Concordia University
Engineering and Computer Science

MECH 313 Engineering Drawing & Design

François Tardy

Prerequisite: MECH 211

Credits: 3

Lecture 1 & 2

Université Concordia University

About the course

This course is not mainly about drawing, but more towards design.

Extension of Mech 211 which is primarily drawing

- Lectures, 75 minutes each
- Two mid-term exams (1-Nov and 29-Nov, tentative)
- 8 Assignments
- Projects (Two students per group)
- Final exam

Exams

Mid-term:

- Closed book exam
- Duration of the test will be 90 minutes.
- Write the midterm test – this is a good means to check your performance.

Final:

- Closed book exam
- Duration of the test is 3 hours

Assignments

Eight assignments that will require significant effort must be completed during the term

The timetable of the assignments is shown in the course outline.

No late submissions are accepted.

Submission of assignments **“ONLY”** at the beginning of the Tutorial.

The Tutorial

There will be a 1 hour 40 minute tutorial, see the course outline for the time and date.

There will be TA who will give more detailed design and drawing instructions

Attending tutorials is necessary as this will help in solving the assignments as well as prepare you for the exams.

The Project

There will be a group design project of design problems.

- Details and specifications will be posted to Moodle.
- See the course outline for the date to form the team.
- Two students per group from the same section.
- The group will have to design and draw a mechanism based on the design constraints defined in the problem; Assembly drawing with parts, and materials specified. Please see the course outline.

Grading Scheme

Grade composition:

- Assignments: 16%
- Project 6%
- Midterm: 28%
- Final: 50%

Lecturer Background

François Tardy

- Department of Mechanical and Industrial Engineering
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- Phone: 3462
- francois.tardy@Concordia.ca
- Moodle

B.Sc.A. Mechanical Engineering (U de Moncton)

M.Ing. Mechanical Engineering (ÉTS)

MBA Energy Management and Finance (HEC Montréal)

Engineering Experience:

- Phoenix Énergie
- PCO Innovation
- Volvo
- United Technologies (Carrier)
- Bombardier Aerospace
- EH2Solar
- Cadexair
- Trans-F-air
- Public Works Canada

Interests:

- Energy: production, management, efficiency and politics
- Transportation
- CVAC-R

Contents of today's lecture

- Theory of Shape Description
- Sections

Theory of Shape Description

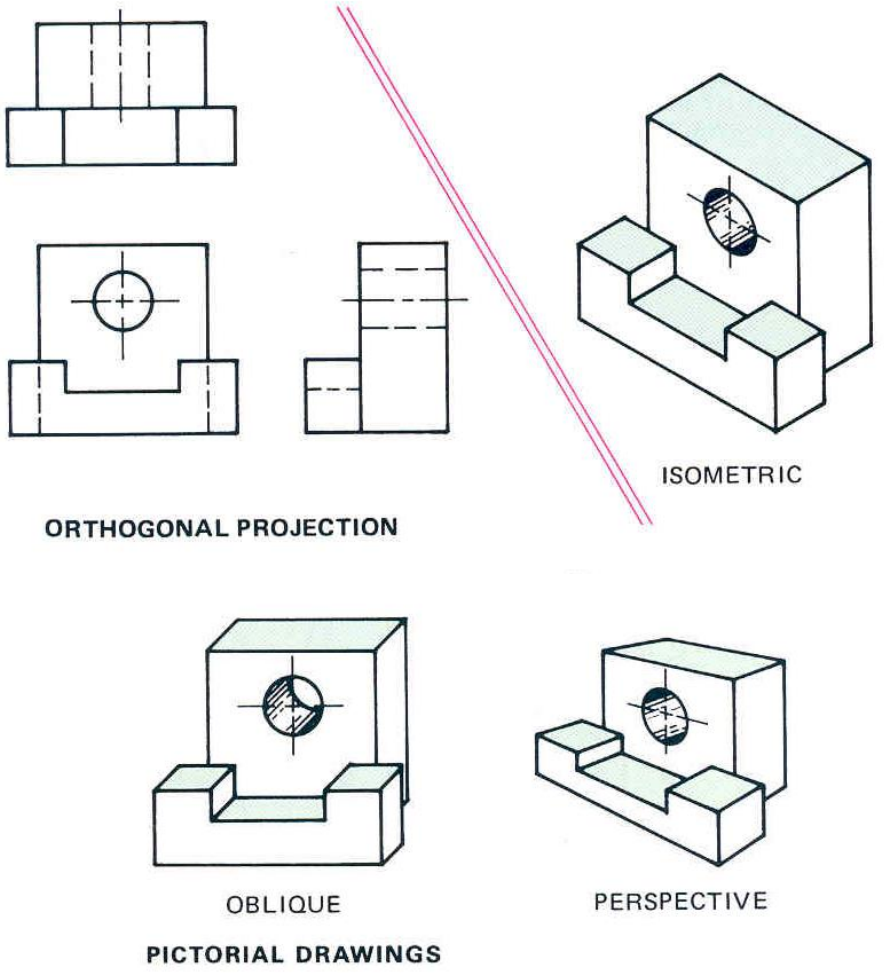
Outline

- Different kind of representations
- Hidden lines
- Inclined surfaces and Circular features
- Oblique surfaces
- One and two view drawings
- Special views
- Conventional representation
- Intersections
- Foreshortened projection

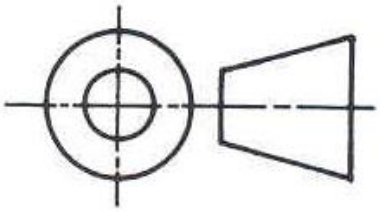
Orthographic Representation

Types of Projection

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



Orthographic Representation



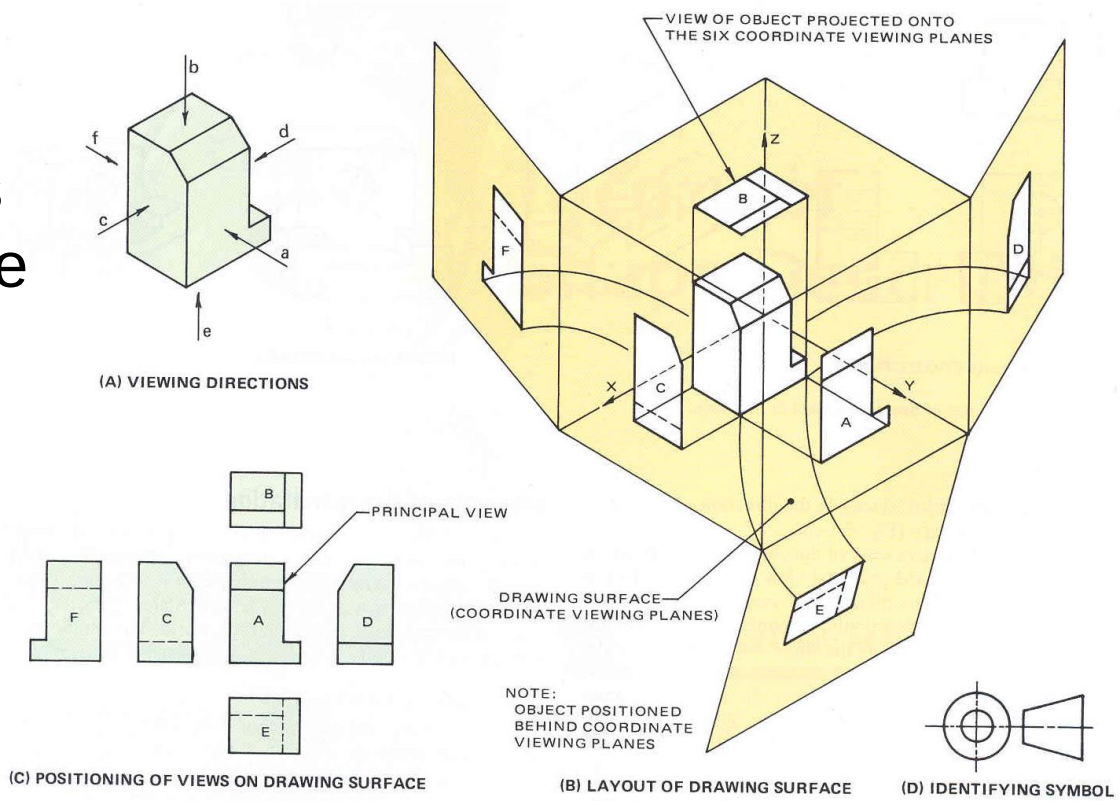
(D) IDENTIFYING SYMBOL

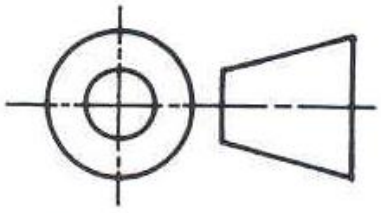
- *Uses parallel orthogonal projection to represent an object*
- *Flat, two dimensional views*
- *Views are positioned on the page according to projection method*
- *An identifying symbol next to the title block indicates which representation method is used*

Orthographic Representation

Third angle projection

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



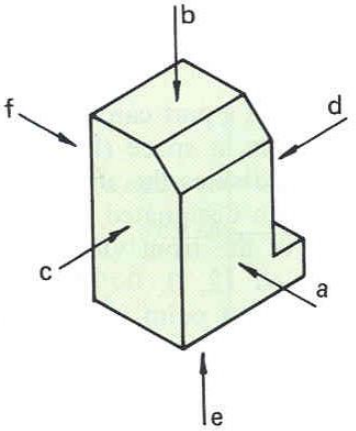


- The most commonly used method in the UK, US and Canada

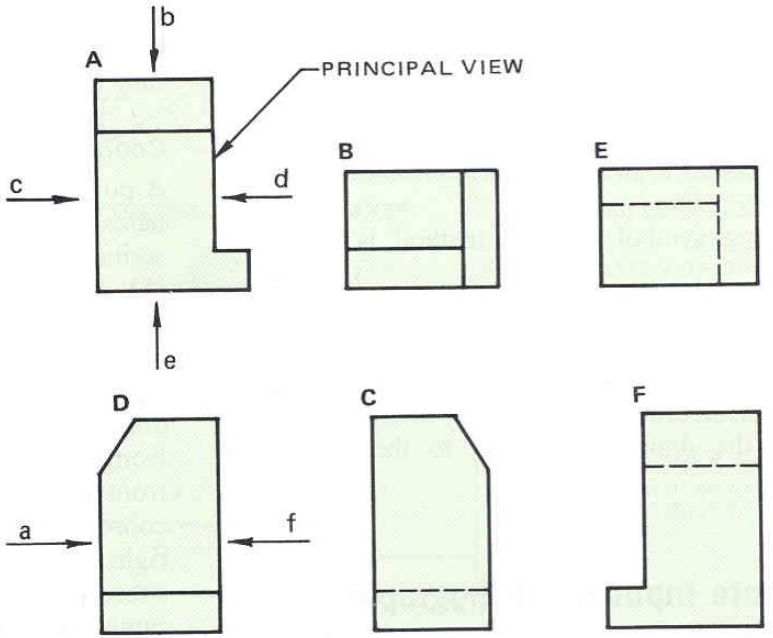
Orthographic Representation

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.



(A) VIEWING DIRECTIONS



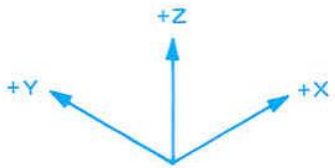
(B) POSITIONING OF VIEWS

Orthographic Representation

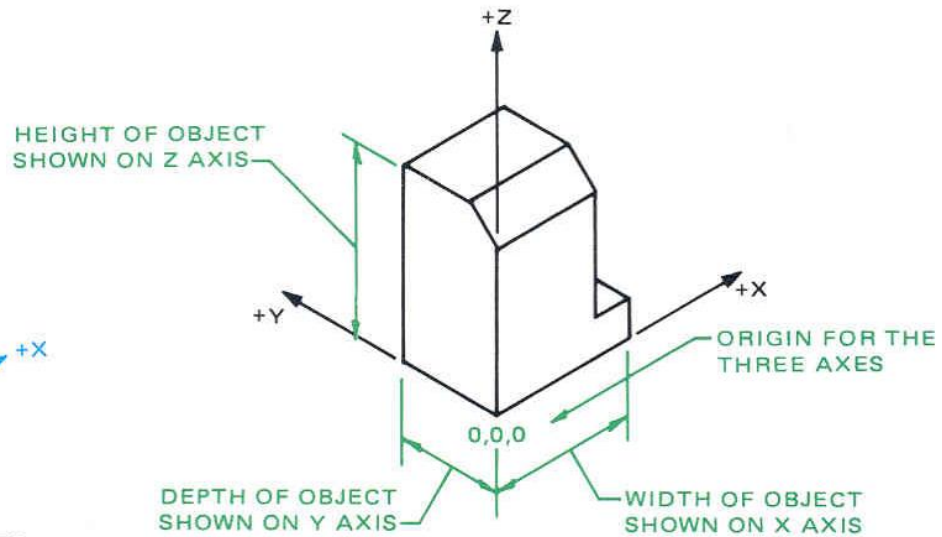
Location of points

- X axis represents width
- Y axis represents depth
- Z axis represents height

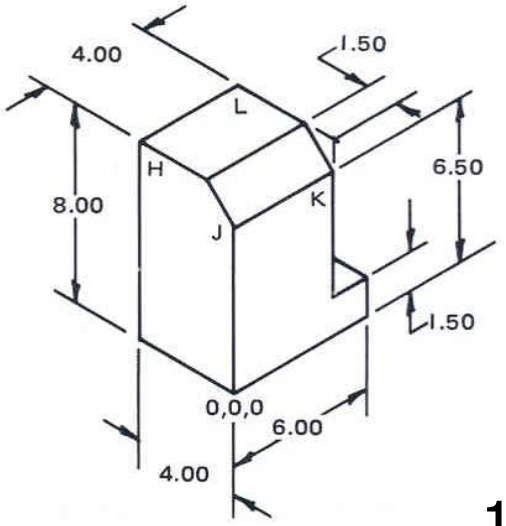
- Origin (0,0,0) can be any convenient place in drawing
- The coordinates for HJKL are shown



(A) DIRECTION OF X, Y, AND Z AXES



(B) POSITIONING OF PART ON THE X, Y, AND Z AXES



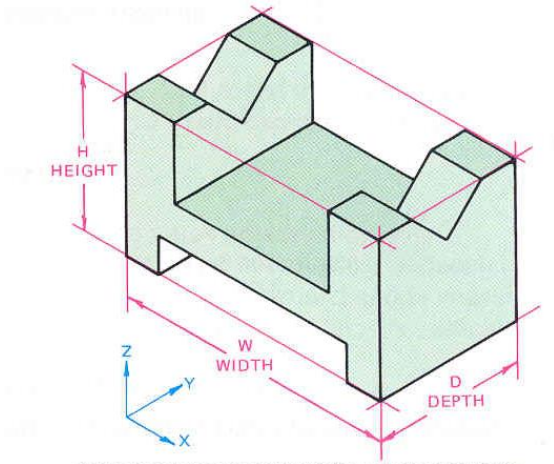
(C) LOCATION OF POINTS

Arrangement of Views

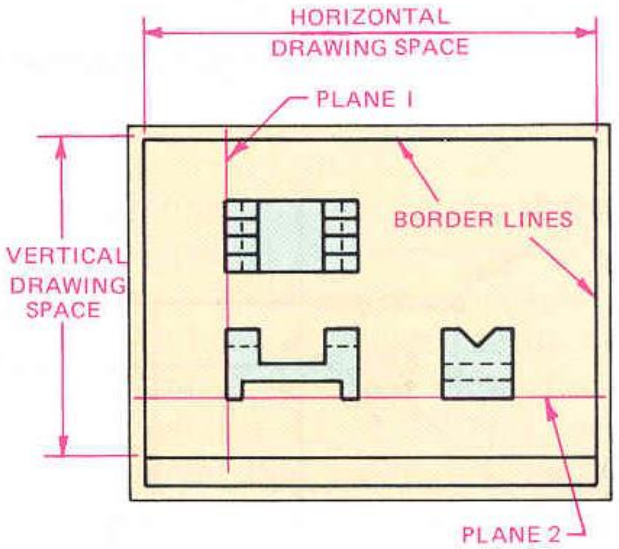
Balancing drawing on paper

- Drafter must anticipate space required
- Draw the views so that they are balanced on the drawing paper

