2.007 Design and Manufacturing I
Spring 2009

Sketching and Drawings

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Prof. David Gossard

Lecture topics (tentative)

- Sketching & Drawings
- Modeling basic components 1
- Modeling basic components 2
- Making drawings
- Assemblies
- Case studies

} CAD

Objectives

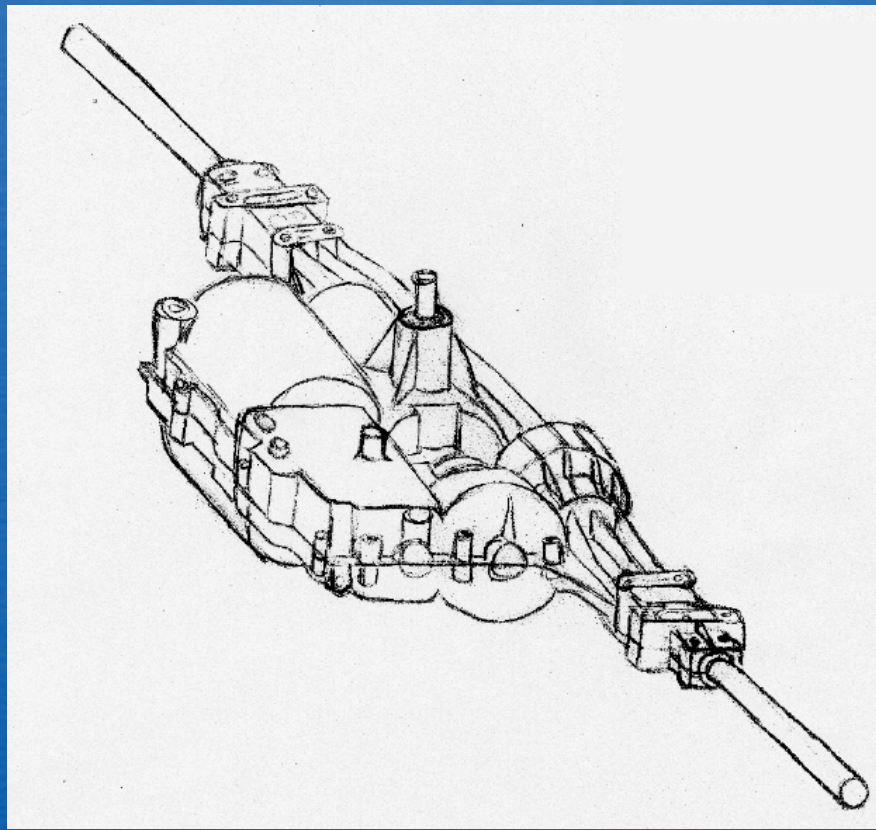
- Enable you to
  - Communicate ideas about physical objects in isometric sketches
  - Understand and create working drawings
  - Create CAD models (parts, drawings, assemblies)
- Caveats:
  - These lectures are only a start, i.e. the basics
  - Mastery requires practice and time

Reminder

- To those who've "seen it before":
  - Bear with us
  - Help those who haven't

Terminology

- **Sketch**
  - Rough, approximate
  - Communicates general shape & proportion
  - Quick, cheap
  - Produced by hand or with simple tools



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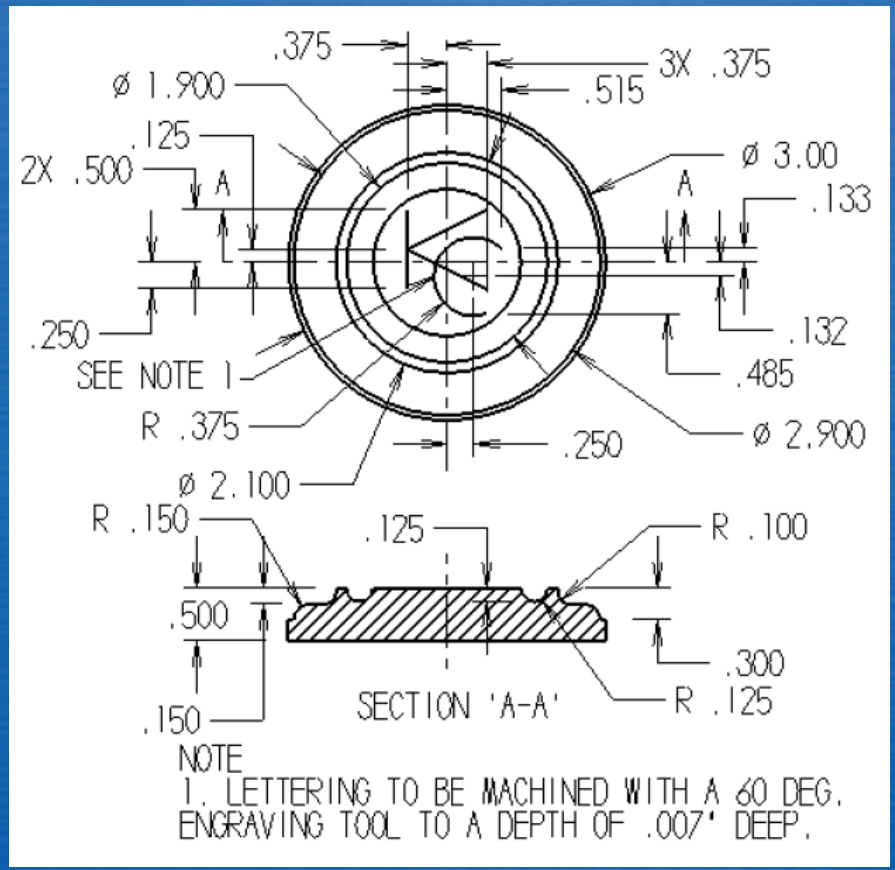
Terminology

- **Drawing**
  - Precise, complete
  - Sufficient to enable fabrication or assembly
  - Not quick, not cheap
  - Produced with tools, esp. computers



