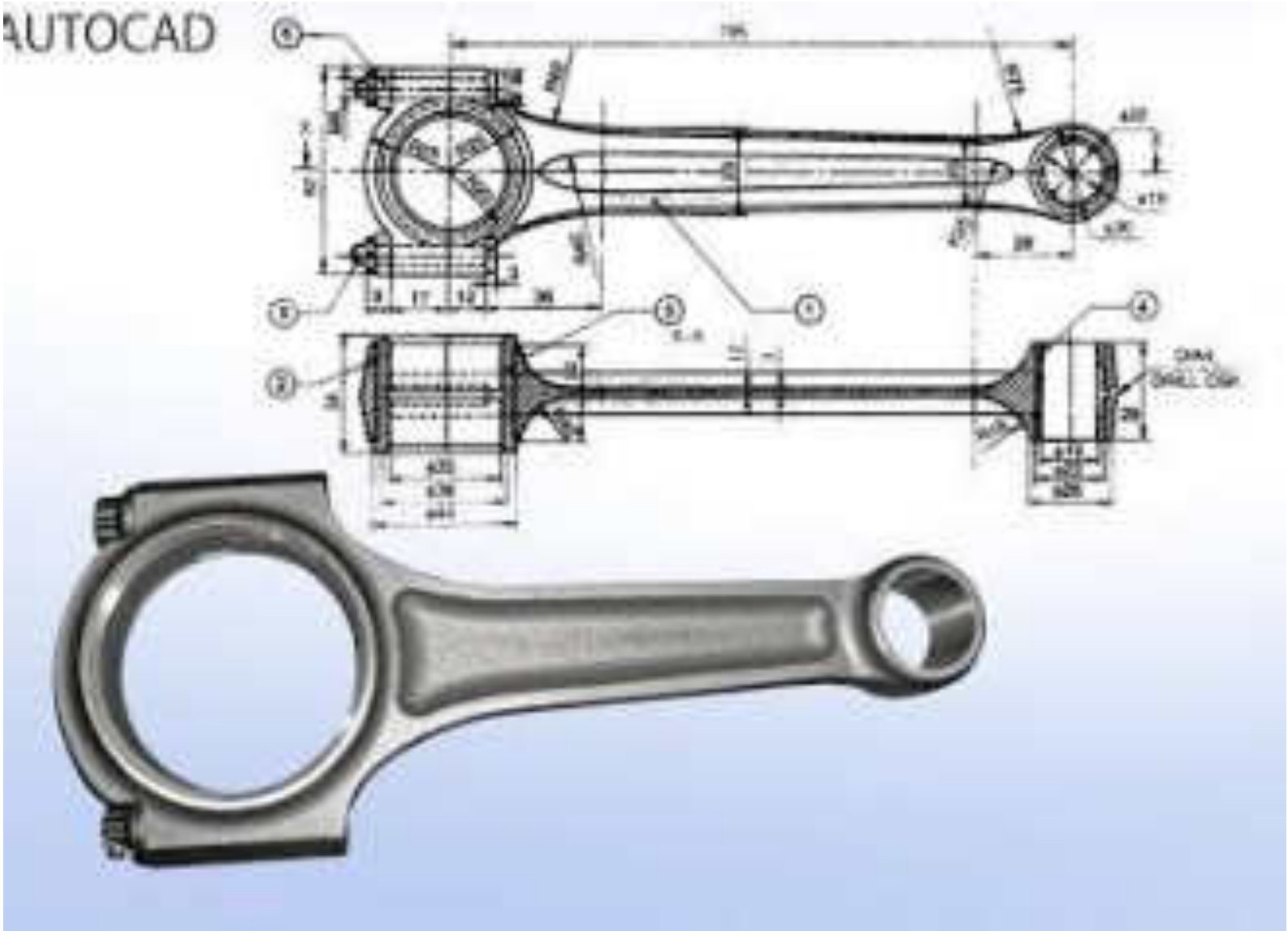


Fig 2.Detail of connecting rod