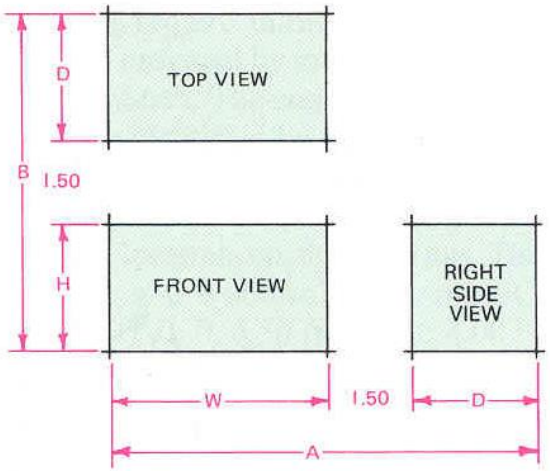
- Avoid crowding or excessive space
- See page 92 for details



(A) DECIDING THE VIEWS TO BE DRAWN AND THE SCALE TO BE USED



(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 Top View & Front View, 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

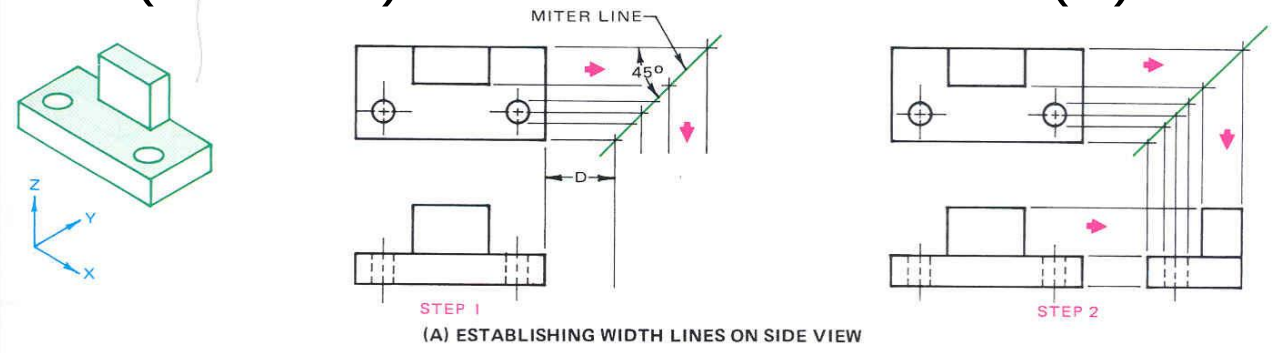


Fig. 6-2-2 Use of a miter line.

Arrangement of Views

Use of Miter Lines

4. Drop vertical lines from where the horizontal lines of the TV intersect the miter line

5. Project horizontal lines to the right of the FV

6. Complete side view

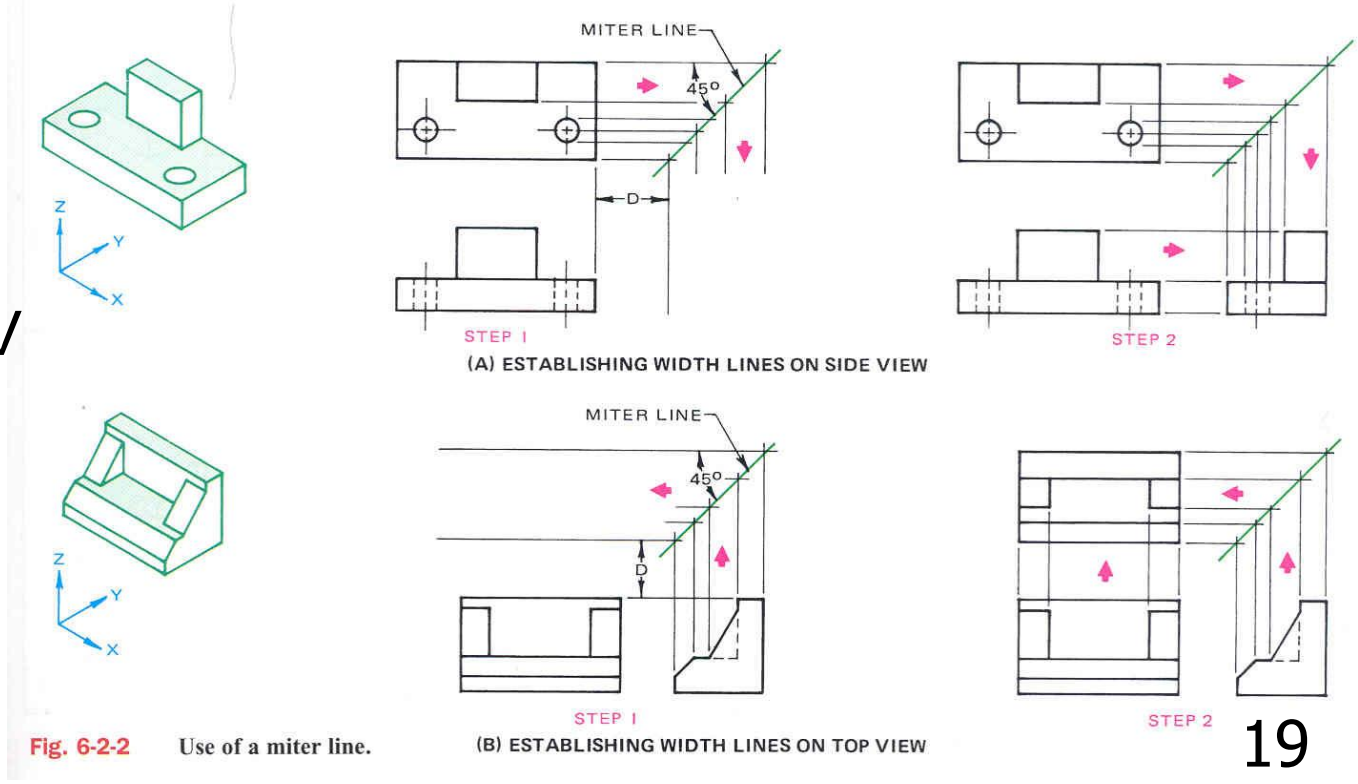
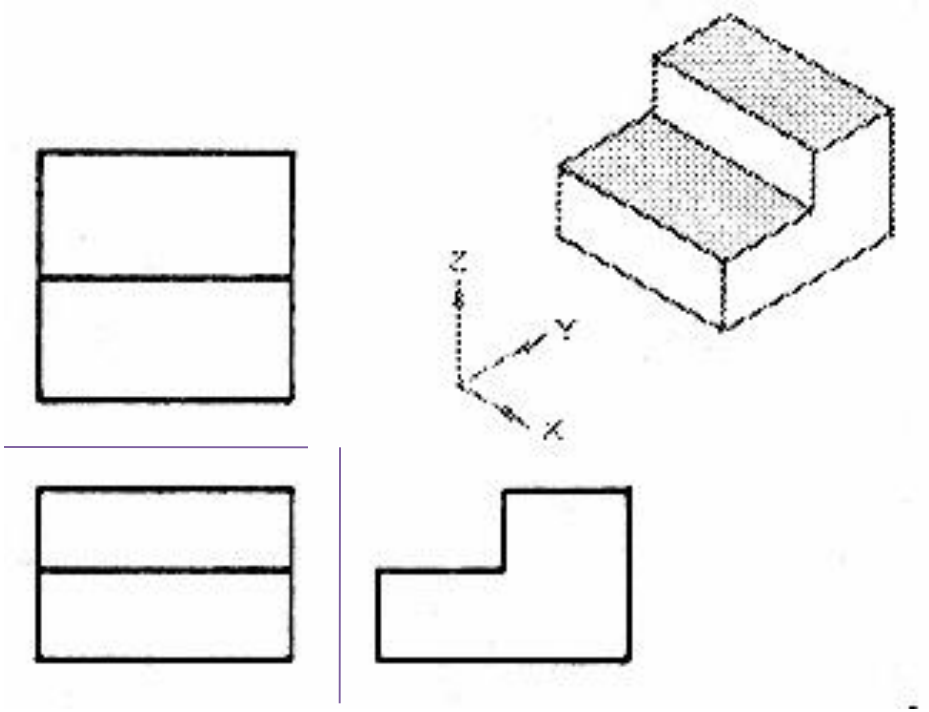


Fig. 6-2-2 Use of a miter line.

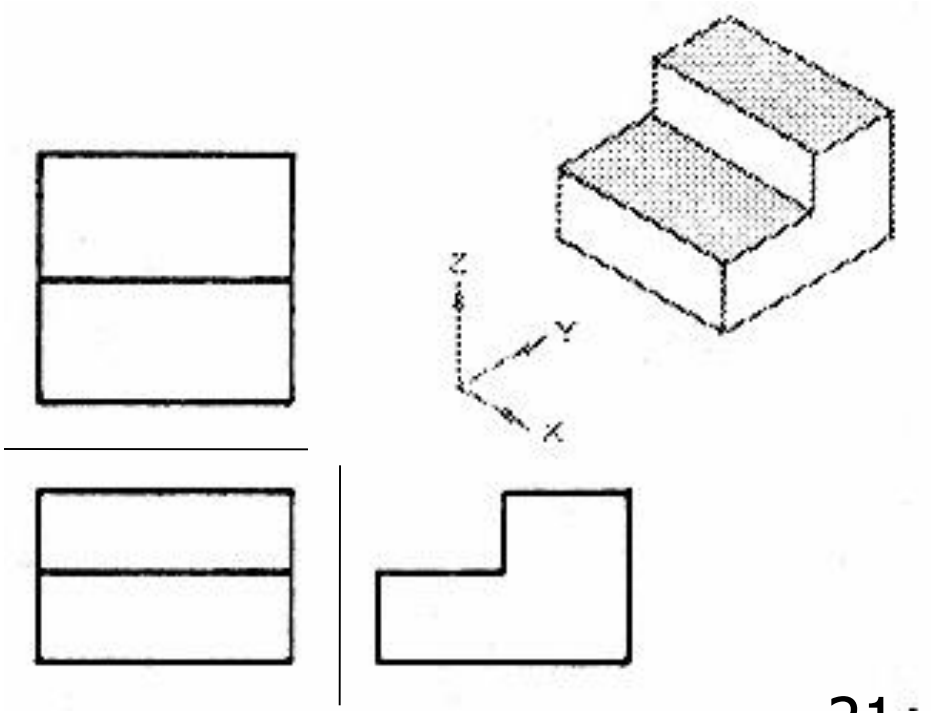
Arrangement of Views

- Use folding lines
- Use divider to draw the third view. (Faster)

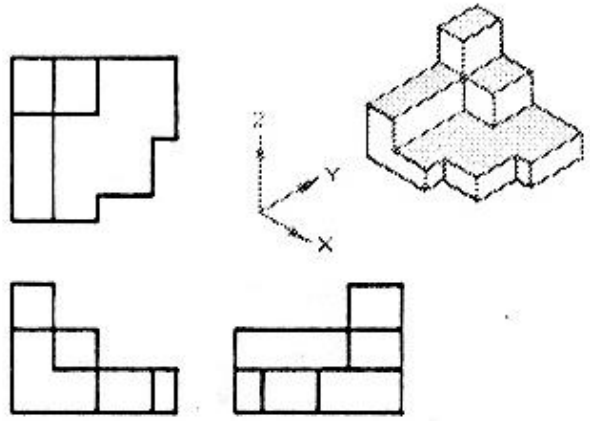


Parallel surfaces

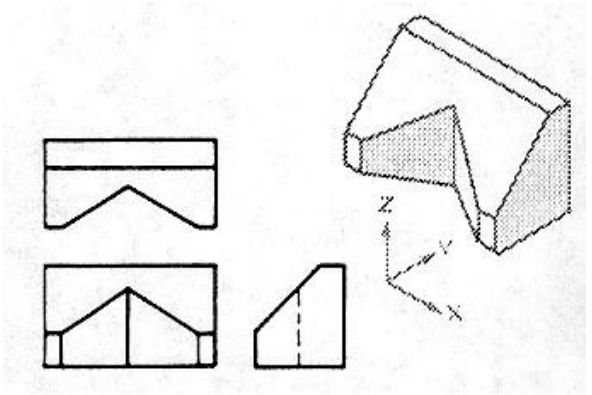
- Parallel surfaces appear parallel to the viewing plane, with and without hidden features
- It will appear as a surface in one view and lines in the other views
- The length of the lines in other views are same as is in the surface view



Types of Flat Surfaces

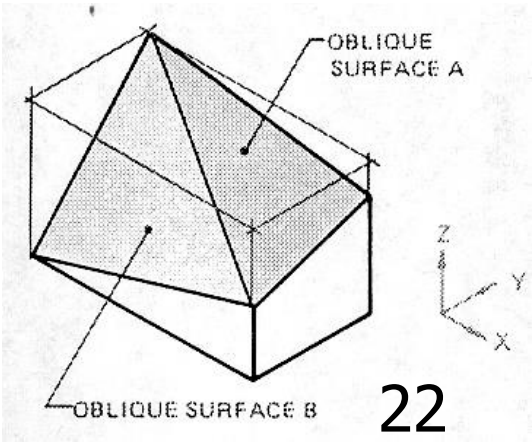


- Parallel surfaces appear parallel to the viewing plane, with and without hidden features



- Inclined surfaces appear inclined in one plane and parallel to the other two principal reference planes

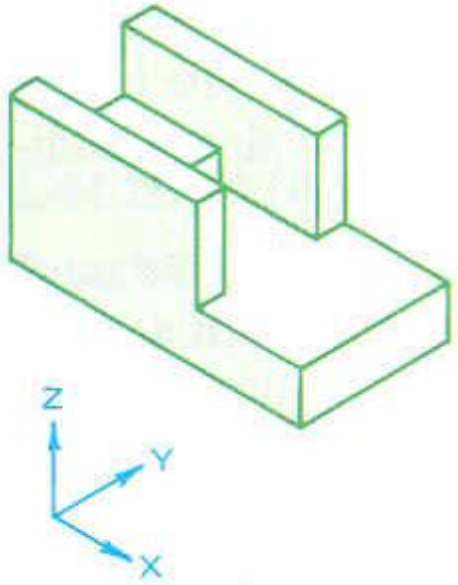
- Oblique surfaces appear inclined in all three reference planes