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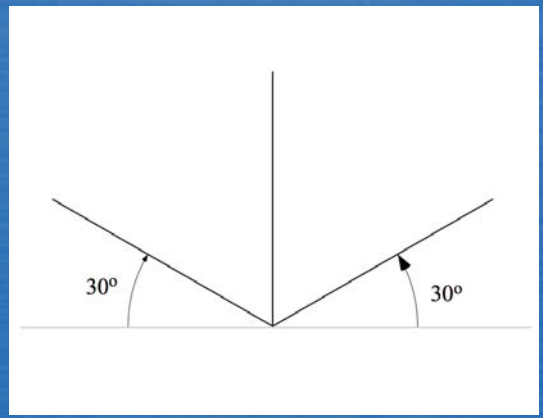
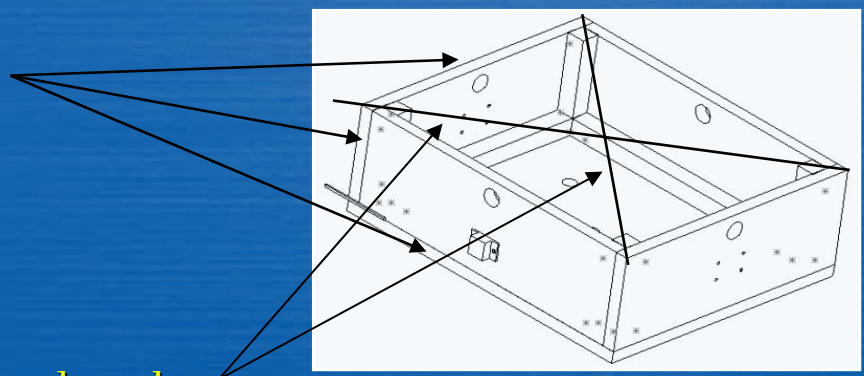
Isometric Sketching

- 3 axes
  - 1 vertical
  - 2 inclined 30º wrt to horizontal
- Lines parallel to axes are true length
  - Used to establish scale





Not true length

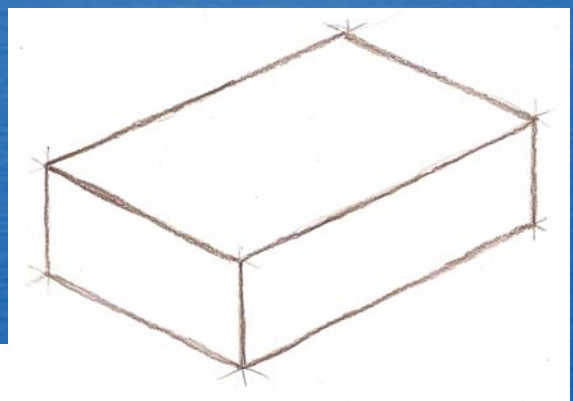
Exercise 1

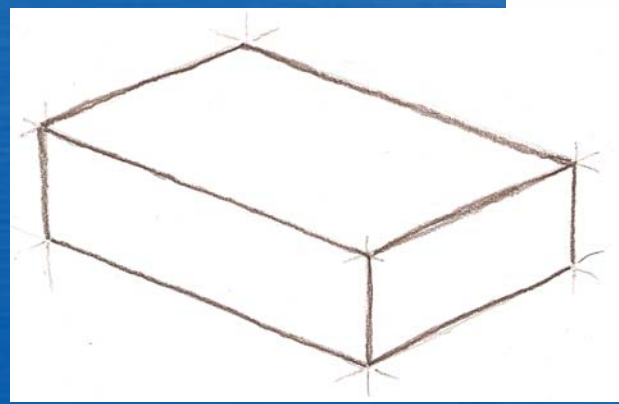
(signal when done…)

- Make an isometric sketch (twice) of:
  a 6-inch long “2x4”, half-scale, lying flat

  - Long axis
    up & to the right

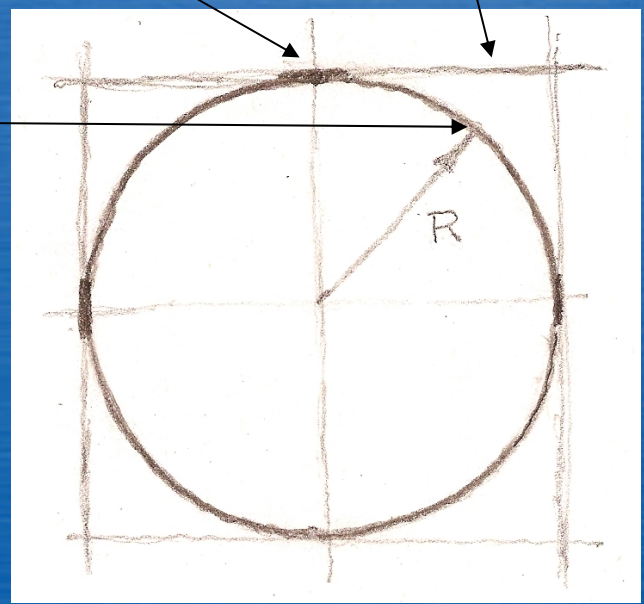
  - Long axis
    up & to the left





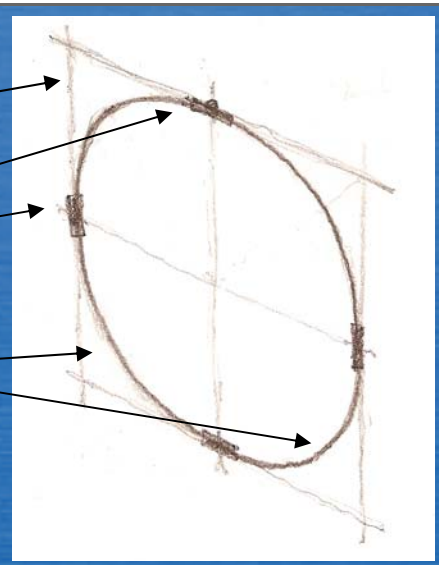
Sketching circles

- Normal: Circle
  - Bounding square
  - Tangency at midpoints
  - Proportion at mid-arc
    - Diagonals? (optional)

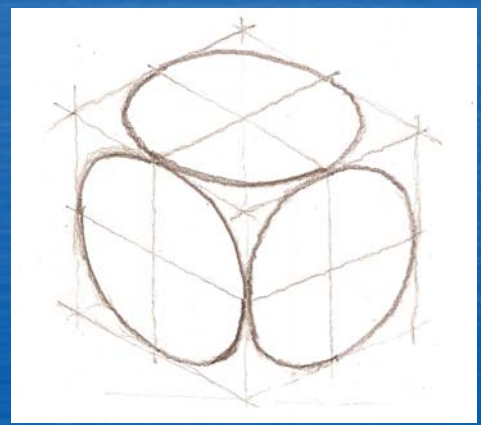


Sketching isometric circles

- Isometric: Ellipse
  - Bounding rhombus
  - Tangency at midpoints
  - Proportion at major & minor axes