AUTOCAD



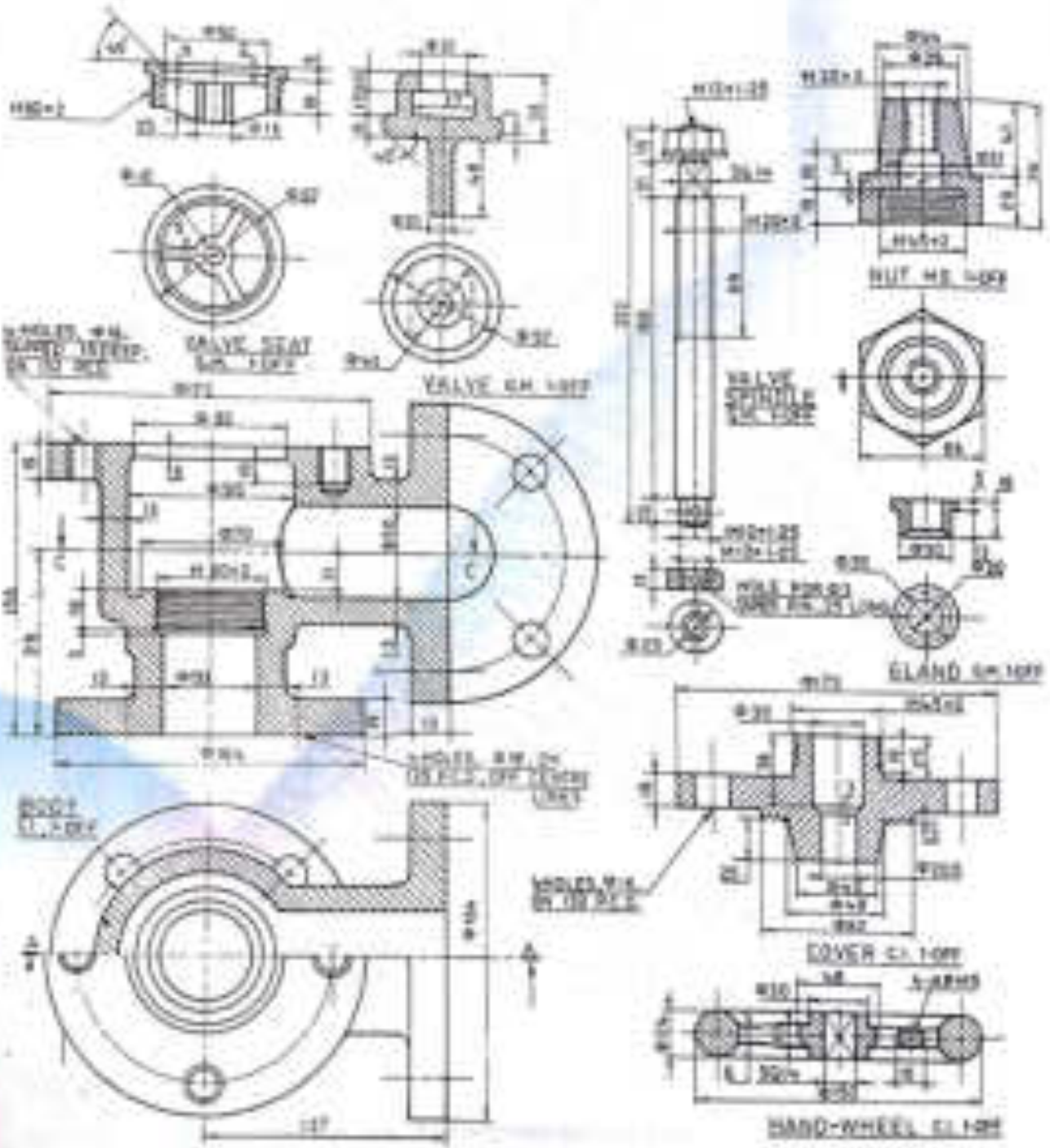
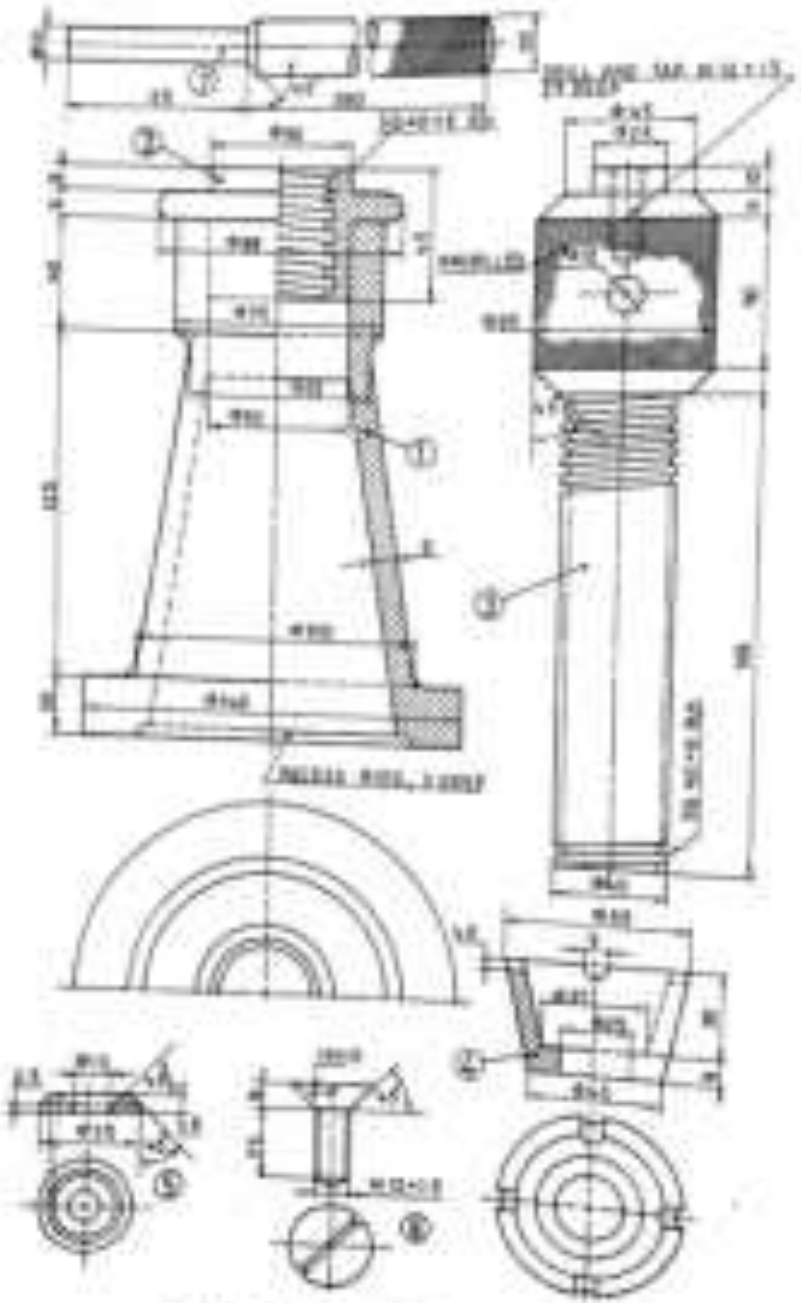