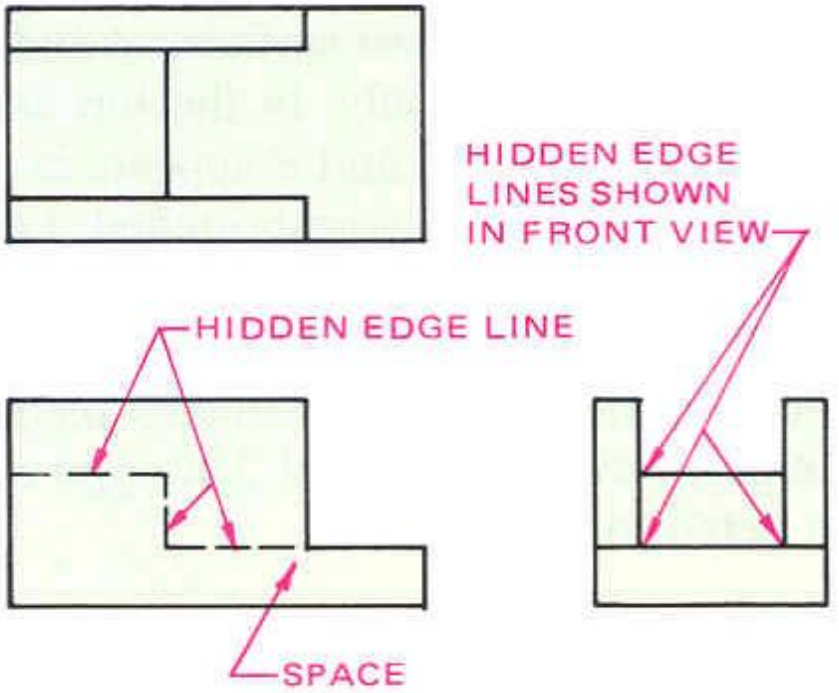


Hidden surfaces and edges

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

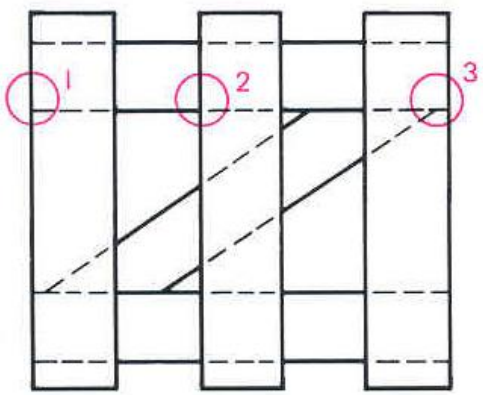




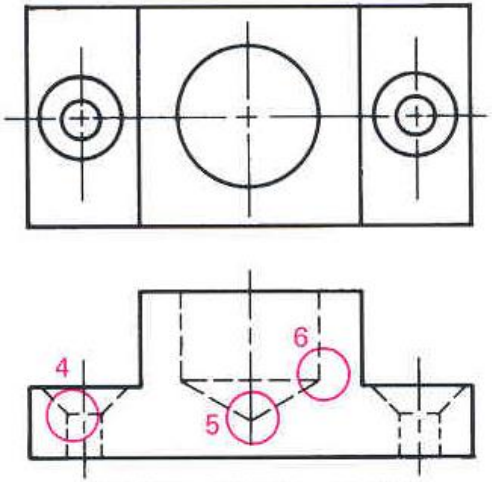
Hidden surfaces and edges

Application of hidden lines

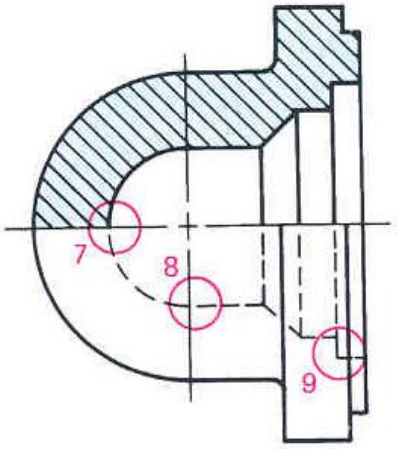
- Lines must begin and end with a dash except when it will be seen as an extension of a visible line
- Dashes should join at corners
- Arcs should start as dashes at tangent points



(A) GATE



(B) INK BOTTLE STAND

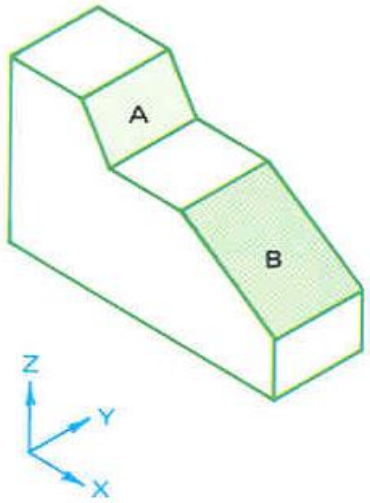


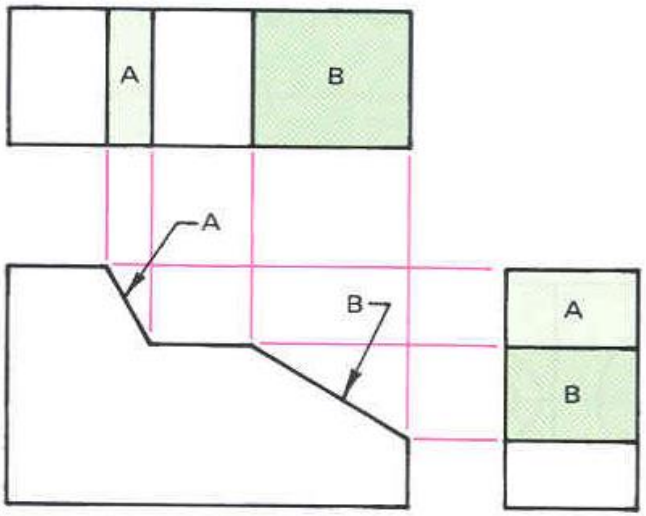
(C) CAP

Inclined Surfaces

Inclined surfaces 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 ? One auxiliary view

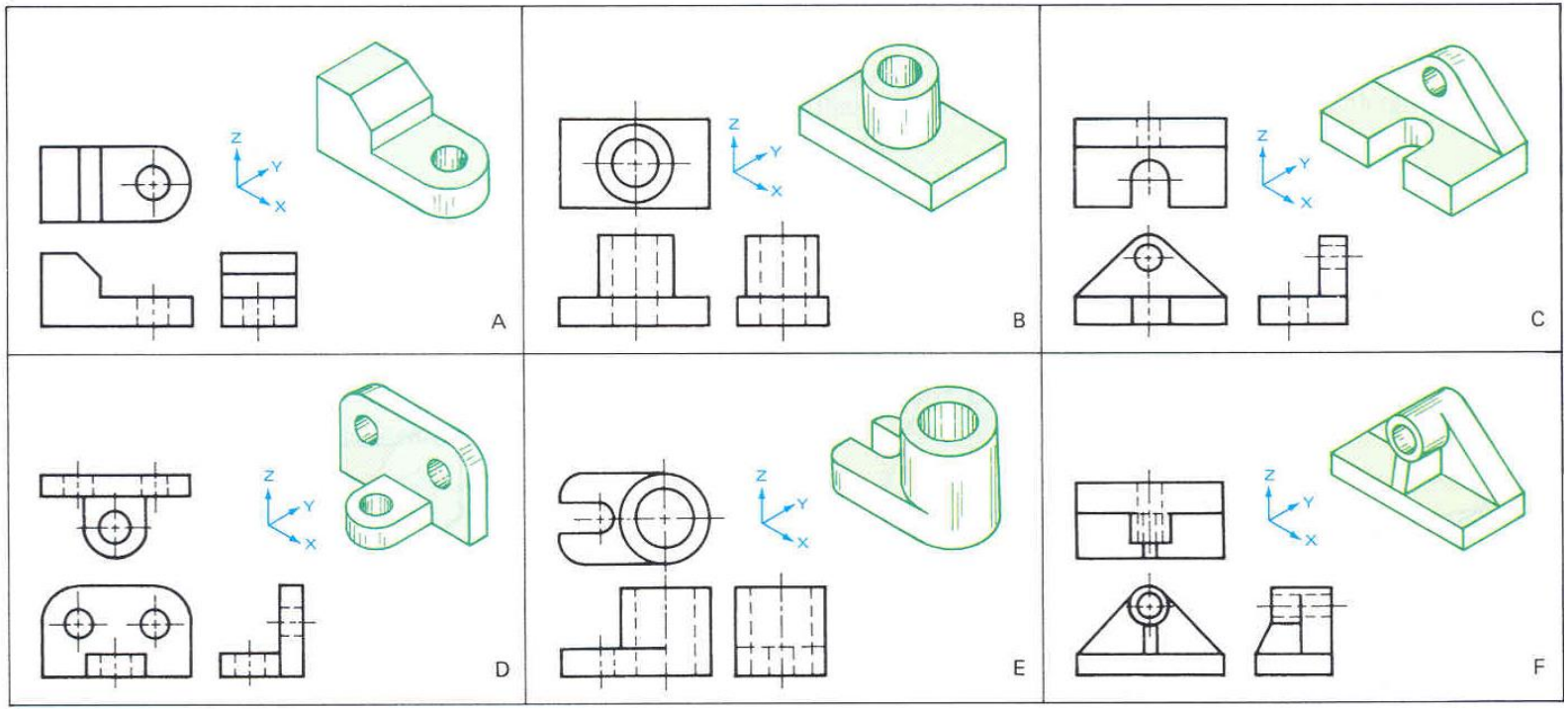




NOTE: THE TRUE SHAPE OF SURFACES A AND B DO NOT APPEAR ON THE TOP OR SIDE VIEWS.

Circular Features

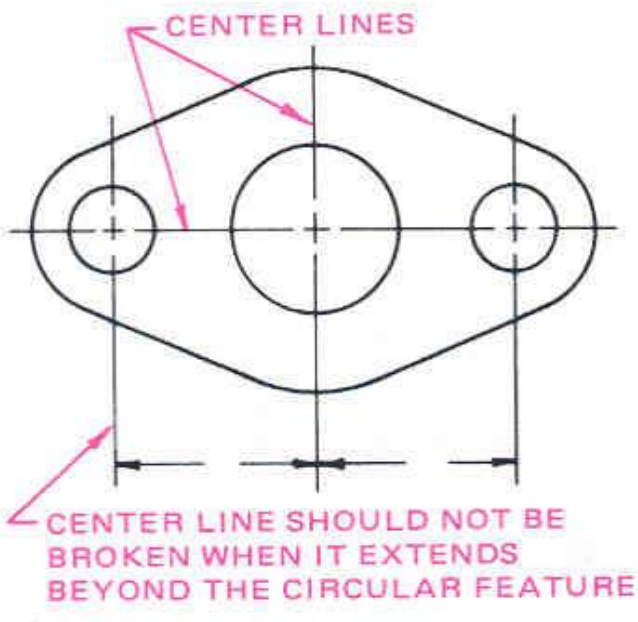
- Appear circular in only one view
- No line shown, when curved surface joins flat surface
- Hidden circles, shown as hidden lines
- Use of center lines

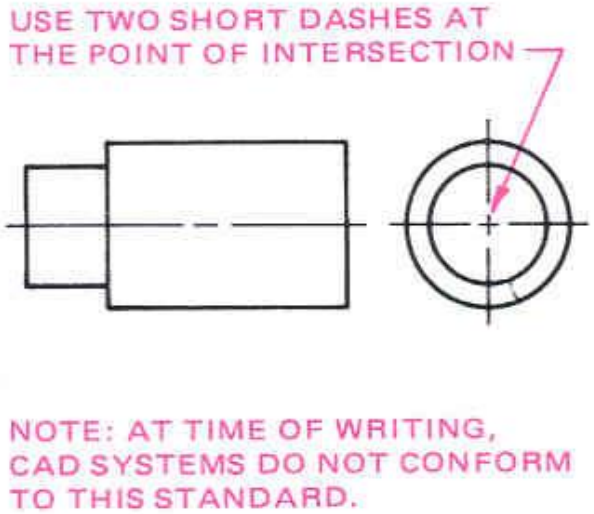


Circular Features

Center line applications

- Thin broken line (alternative long and short dashes)
- To locate center of circles or cylinders
- Lines should project beyond the outline of the referred part (not all the times, large part with small holes - No)
- Point of intersection of center lines must be used two short dashes.





Oblique Surfaces

Oblique surfaces 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 True Shape of oblique surface? (1,2,or 3 how?)

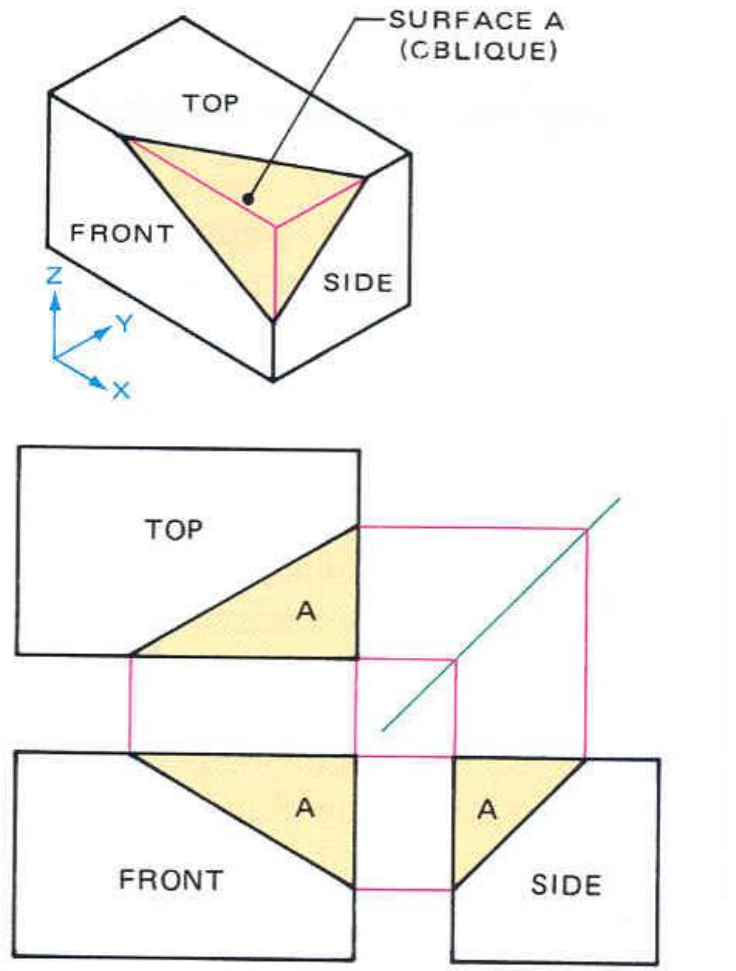


Fig. 6-7-1 Oblique surface is not its true shape in any of the three views.

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

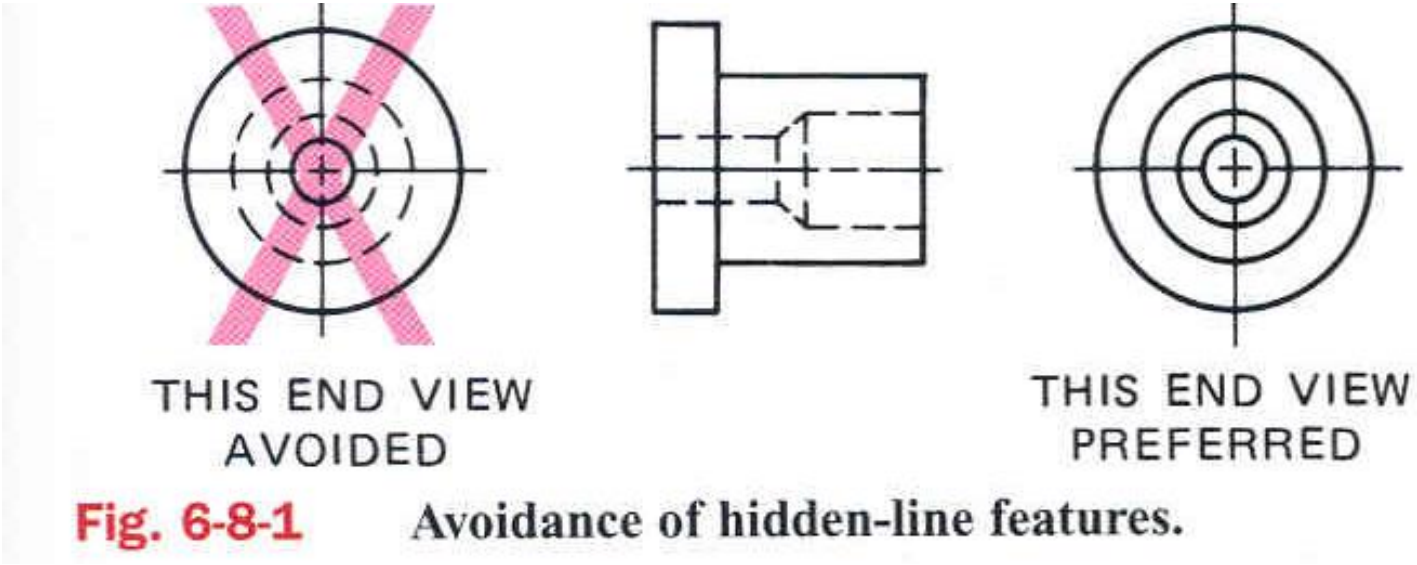


Fig. 6-8-1 Avoidance of hidden-line features.