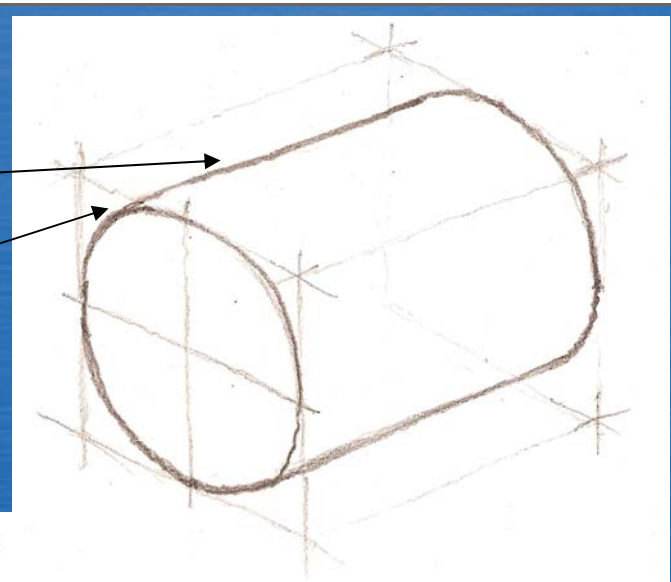


- Sketching circles on principal planes
  - Ellipses in different orientations
  - Cube, tangent points, curves

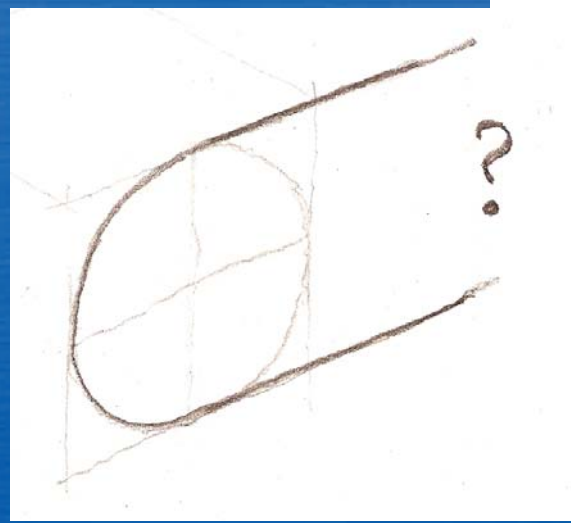


Sketching isometric cylinders

- Tangent lines
  - normal to plane of ellipse
  - leave from ellipse's major axis, NOT from tangency points !

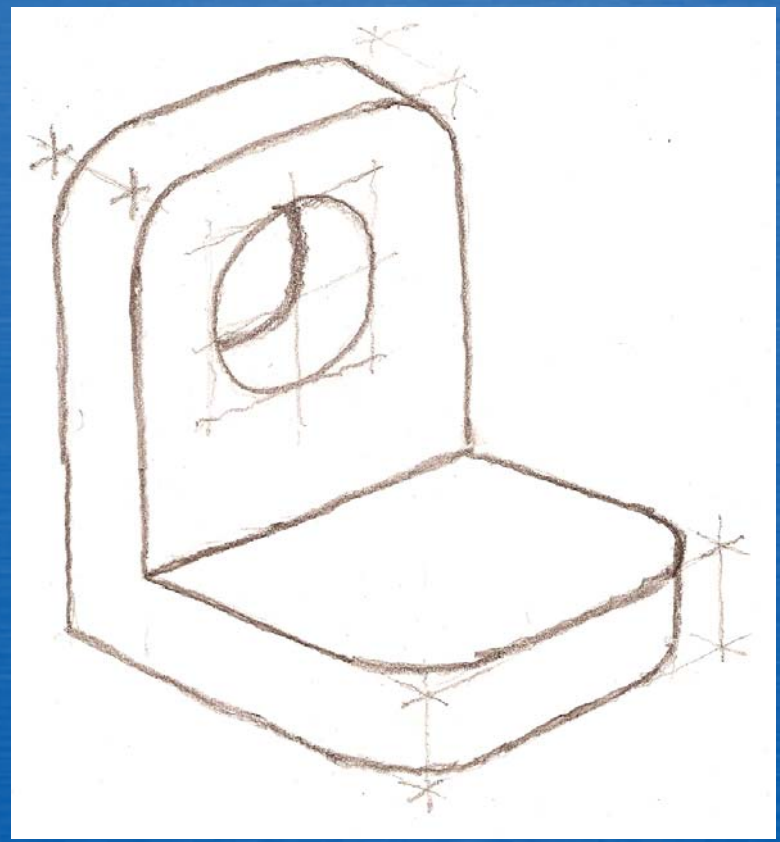


- Rookie error



Exercise 2

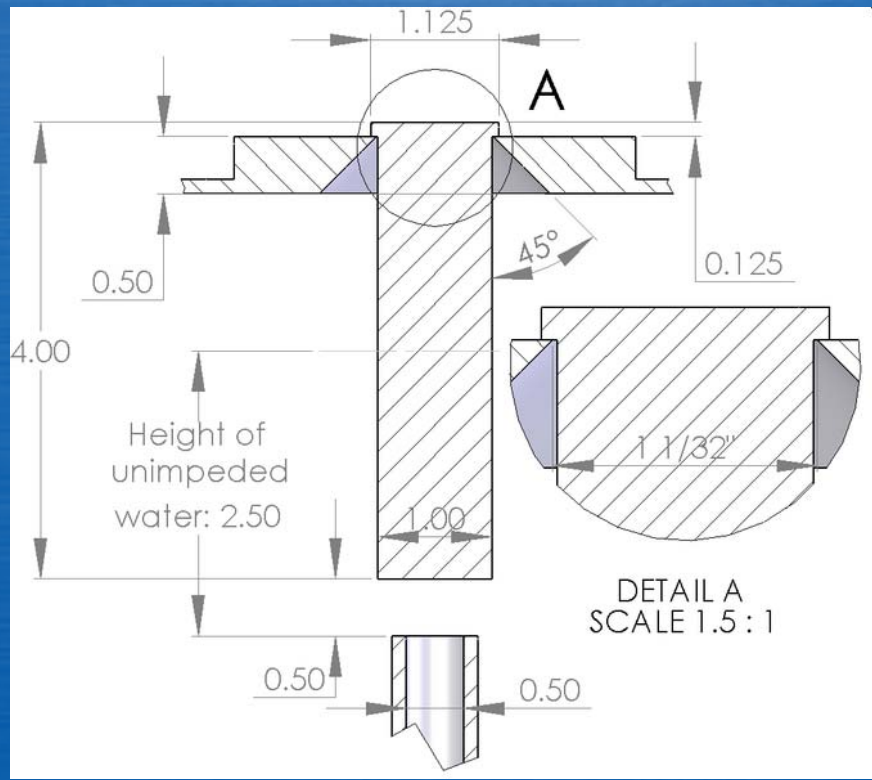
- Sketch a block letter “L”
  - 1 x 1 base
  - 1.5 height
  - 0.25 thickness
- Sketch fillets on the 4 shortest edges (0.25 radius)
- Sketch a hole through the vertical face (0.5 diameter)



PRACTICE !!!

