WELCOME TO

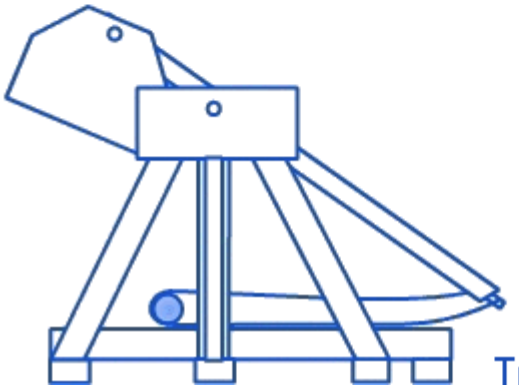
MECH 211, Mechanical Engineering Drawing

Time: M _ W _ _ 10:15 - 11:30

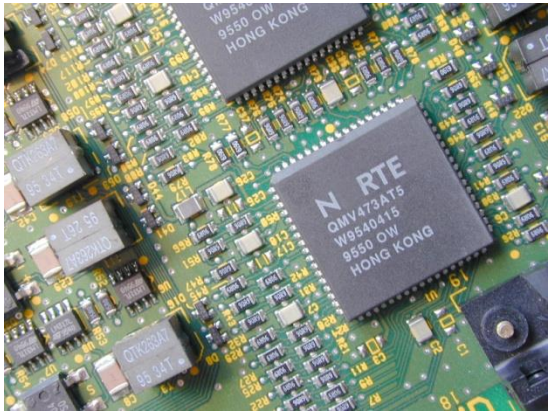
Credits: 3.5 Session: Fall 2013

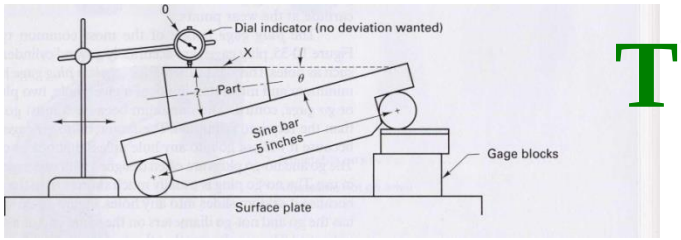
Introduction

Lecture 1



Whatever area you will choose…





This course is fundamental.