One and two view drawings

One View drawing – Thin or symmetrical

- Third dim (thickness) expressed as note or symbols
- Abbreviations such as HEX ACRFLT (hexagon across flat), 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

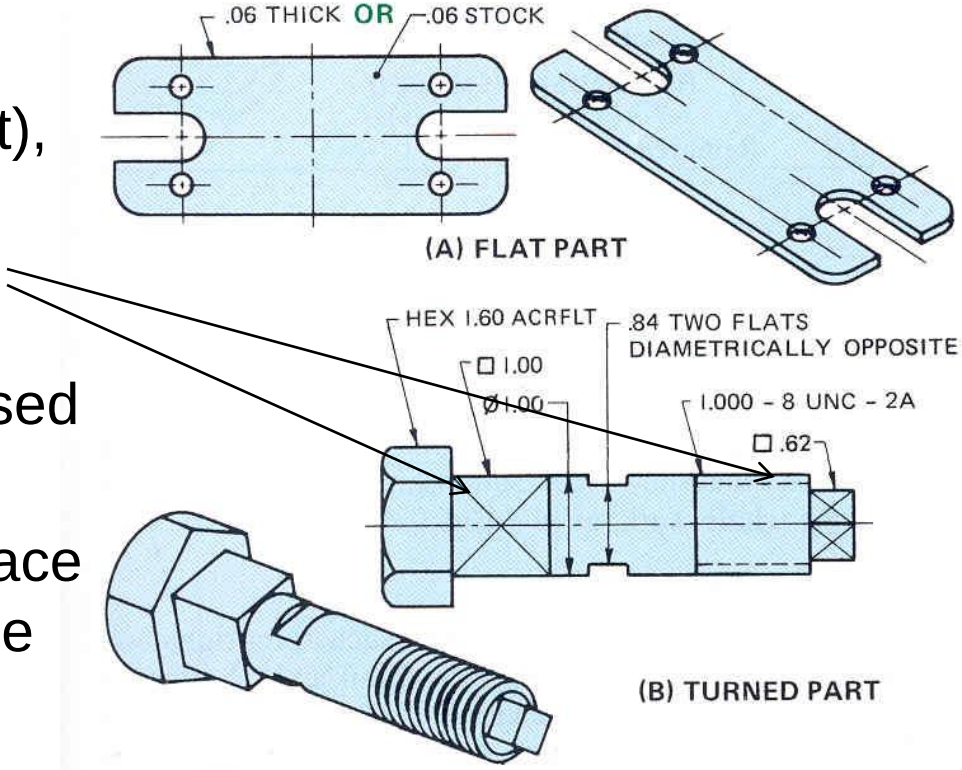
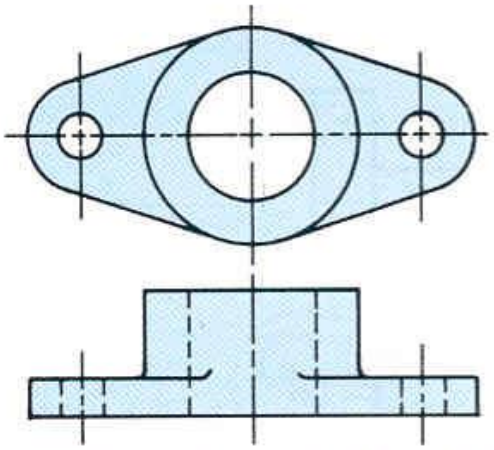


Fig. 6-8-2 One-view drawings.

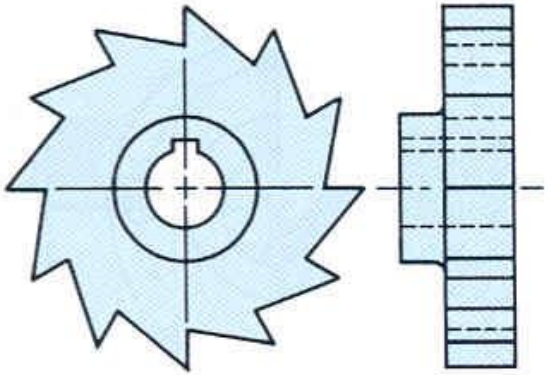
One and two view drawings

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



(A) SIDE VIEW NOT REQUIRED



(B) TOP VIEW NOT REQUIRED

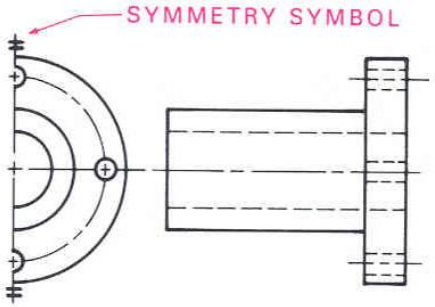
Fig. 6-8-3 Two-view drawings.

Special views

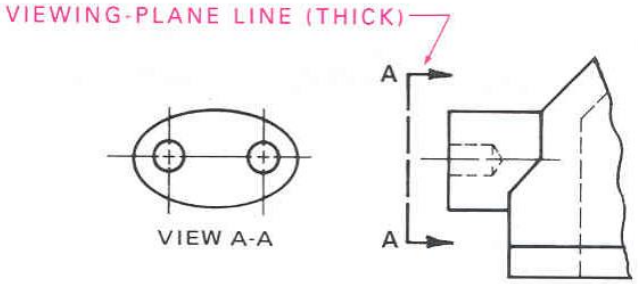
Partial views

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

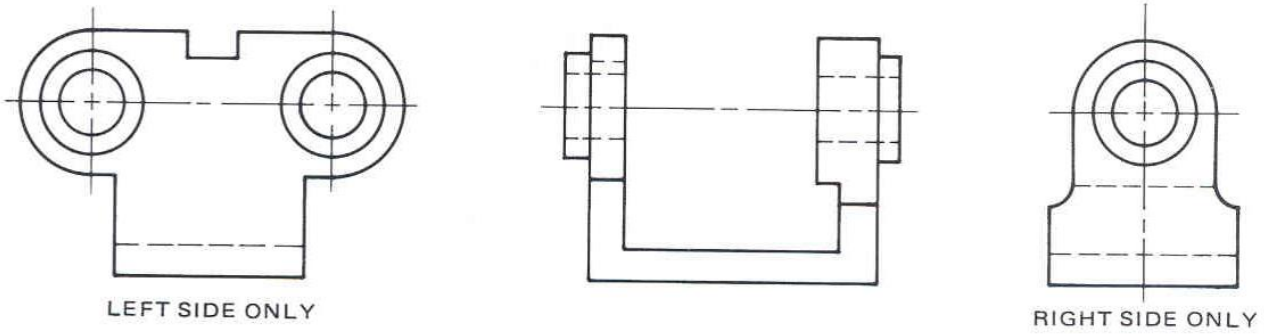
- For complex shapes, side views sometimes maybe sometimes partial



(A) WITH HALF VIEW



(B) PARTIAL VIEW WITH A VIEWING-PLANE LINE USED TO INDICATE DIRECTION

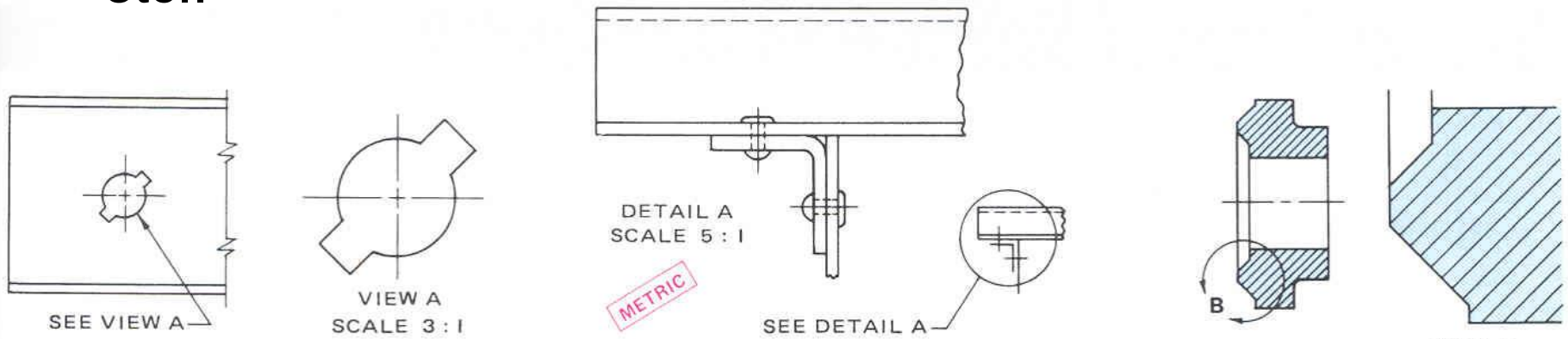


(C) PARTIAL SIDE VIEWS

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 scale, angle, direction etc..



Note: The scale for the enlarged view must be shown on drawing

(A) ENLARGED VIEW OF FEATURE (B) ENLARGED VIEW OF ASSEMBLY (C) ENLARGED REMOVED VIEW

Fig. 6-9-3 Enlarged views.

Special views

Key Plan

- Used primarily in structural drawings
- Includes a small key plan using Bold lines to show relationship between structures on that sheet to the whole work

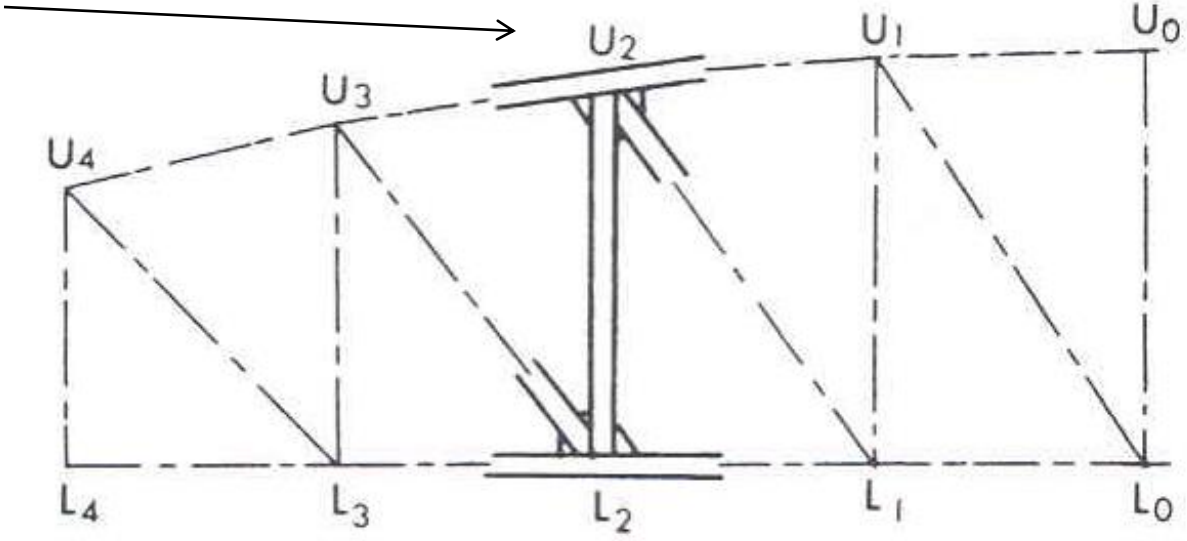


Fig. 6-9-4 Key plan.

Conventional representation

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

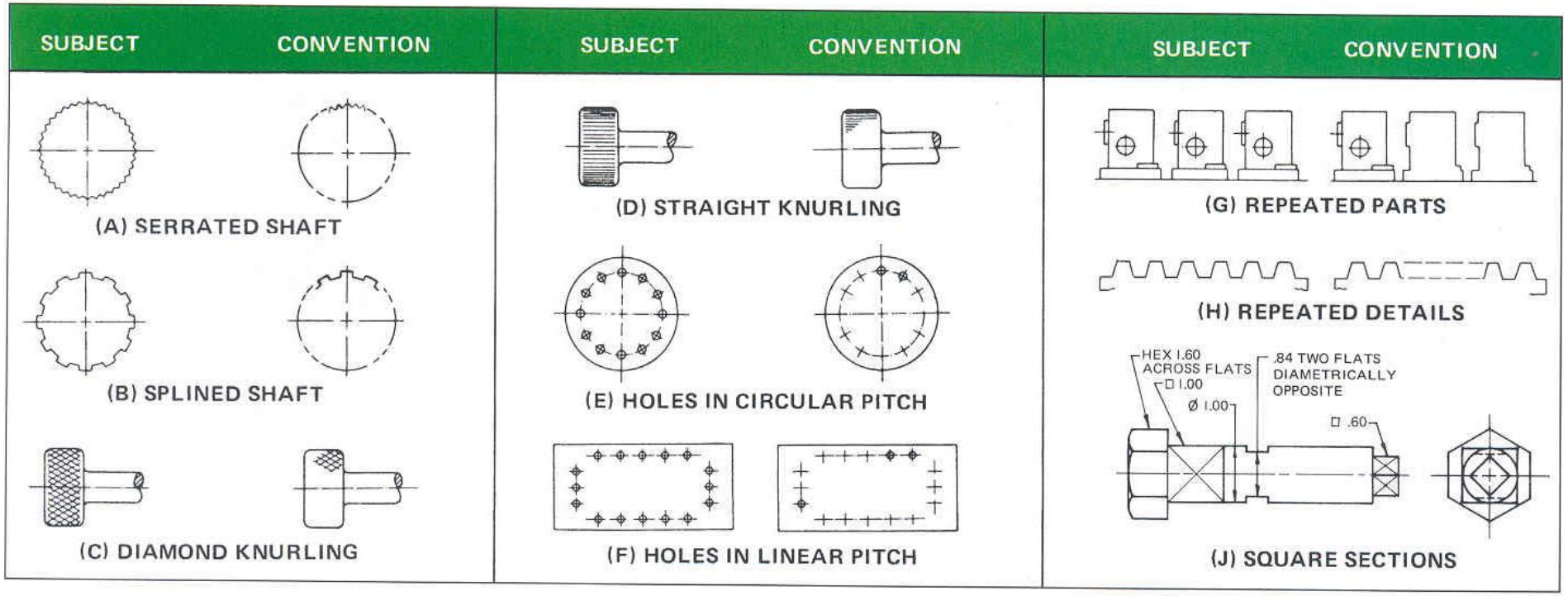
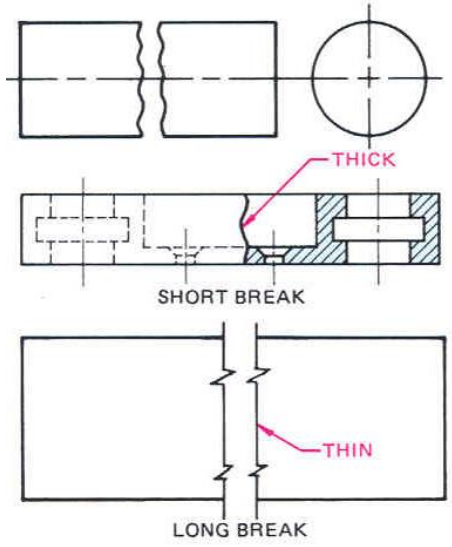


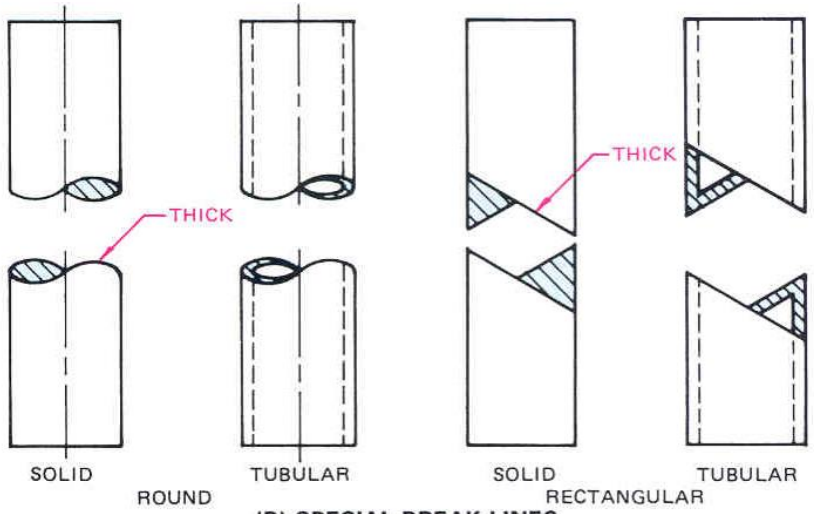
Fig. 6-10-1 Conventional representation of common features.