Drawings

- Are a special language for communicating about physical objects
  - Reading
  - Writing
- Can be a legal definition
- 3+ types of information:
  - Shape
  - Nominal dimensions
  - Tolerances
    - Other attributes (e.g. finish)



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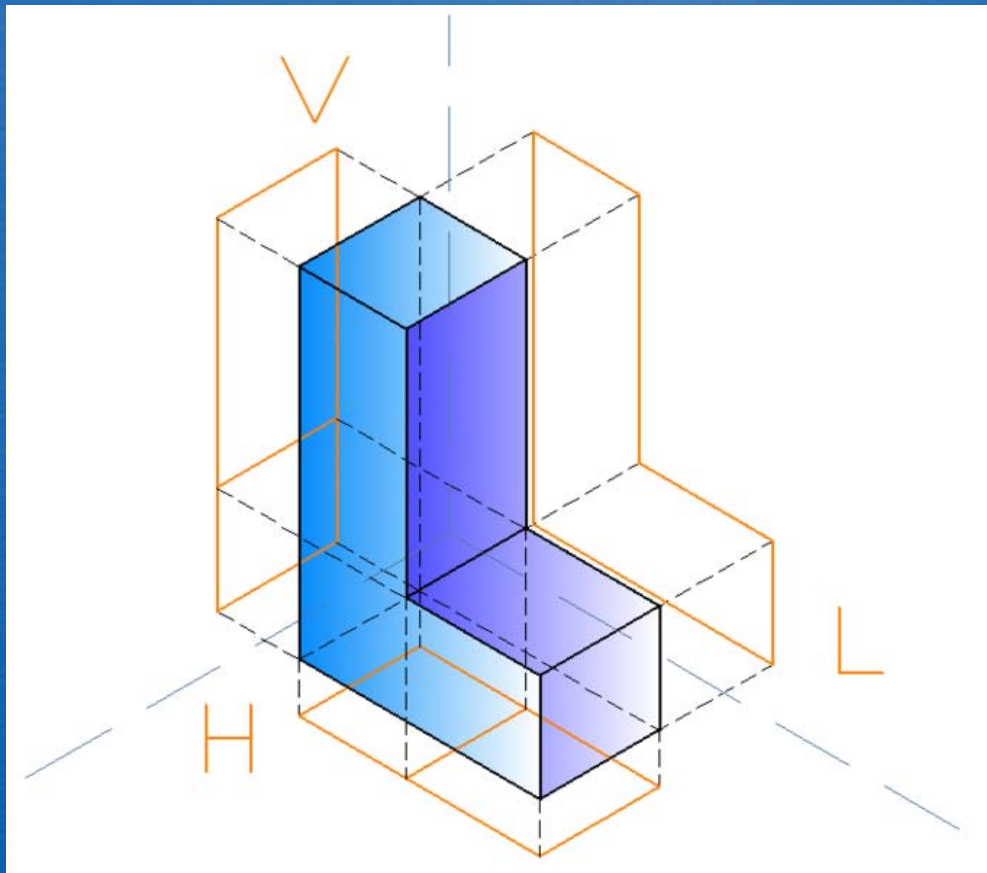
Orthographic Projection

- Outline of 3D object projected onto 2D plane
  - Transparent plane in front of the 3D object
  - Important points projected onto plane and connected
    - normal to plane
- One “view” of the object (planar)



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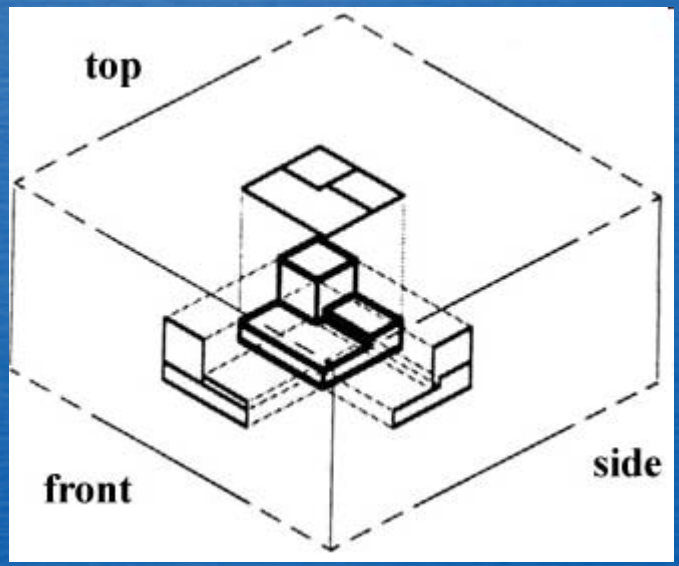
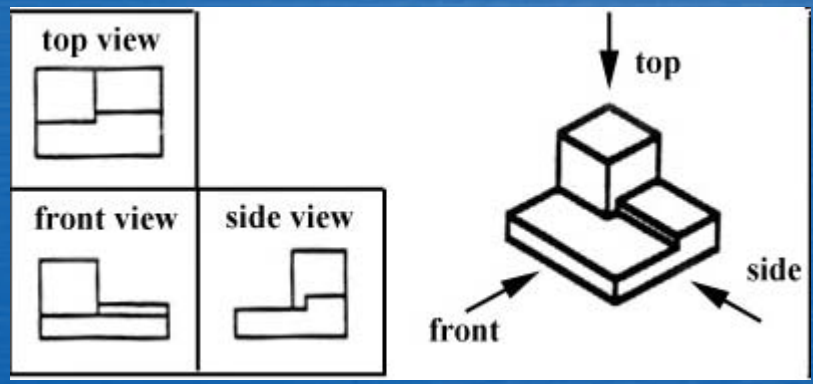
Principal Views

- “Glass Box” organization
- Multiple planes give multiple views
- Views are aligned





Principal Views (2D)