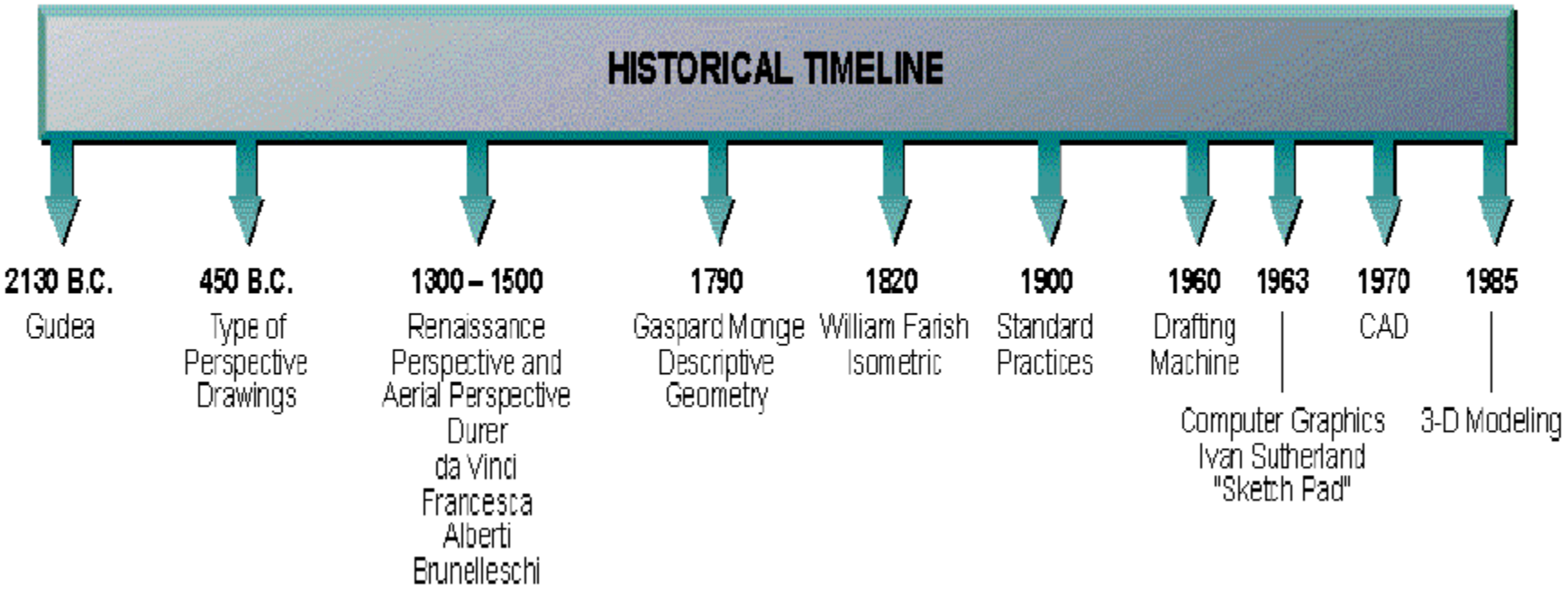
A bit of history

- The objective need to communicate

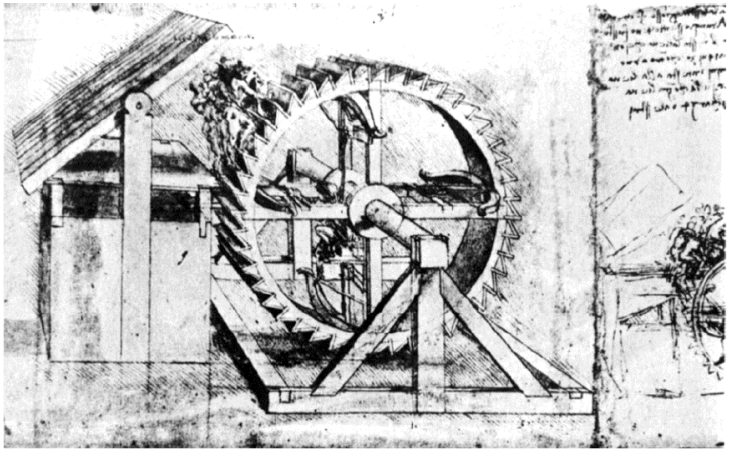
©Bibliothèque nationale de France

A bit of history

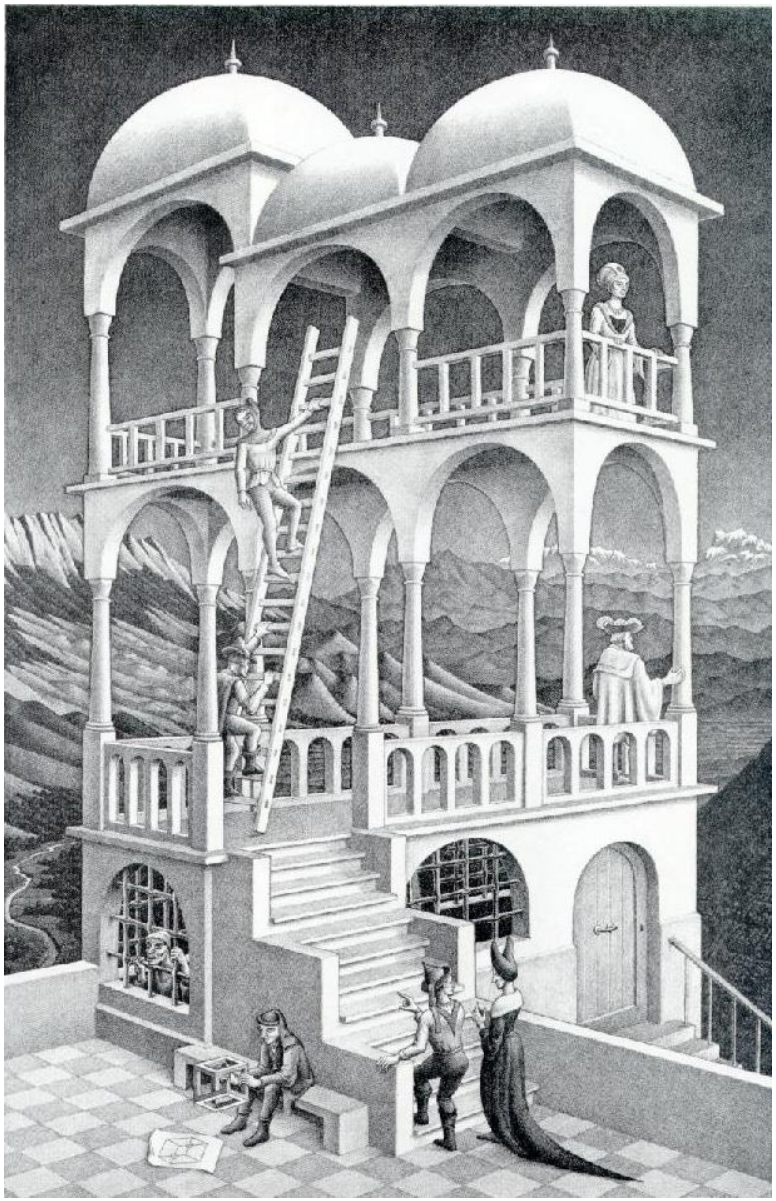
- The time line



History in images



Artistic Drawing



"Paper could take about anything"

Observe the way
the posts are crossing

Have you ever seen
such a construction?

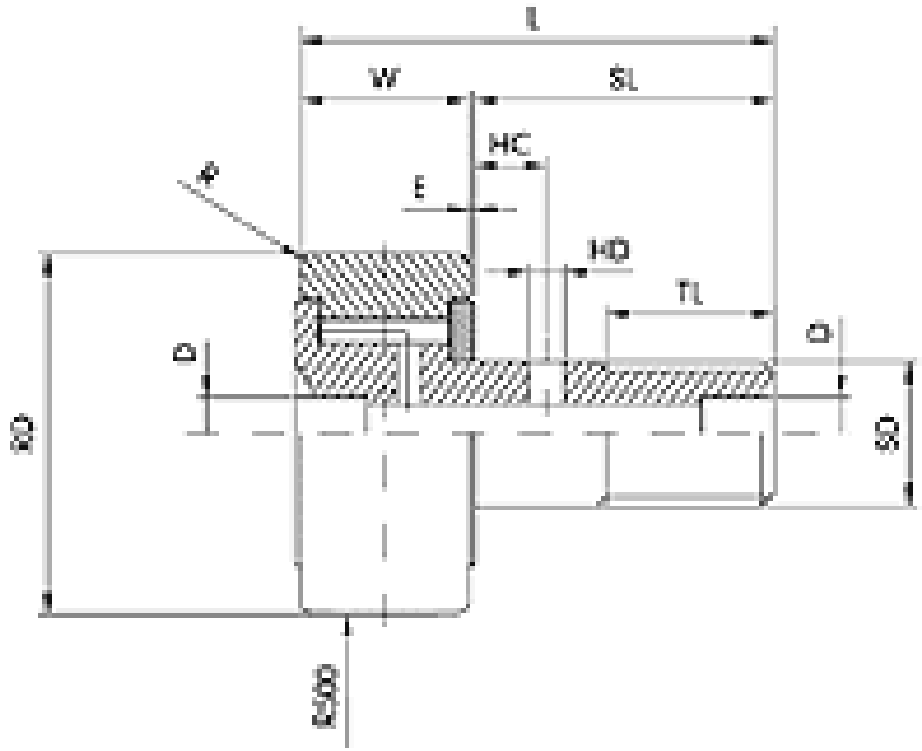
The fundamental difference ?

Artistic Drawing

"On the Internet, nobody knows you're a dog."

© Cartoonbank.com

Mechanical/Technical drawing

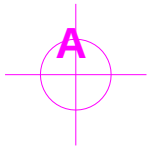


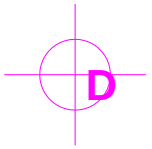
Content of the Course

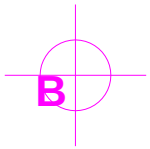
Introduction to graphic language and design — means and techniques. The third and the first angle projections. Orthographic projection of points, lines, planes and solids. Principal and auxiliary views. Views in a given direction. Sectional views. Intersection of lines, planes and solids. Development of surfaces. Drafting practices. Dimensioning, fits and tolerancing. Computer-aided drawing and solid modelling. Working drawings — detail and assembly drawing. Design practice. Machine elements representation. Case Study