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



(A) GENERAL-USE BREAK LINES



(B) SPECIAL BREAK LINES

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

L1-1 Conventional breaks.

Cylindrical intersections

Conventional representation of holes in cylinders

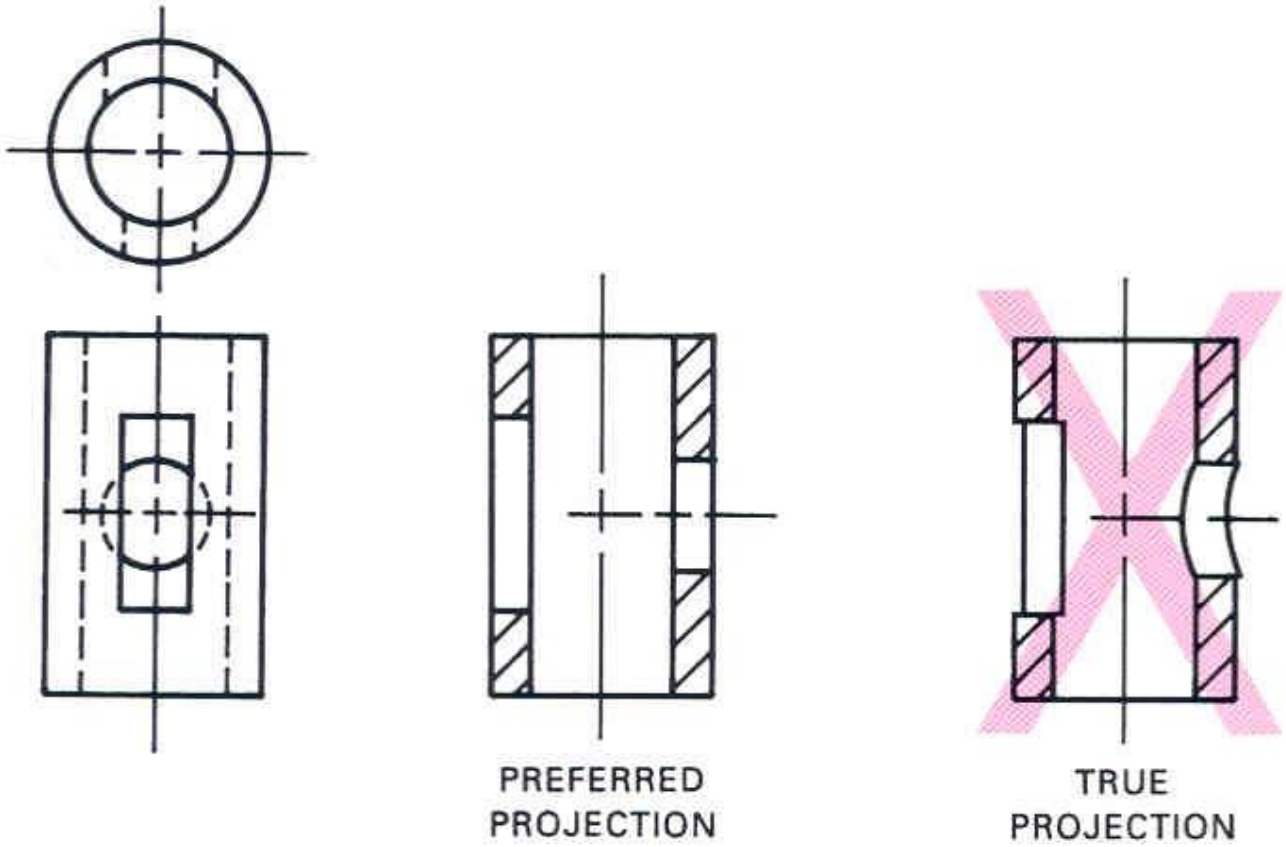


Fig. 6-13-2 Conventional representation of holes in cylinders.

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

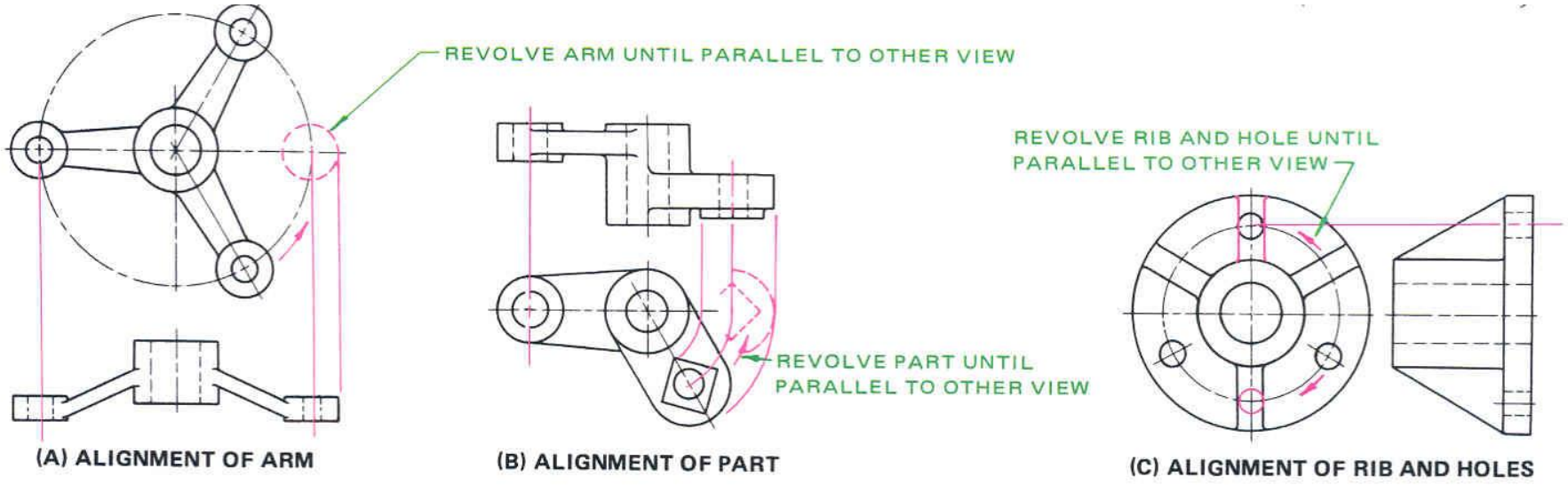


Fig. 6-14-1 Alignment of parts and holes to show true relationship.

Intersections of unfinished surfaces

- Intersection of unfinished surfaces that are rounded or filleted indicated by line at theoretical line of intersection
- True projection is often misleading
- For large radius no line is drawn

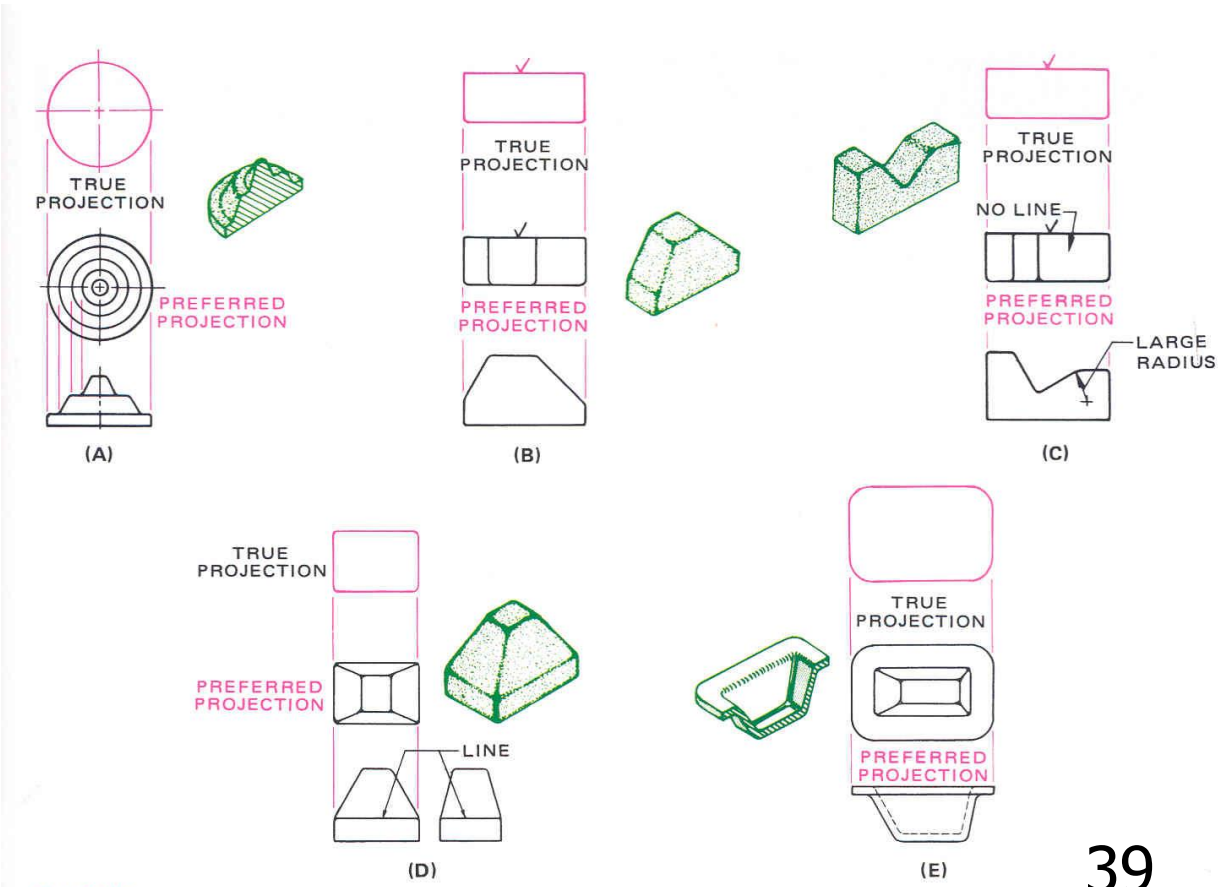


Fig. 6-15-1 Conventional representation of rounds and fillets.

Intersections of unfinished surfaces

- Ribs and arms that blend into features terminate in curves called runouts
- With manual drafting, small curves – freehand; large curves – irregular curves, compass, template

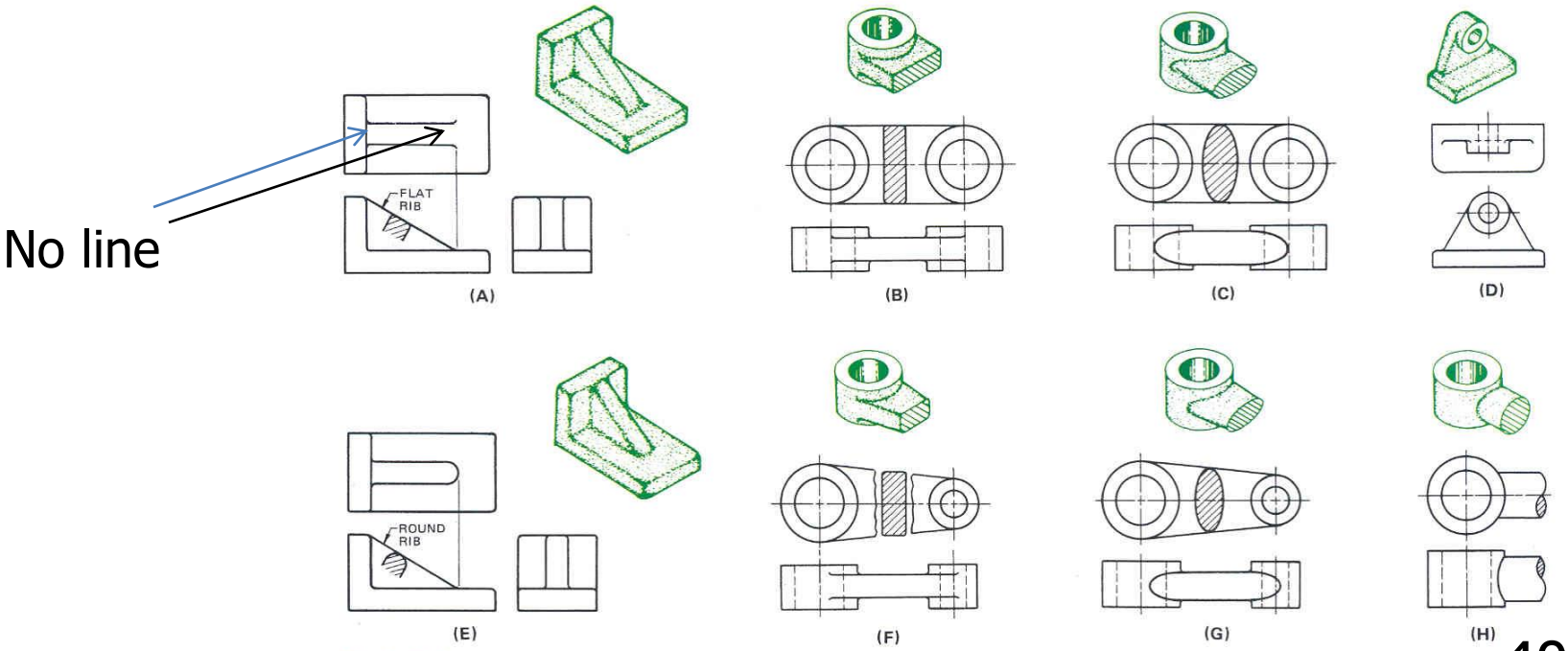


Fig. 6-15-2 Conventional representation of runouts.