- 6 principal views
- Views are aligned

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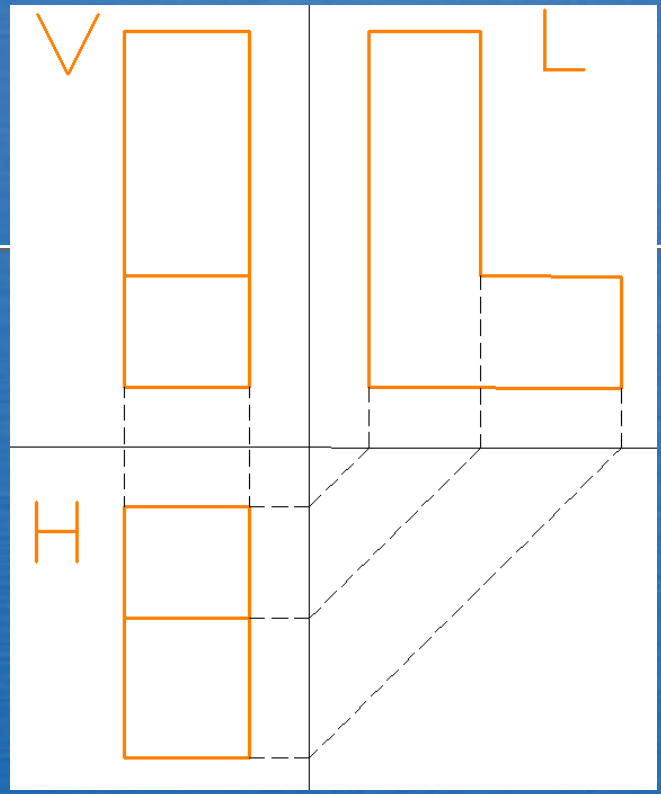
View Selection

- Non-symmetric parts:
  - Front, side, top
  - Front = largest

- Axially symmetric parts often need only 2 views



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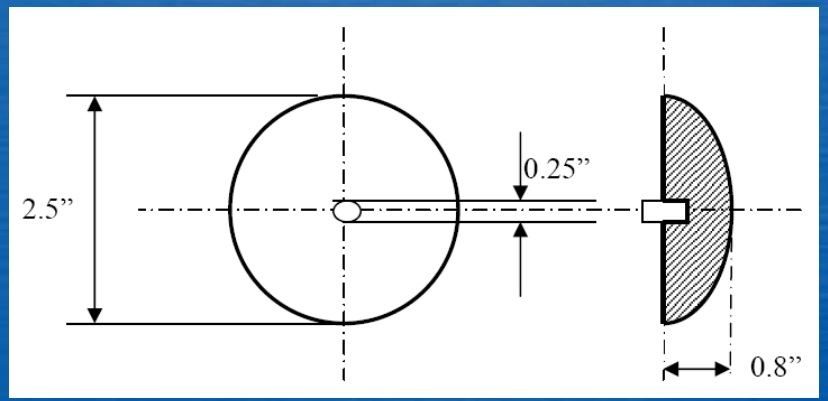

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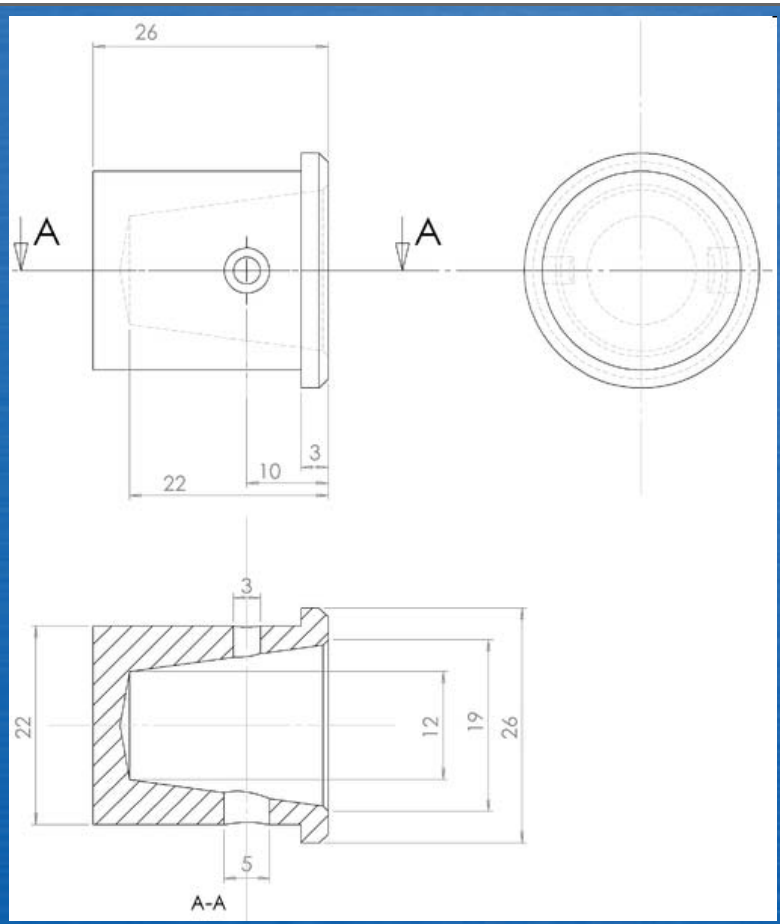
Interpreting Lines

- Lines (solid or dashed) can mean
  - Edge view of surface
  - Intersection of two surfaces
  - Surface limit
- Dashed lines means lines “hidden” in current view
- Centerlines are special, have their own symbol