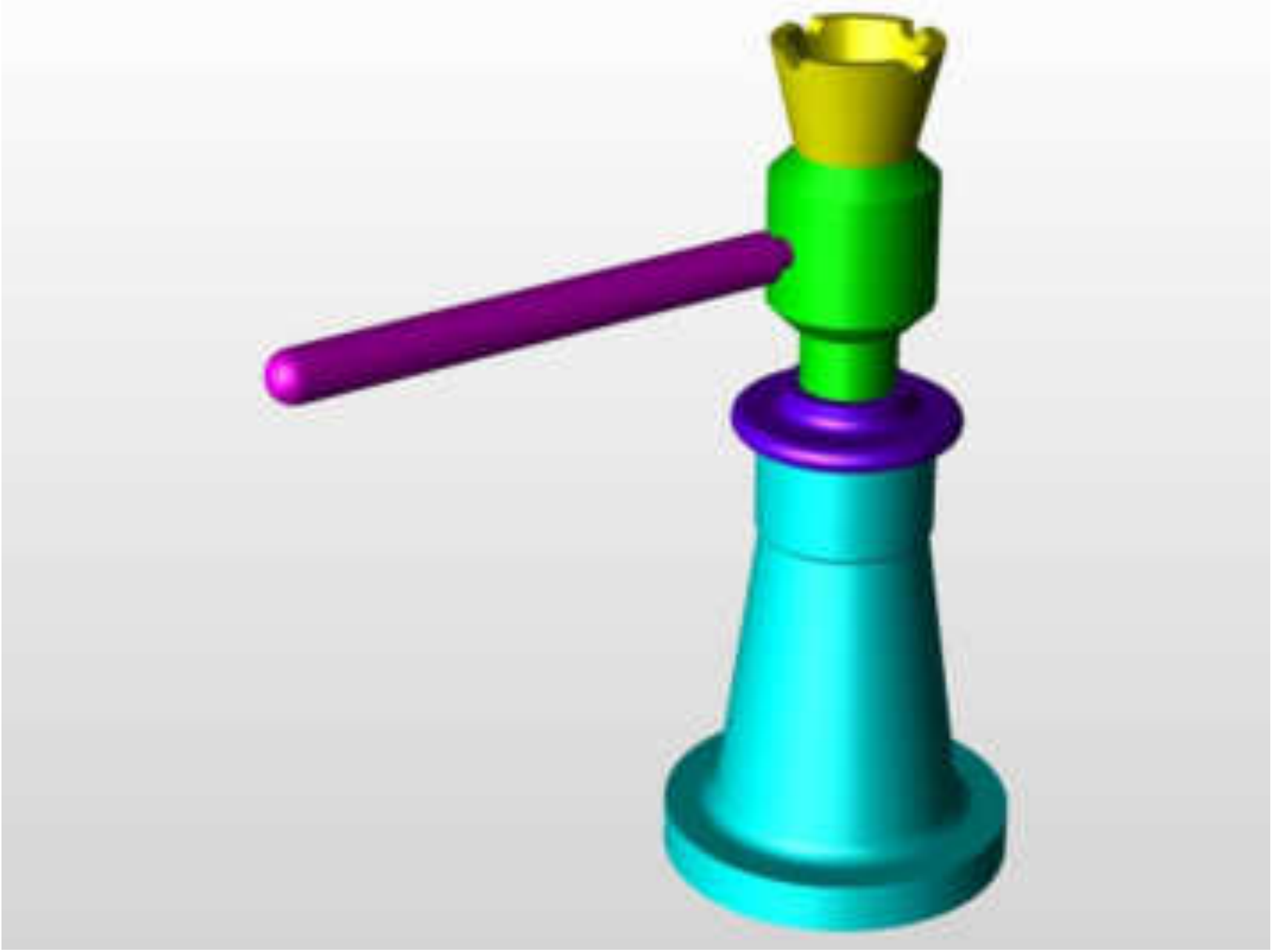


Fig 24.5 