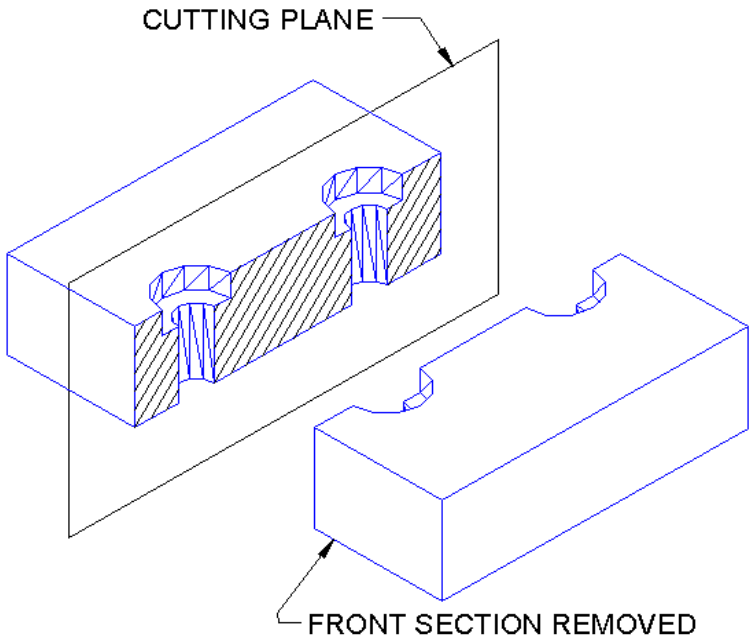
Sections

Outline

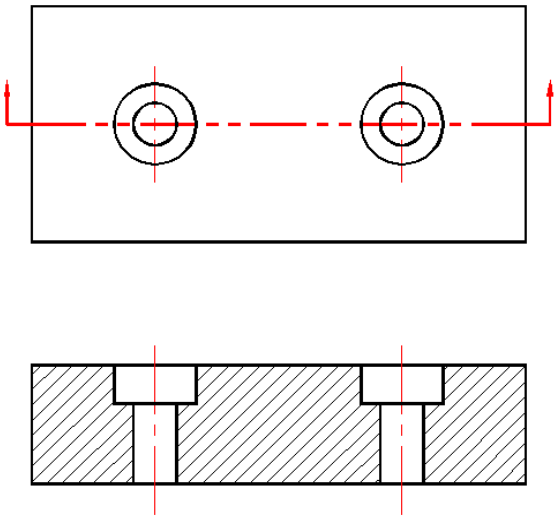
- Sectional views
- More sectional views in one drawing
- Half sections
- Threads and Assemblies in section
- Offset section
- Ribs, hoes and lugs in section
- Revolved and removed section
- Phantom lines

Sectional Views

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

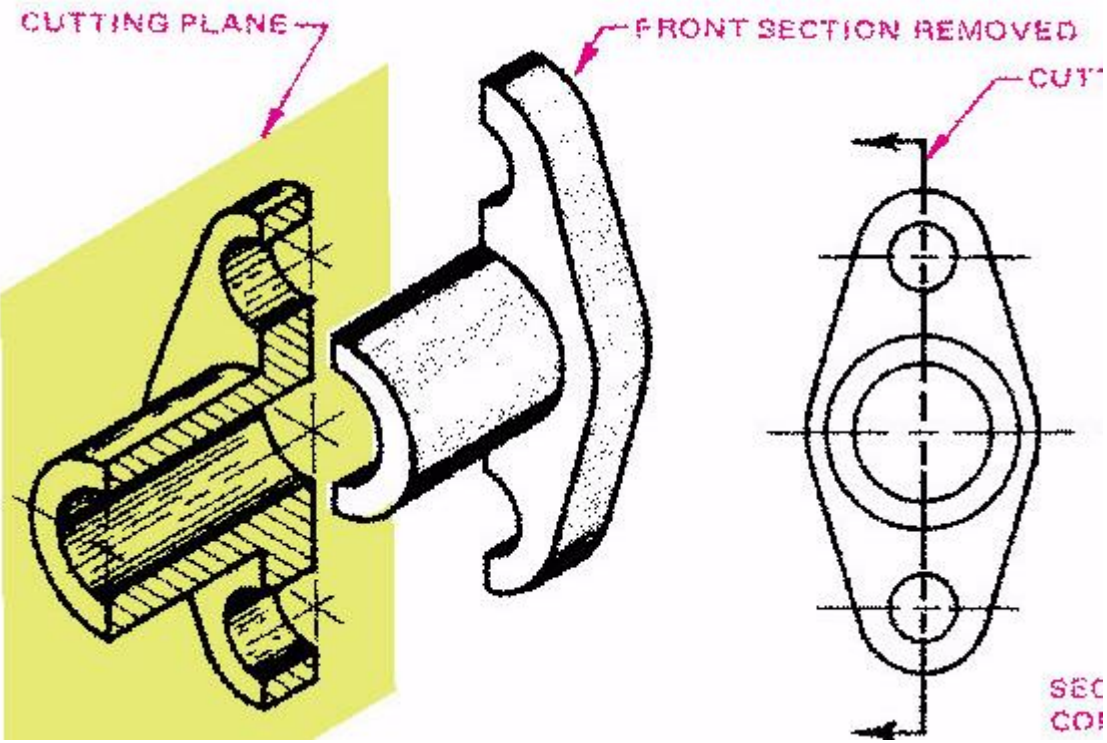


FULL SECTION



Sectional Views

Full Section

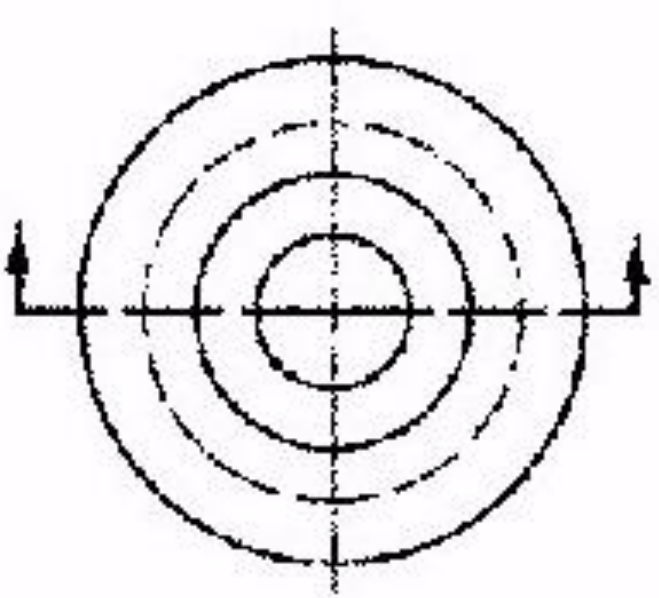


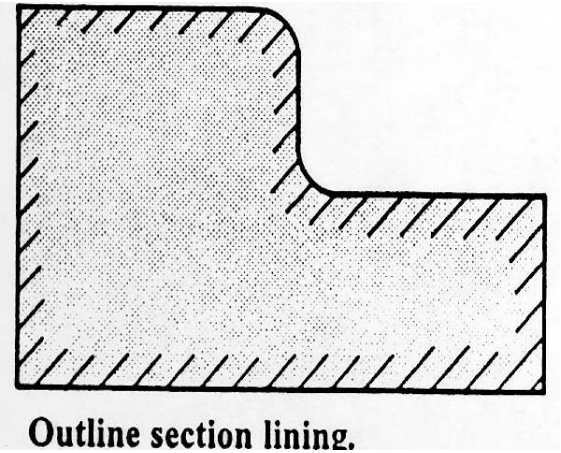
- A section view in which the cutting plane extends entirely through the object in a straight line

Sectional Views

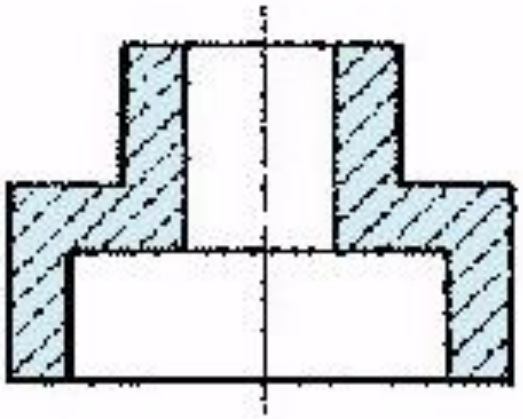
Sectional lining

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





Outline section lining.



Sectional Views

General Purpose Sectional lining

- 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

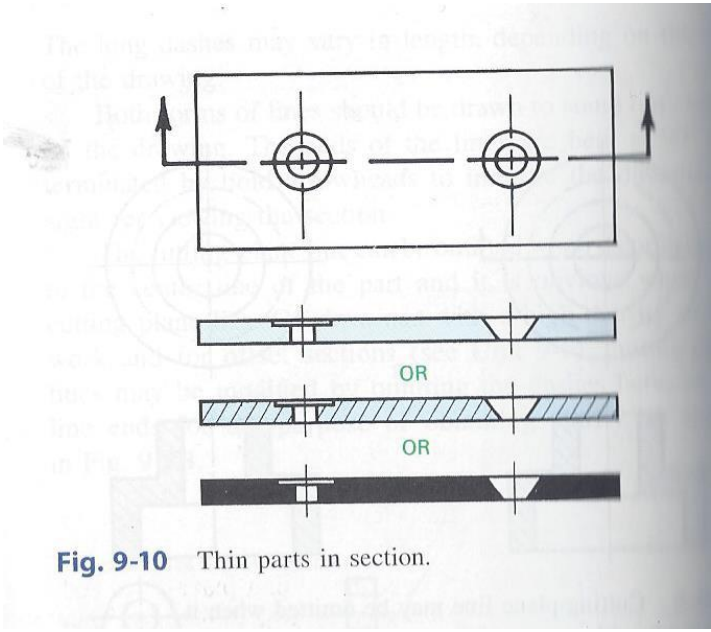


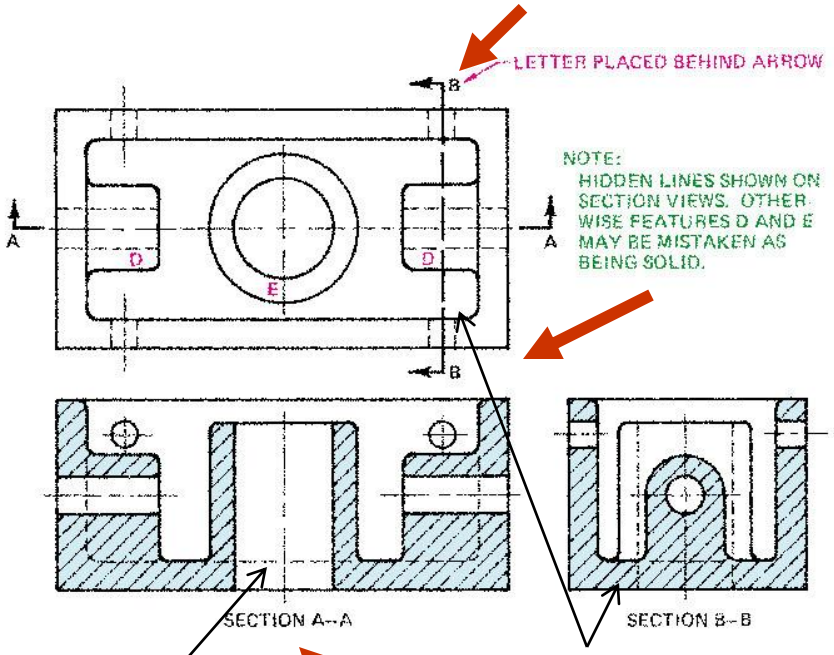
Fig. 9-10 Thin parts in section.

- To look for

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

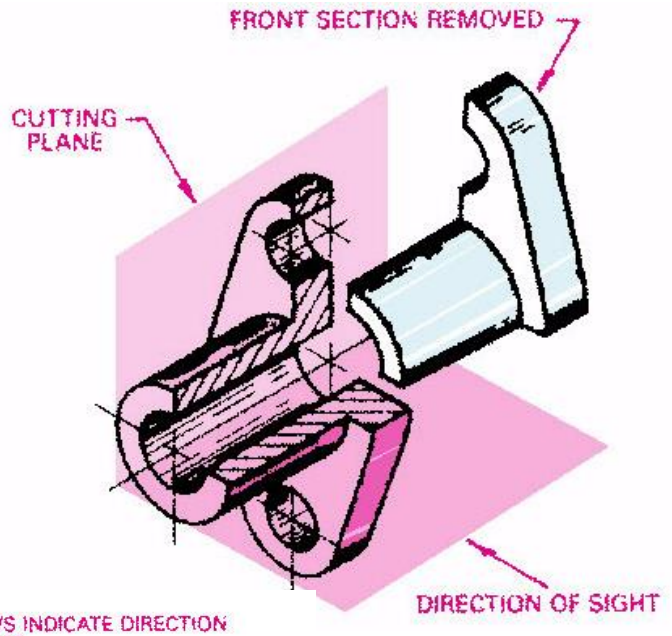
Two or more Sectional Views

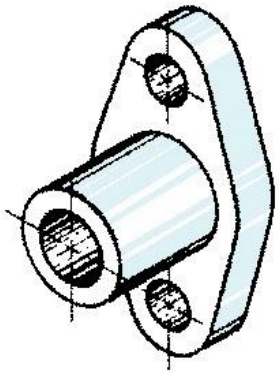
- If two or more sections appear on the same drawing:
- Cutting-plane lines are identified by two identical capital letters
- Sectional view subtitles incorporate the identification letters.

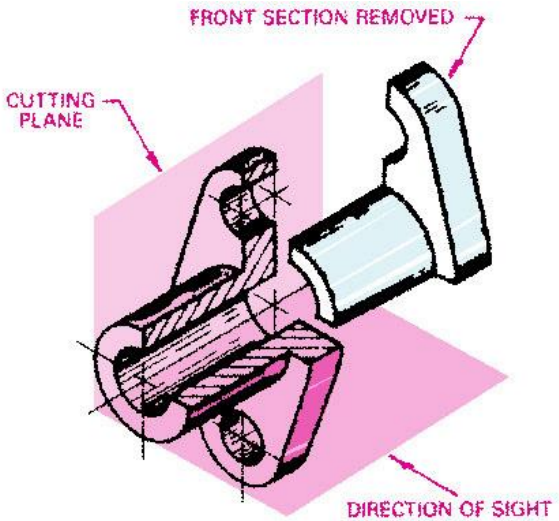


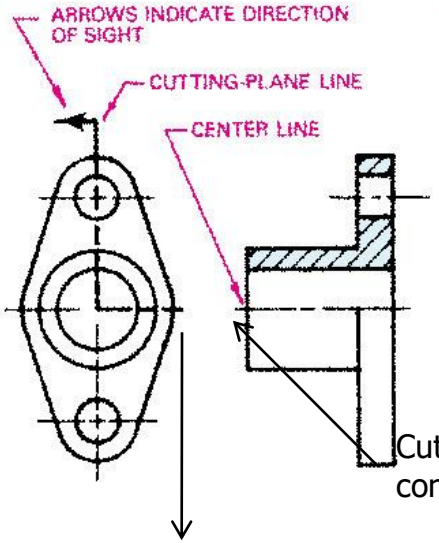
Half Sections

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









Half Sections

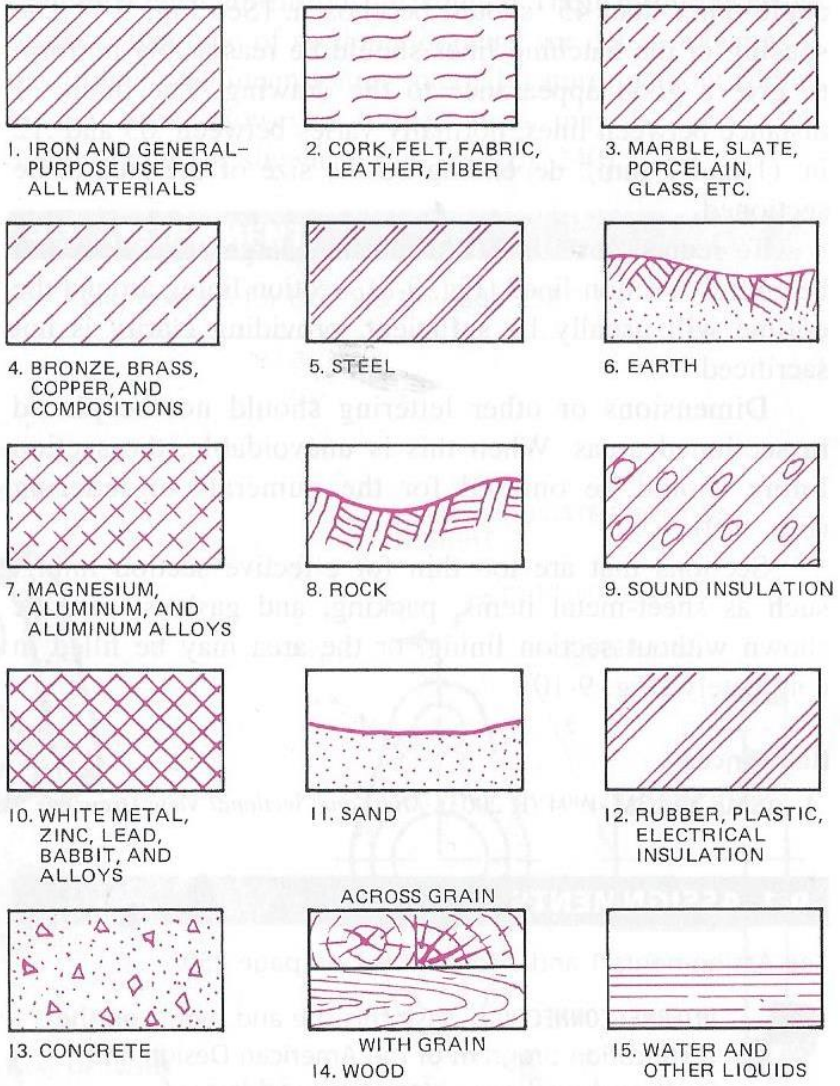


Fig. 9-6 Symbolic section lining.