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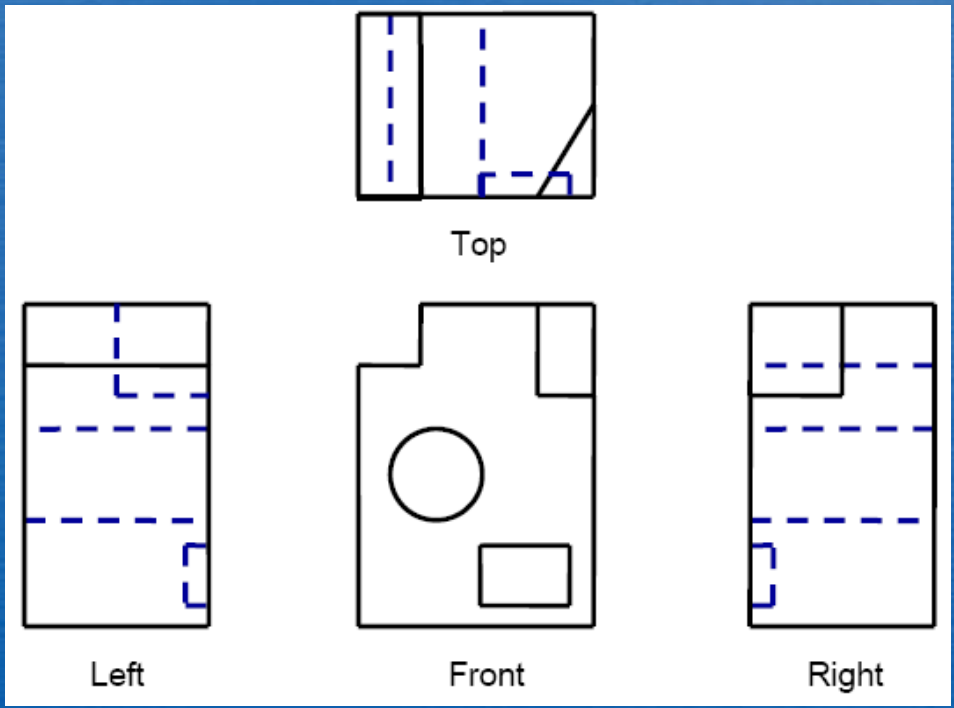
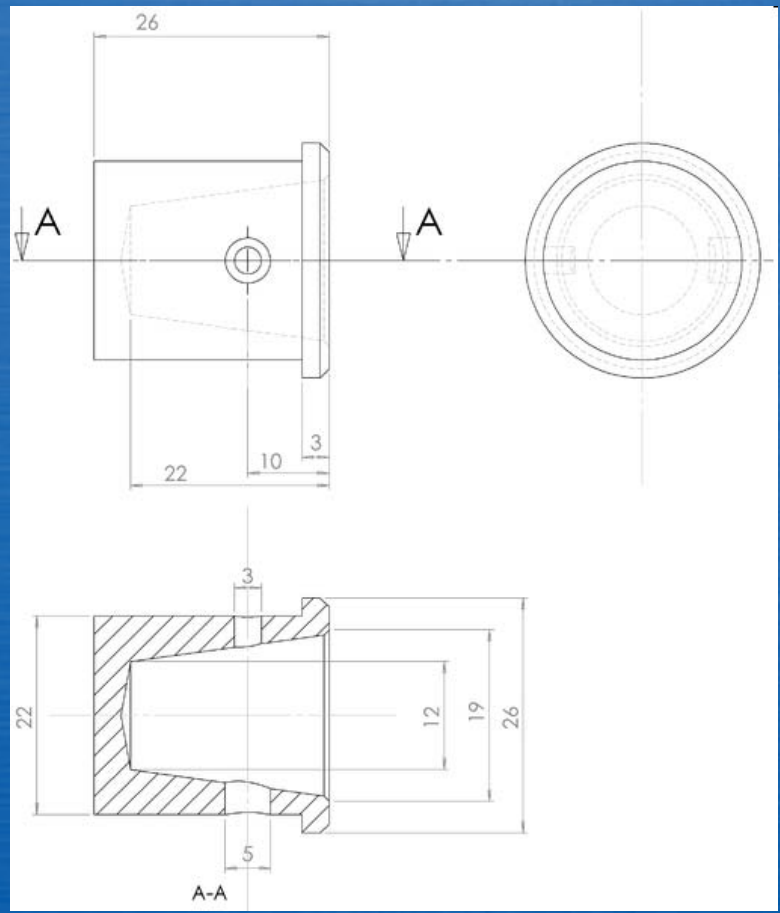
Exercise 3

- Make an isometric sketch of the object depicted in the following orthographic projections



Sections

- A cut-away view to reveal detail
  - An imaginary plane (section plane) cuts the object
  - Cut material is cross-hatched
- Section plane is identified
  - Heavy dashed line
  - Arrows
  - Letters



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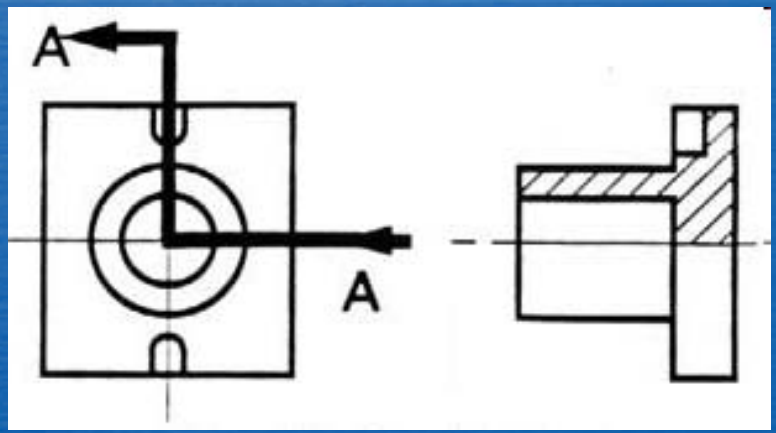
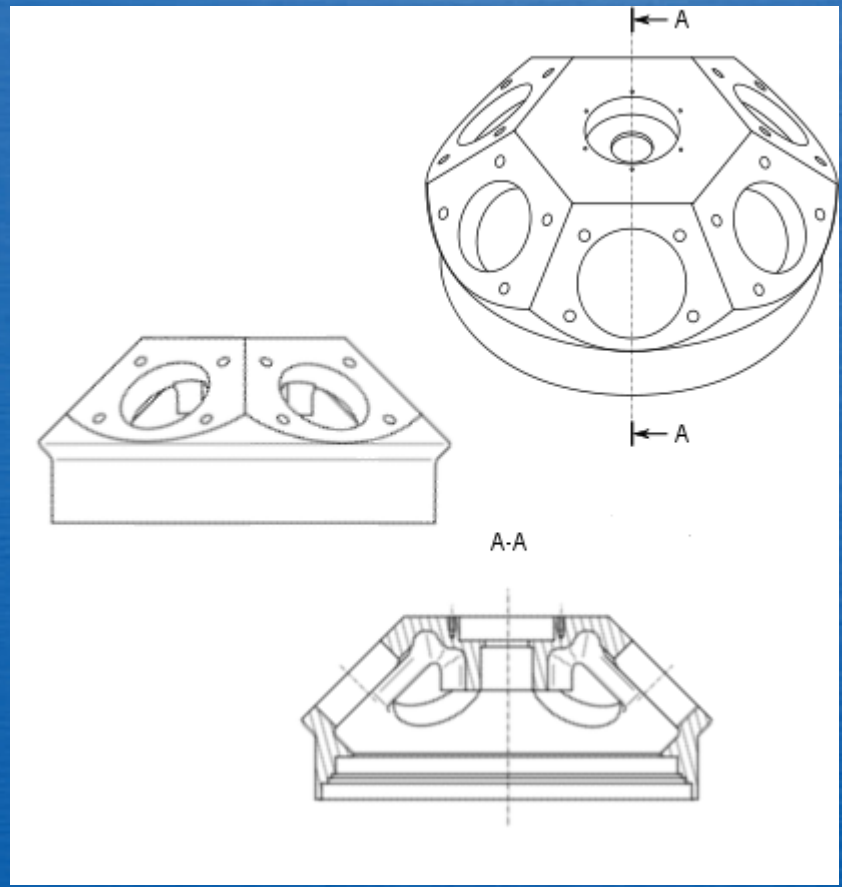
Section Views ("Sections")