Details of a 50 mm Steam Stop Valve (First Angle Projection)





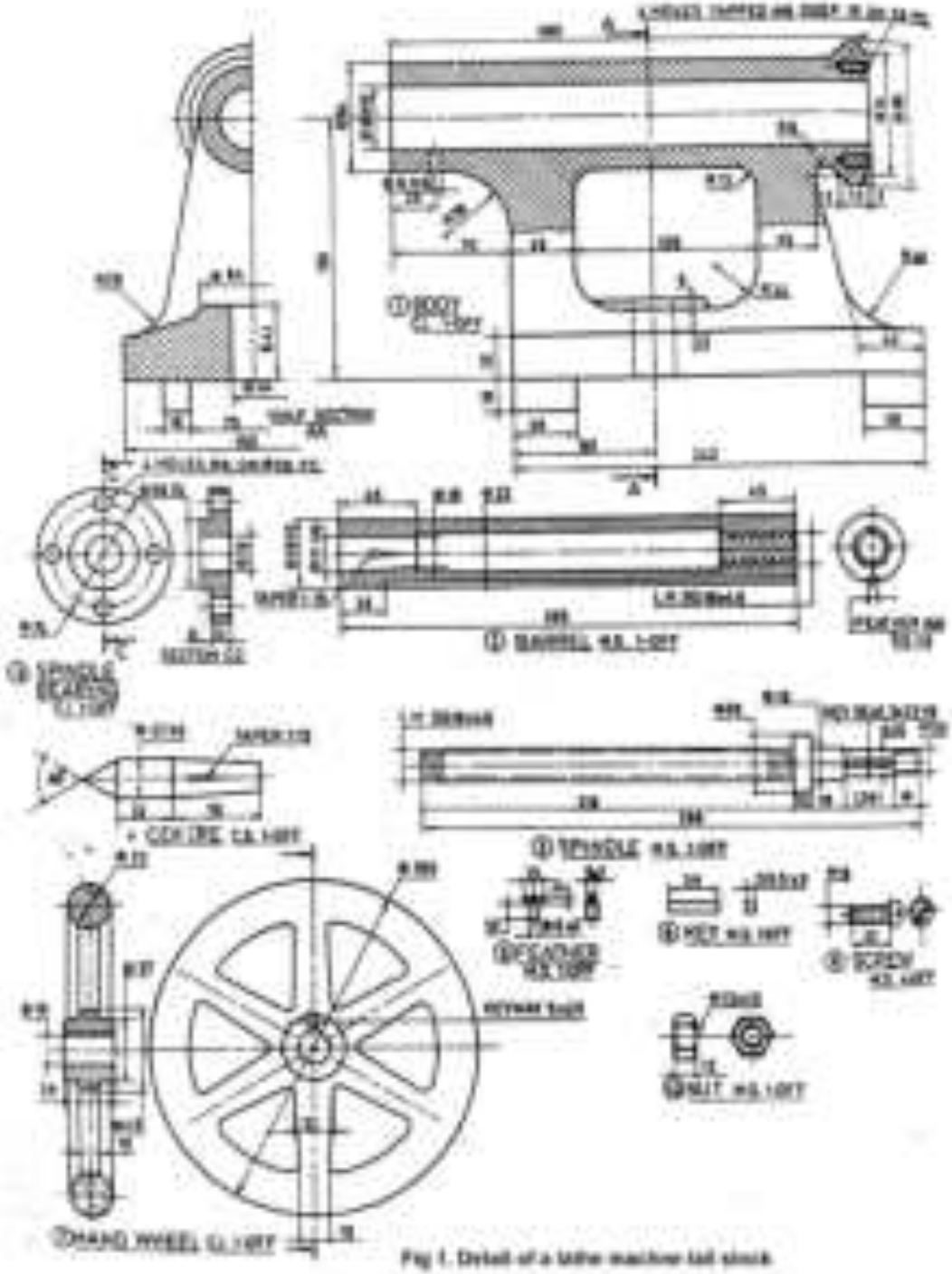


Fig 1. Detail of a lathe machine tail stock