Threads in Sections

Representation of threads in drawing

- Detailed, Schematic, Simplified

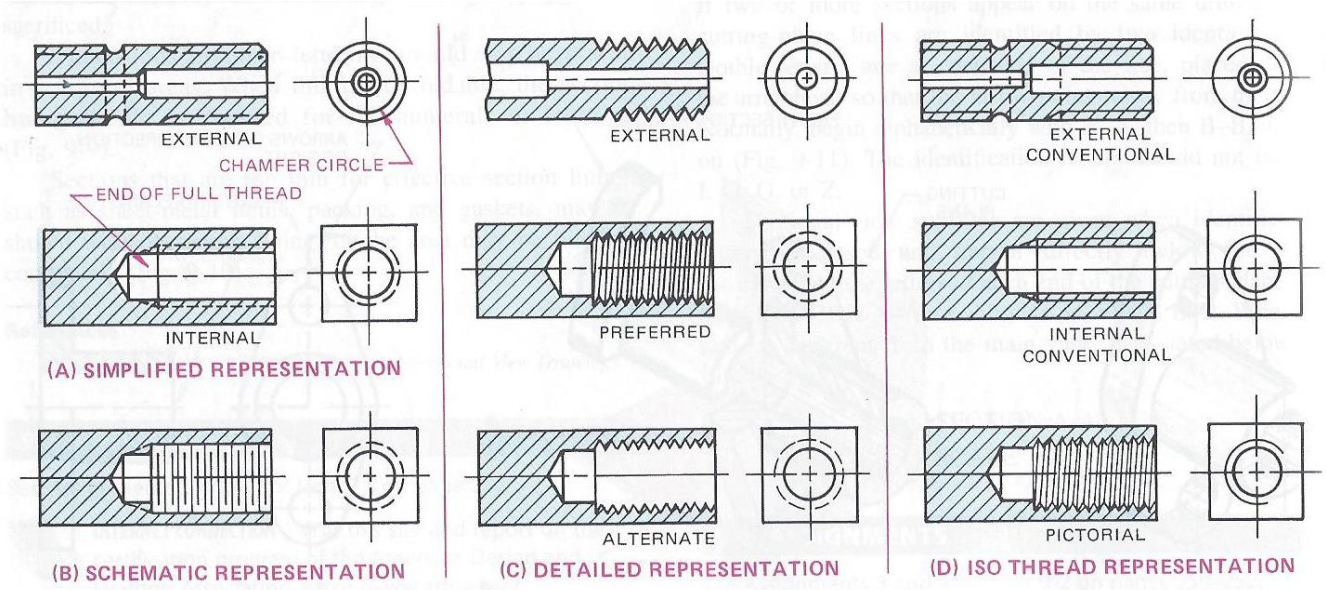
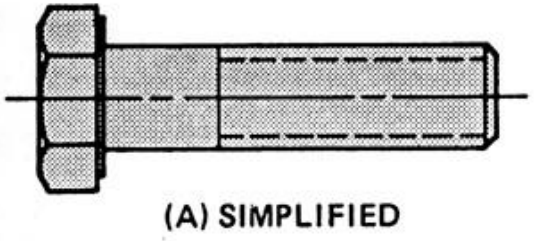
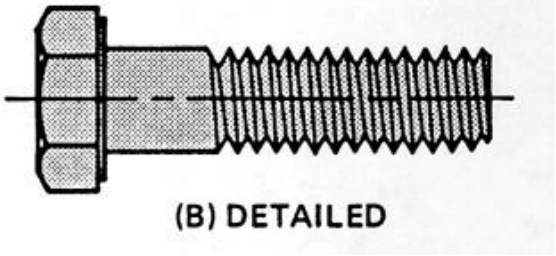
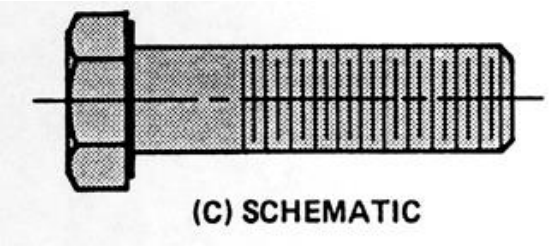


Fig. 9-15 Threads in section.



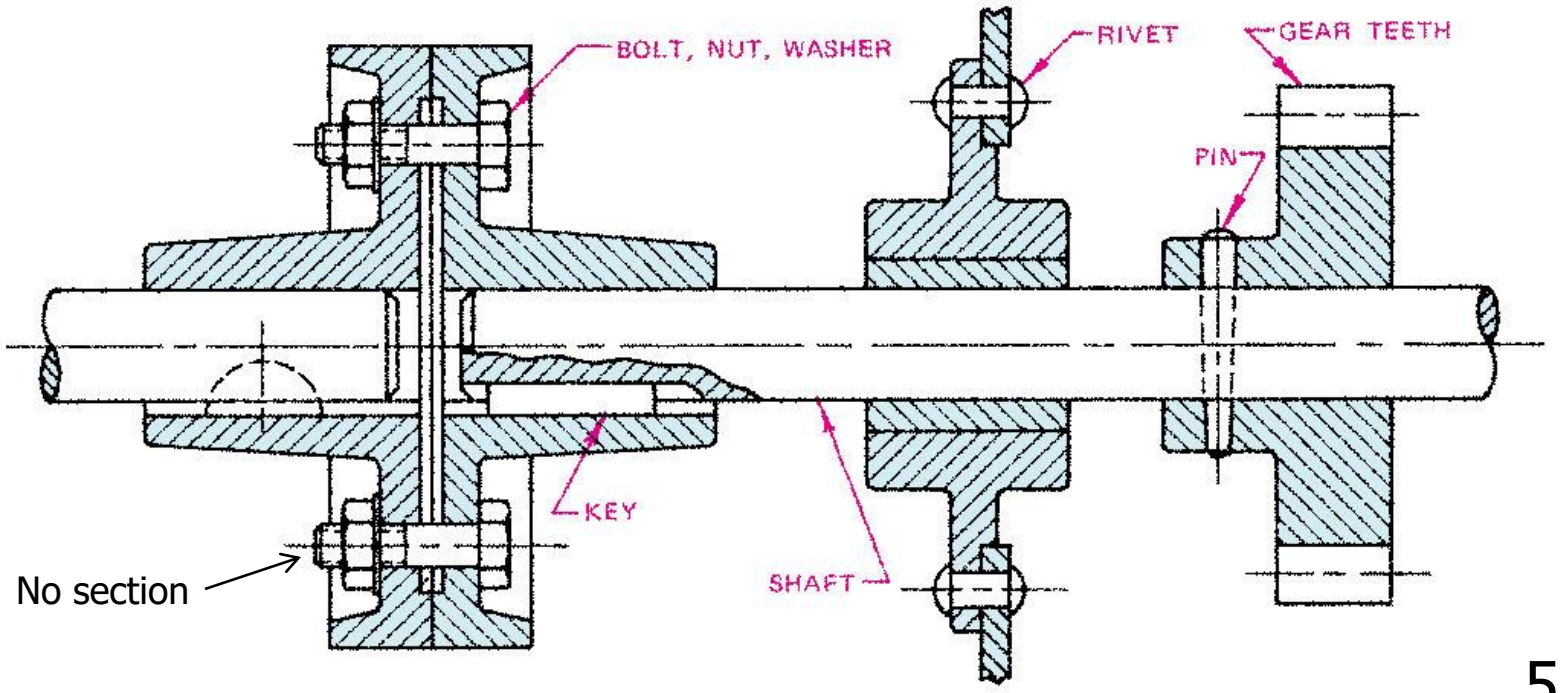




Assemblies in Sections

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

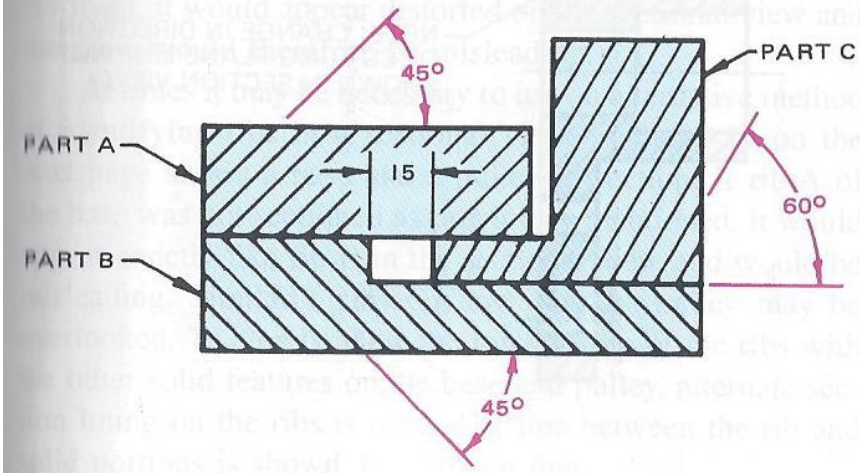
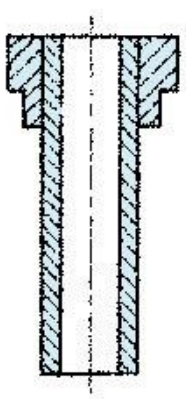
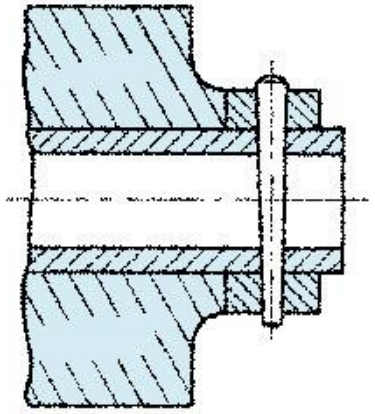


Fig. 9-18 Direction of section lining.



(A) ADJACENT PARTS



(B) ANGLE AND SPACING OF SECTION LINING

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

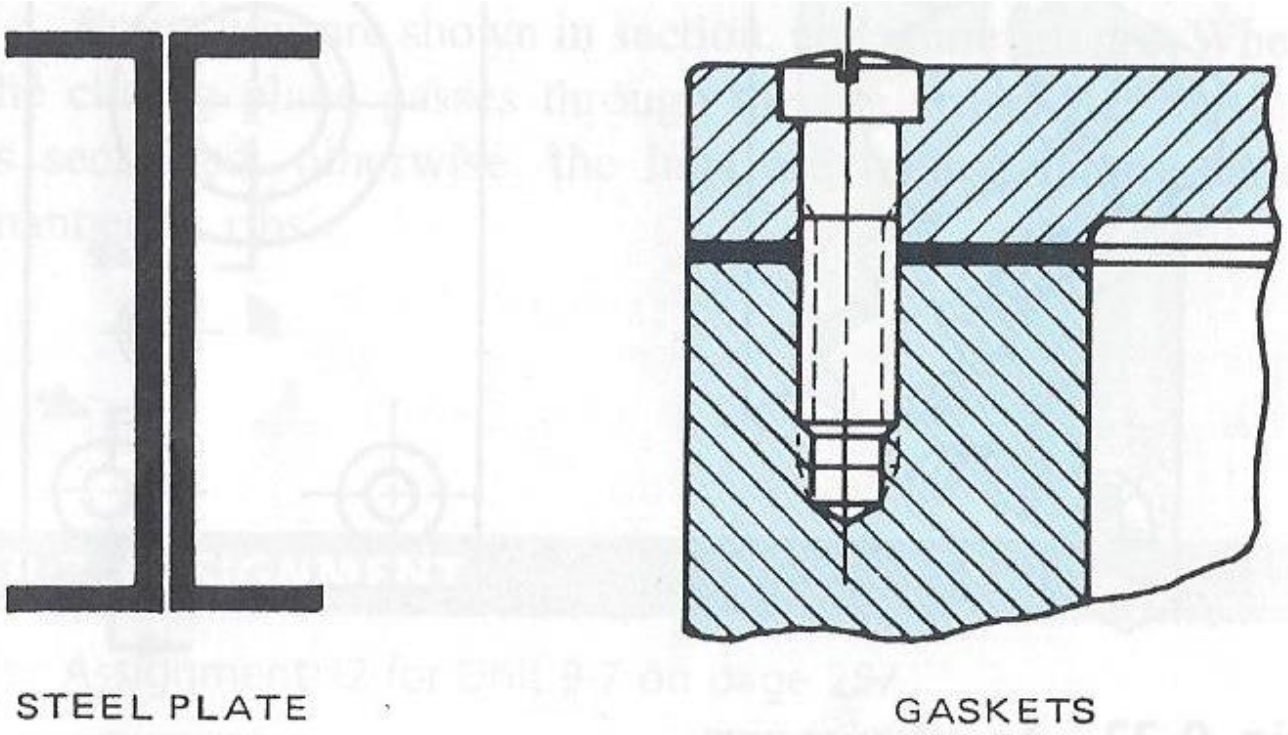
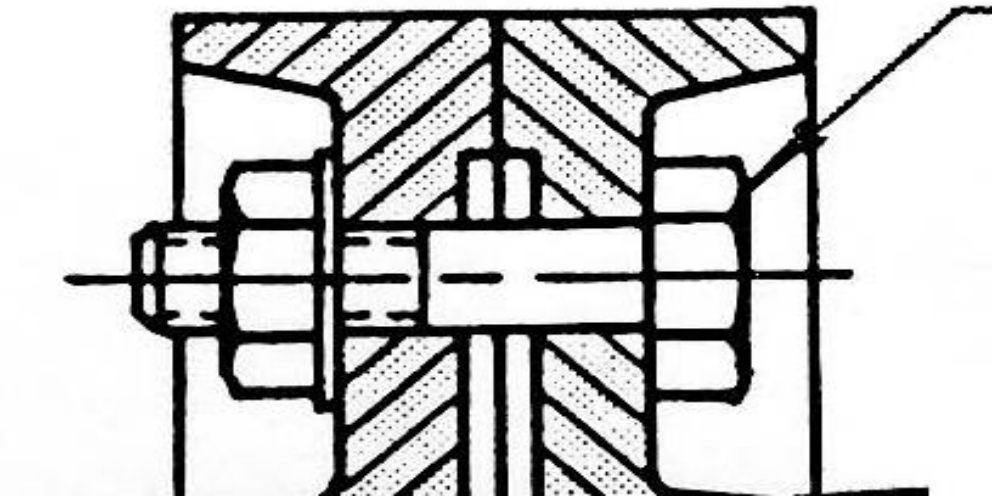


Fig. 9-20 Assembly of thin parts in section.

Assemblies in Sections

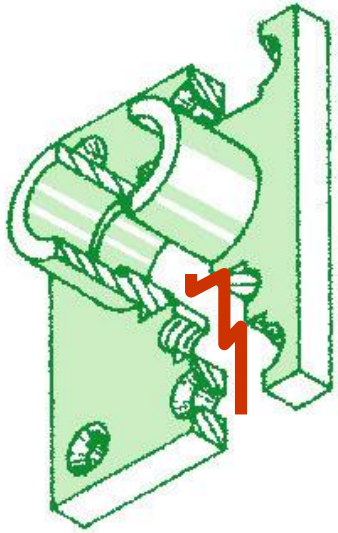
Parts generally not sectioned:

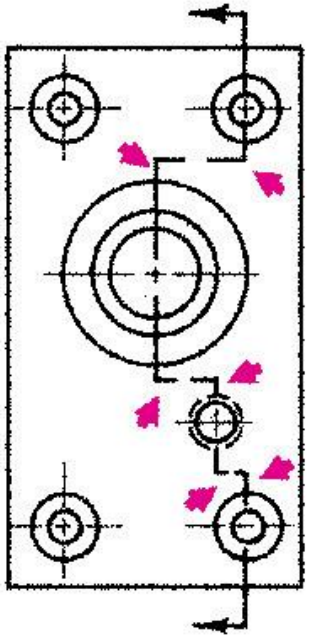
- Shafts
- Bolts
- Pins
- Keyseats
- Similar solid parts
  - A broken-out section of a shaft may be used to describe a key, keyseat, or pin.