- Objectives:
  - Eliminate confusion
  - Aid "readability"





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Sections

- Section plane may “jog” to show features of interest

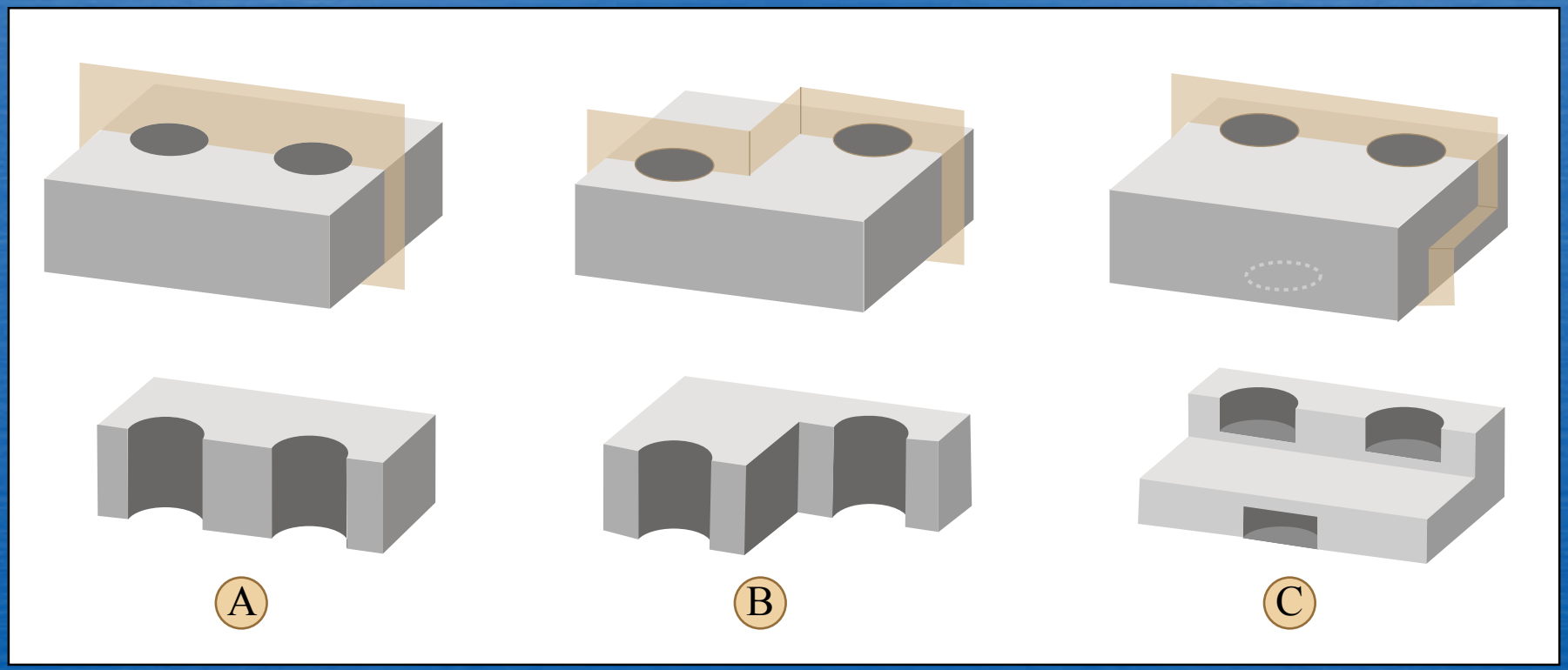
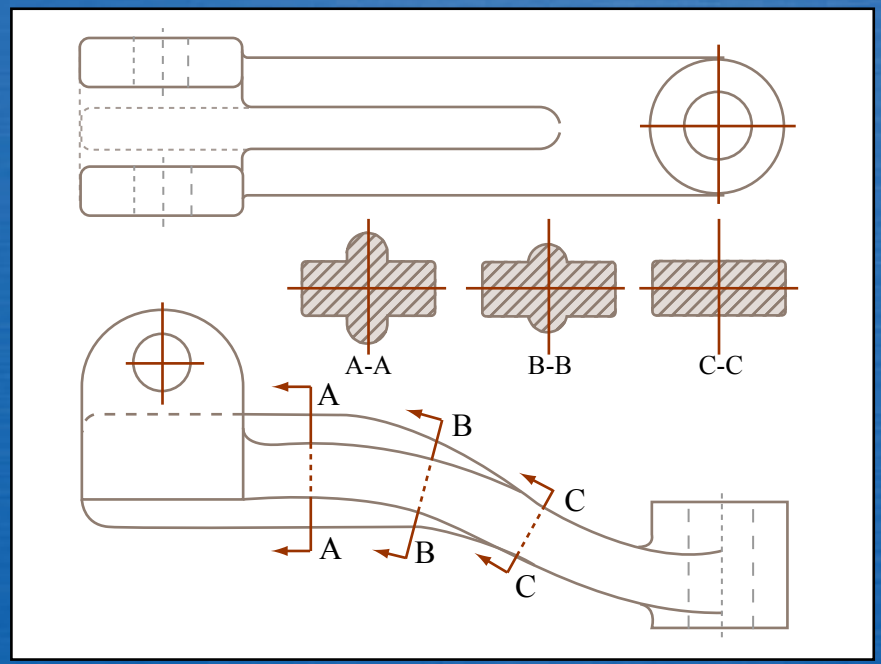


Figure by MIT OpenCourseWare.

Partial Sections

- Removed section
- Rotated section



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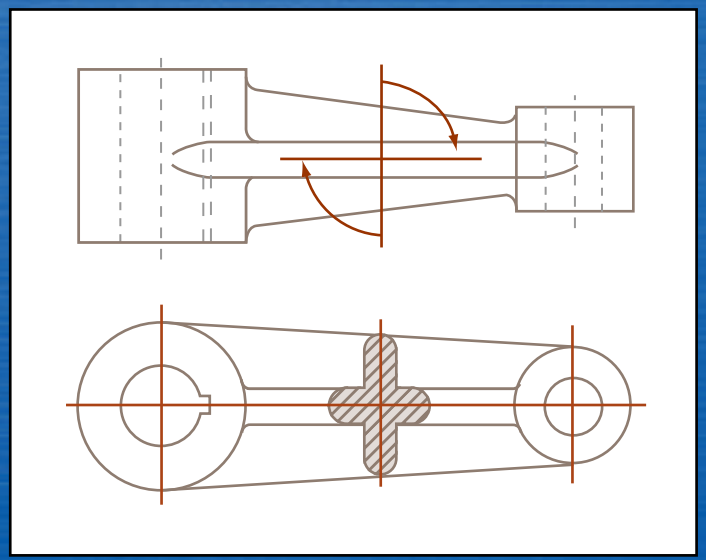

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Section View Conventions

- Show all visible edges

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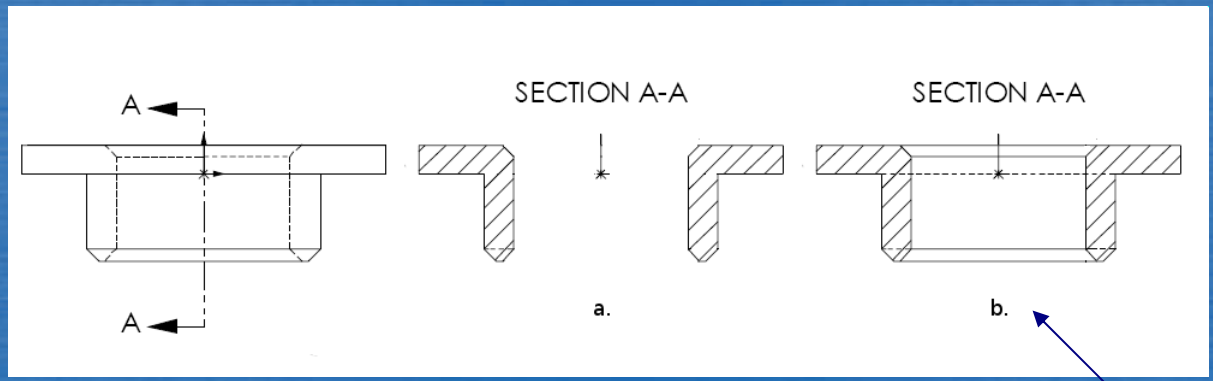
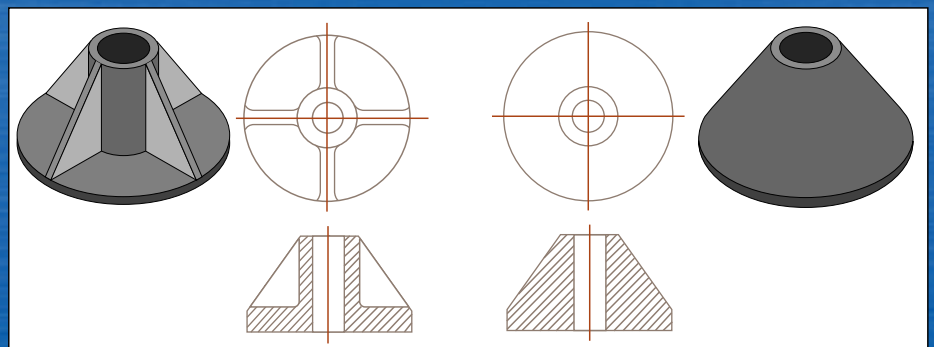


B is preferred

- Don't cross-hatch ribs

A is correct



Ribs in section. Ribs are treated as though the cutting plane were in front of them, to avoid misreading the section as a solid.

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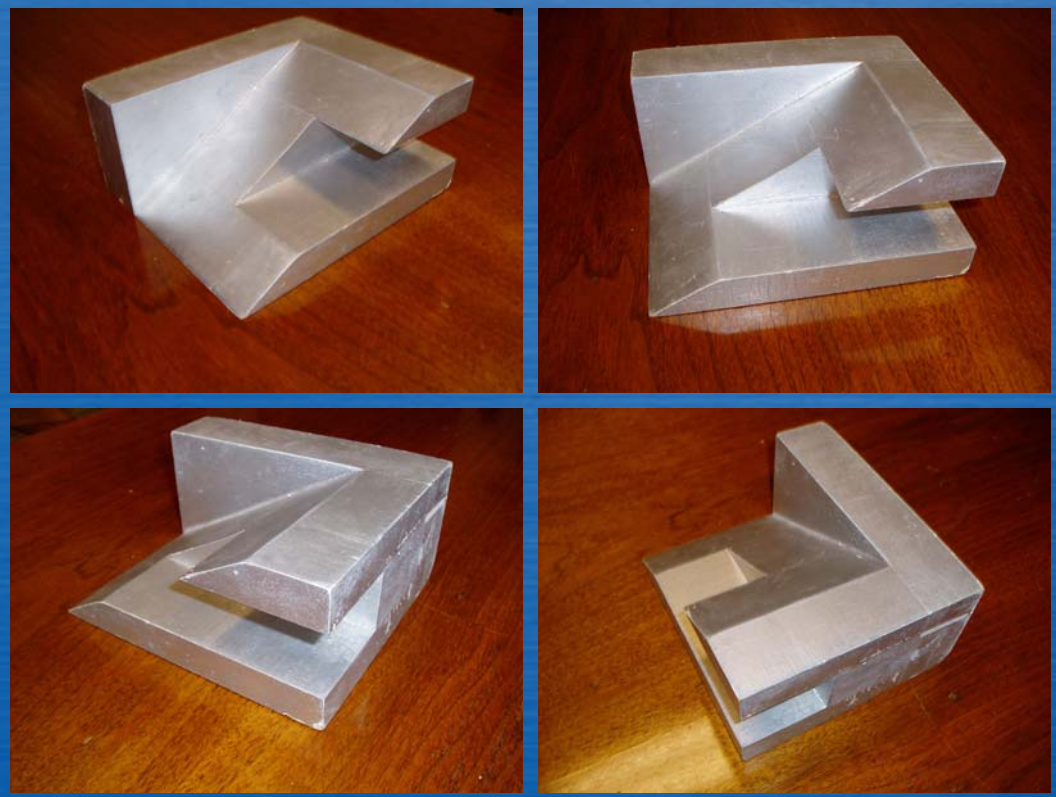
Exercise 4

- Sketch (the) three principal views of the following object



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