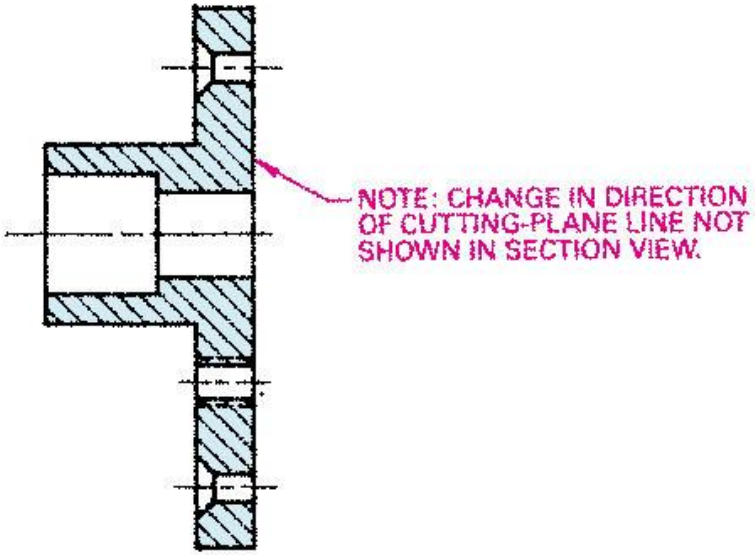


Offset Sections

A cutting plane can be bent to include several surfaces

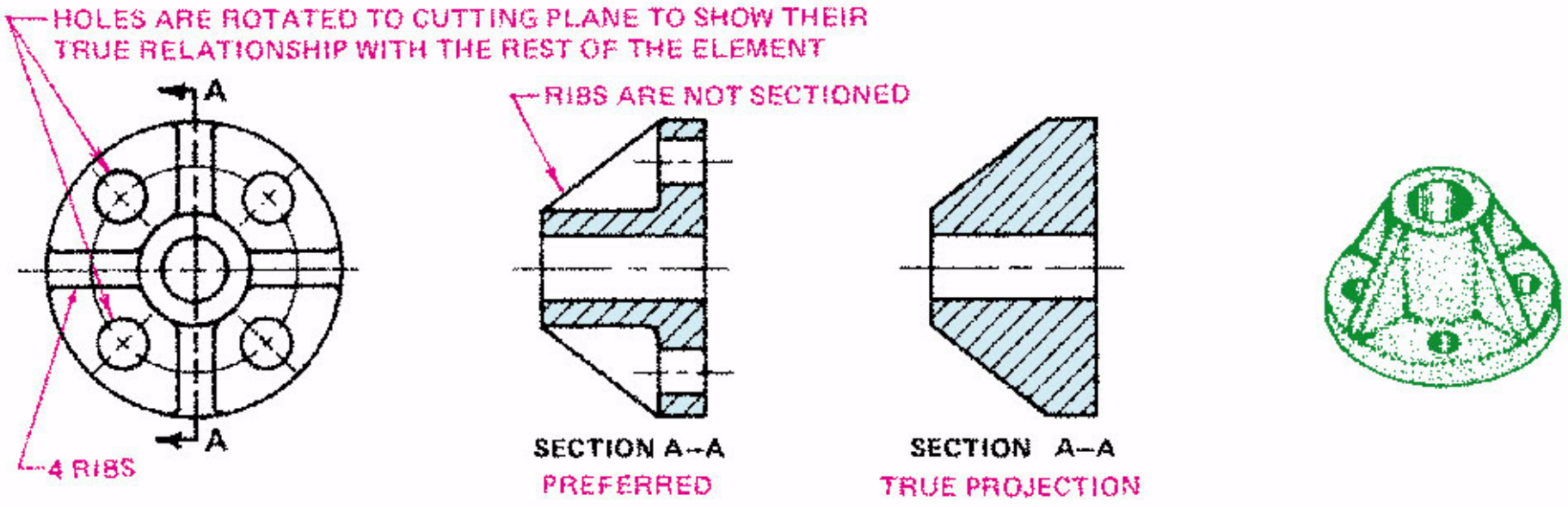






Ribs, Holes, and Lugs in Sections

Parts generally not sectioned:

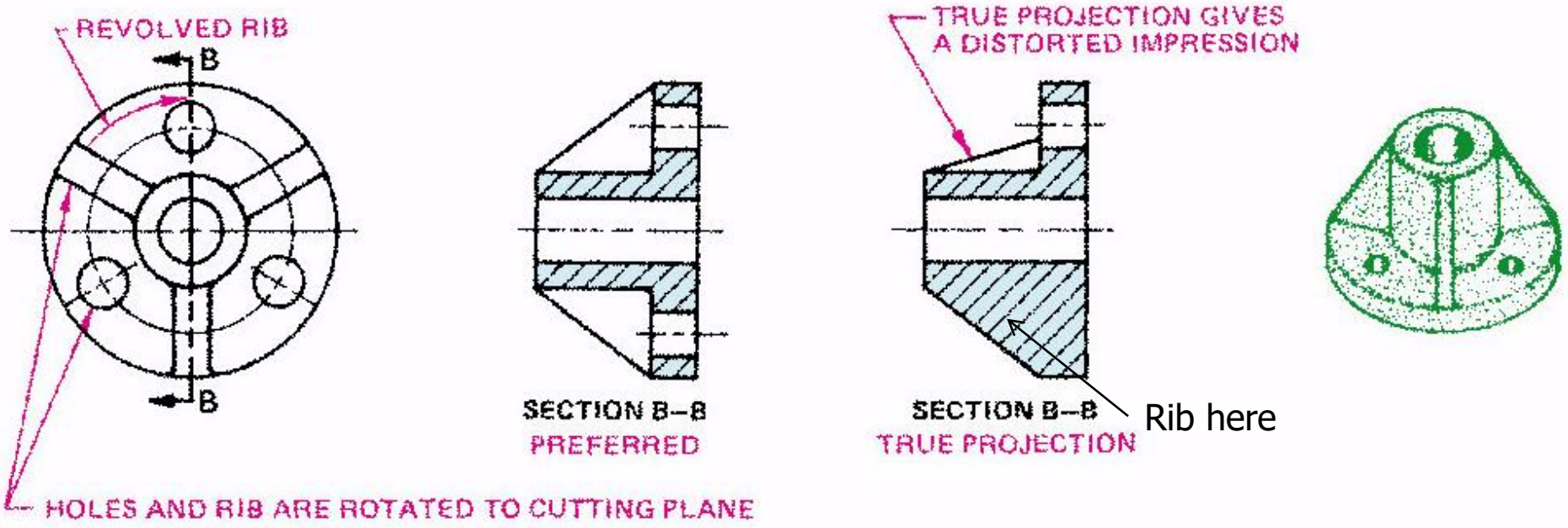


- Conventions for aligning ribs, holes and lugs in section

Ribs, Holes, and Lugs in Sections

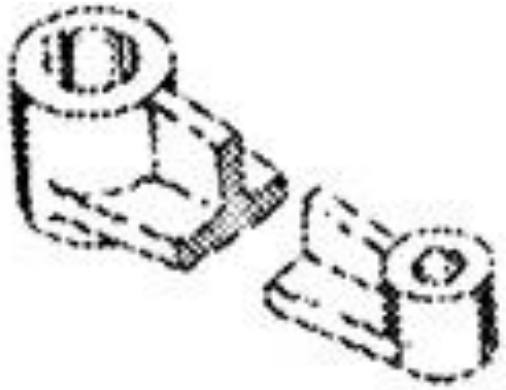
Aligning and rotating

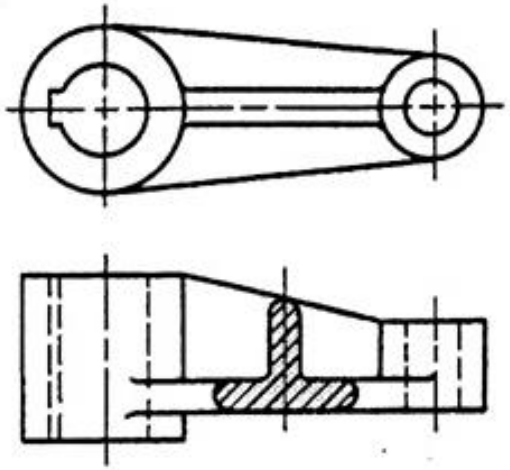
- When a true projection would be misleading, the rib, hole or lug is revolved to show its true relationship to the part



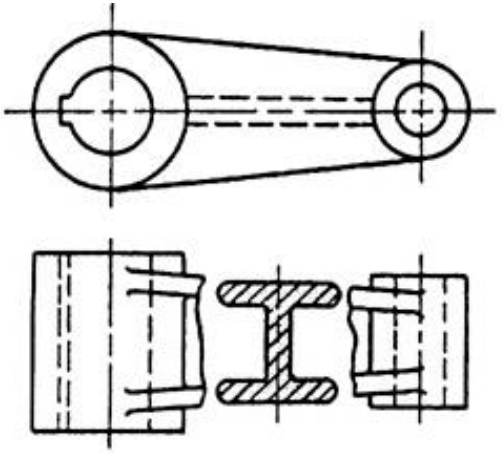
Revolved and Removed Sections

Ribs, spokes, and arms





(B) REVOLVED SECTION

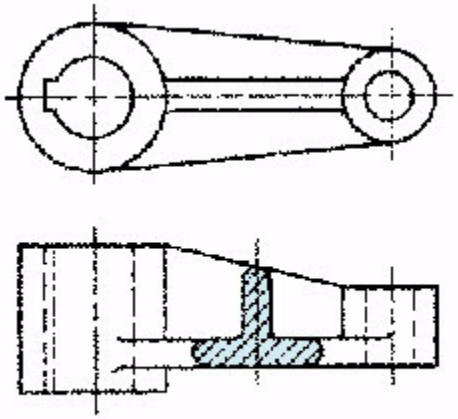


(D) REMOVED SECTION WITH MAIN VIEW BROKEN FOR CLARITY

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



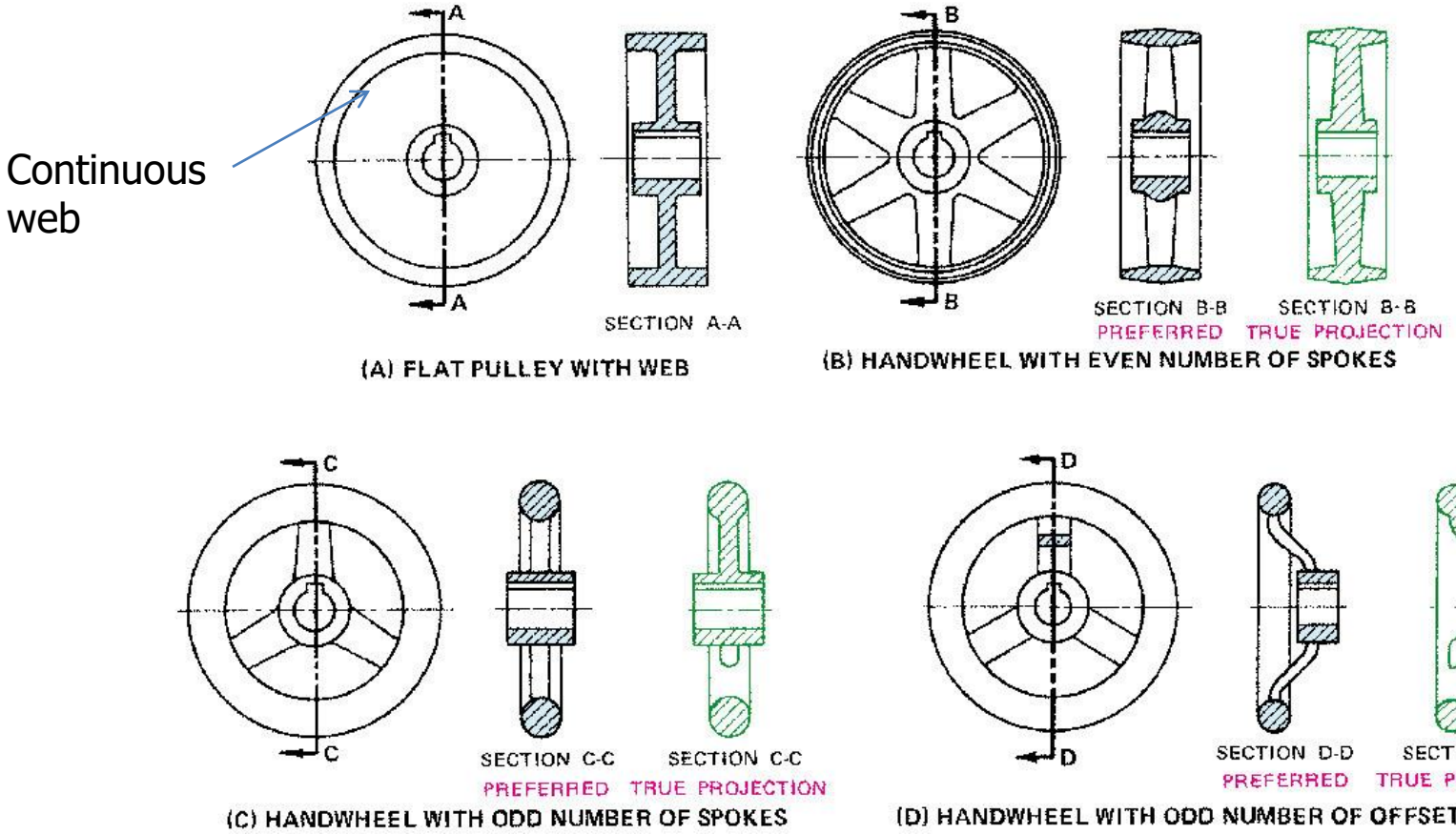
(B) REVOLVED SECTION

Removed section:

- Removed to an open area on drawing; may be enlarged. Shorten object length.

Spokes and Arms in Sections

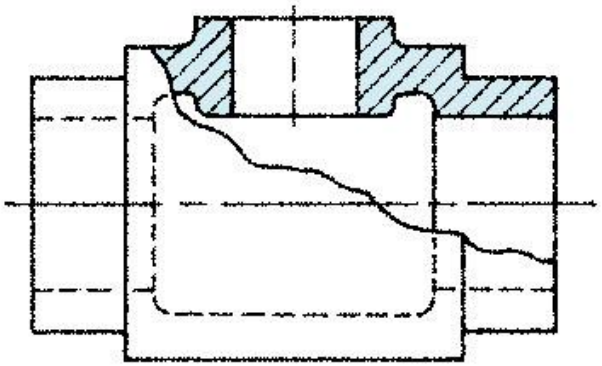
- Section lining is not drawn on parts that are
  - Not solid
  - Not continuous around the hub



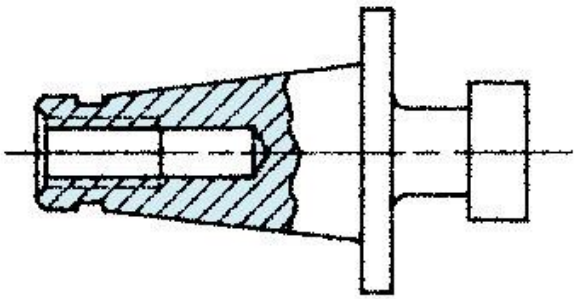
Partial or Broken out Sections

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

EXAMPLE 1



EXAMPLE 2



EXAMPLE 3