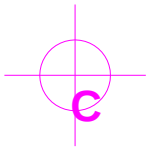
Content of the Course

A, B, C, D ARE POINTS





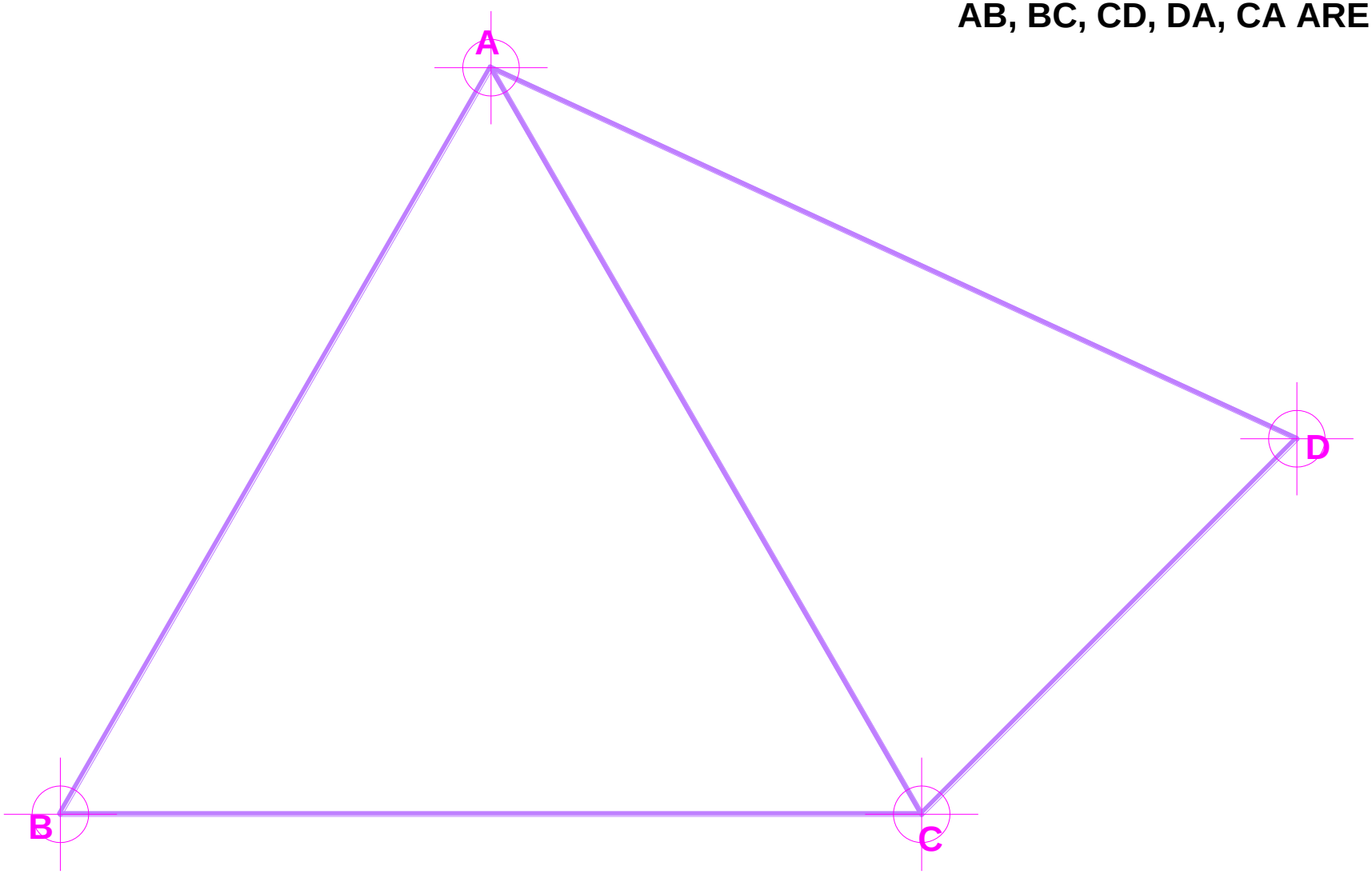




Content of the Course

A, B, C, D ARE POINTS

AB, BC, CD, DA, CA ARE LINES

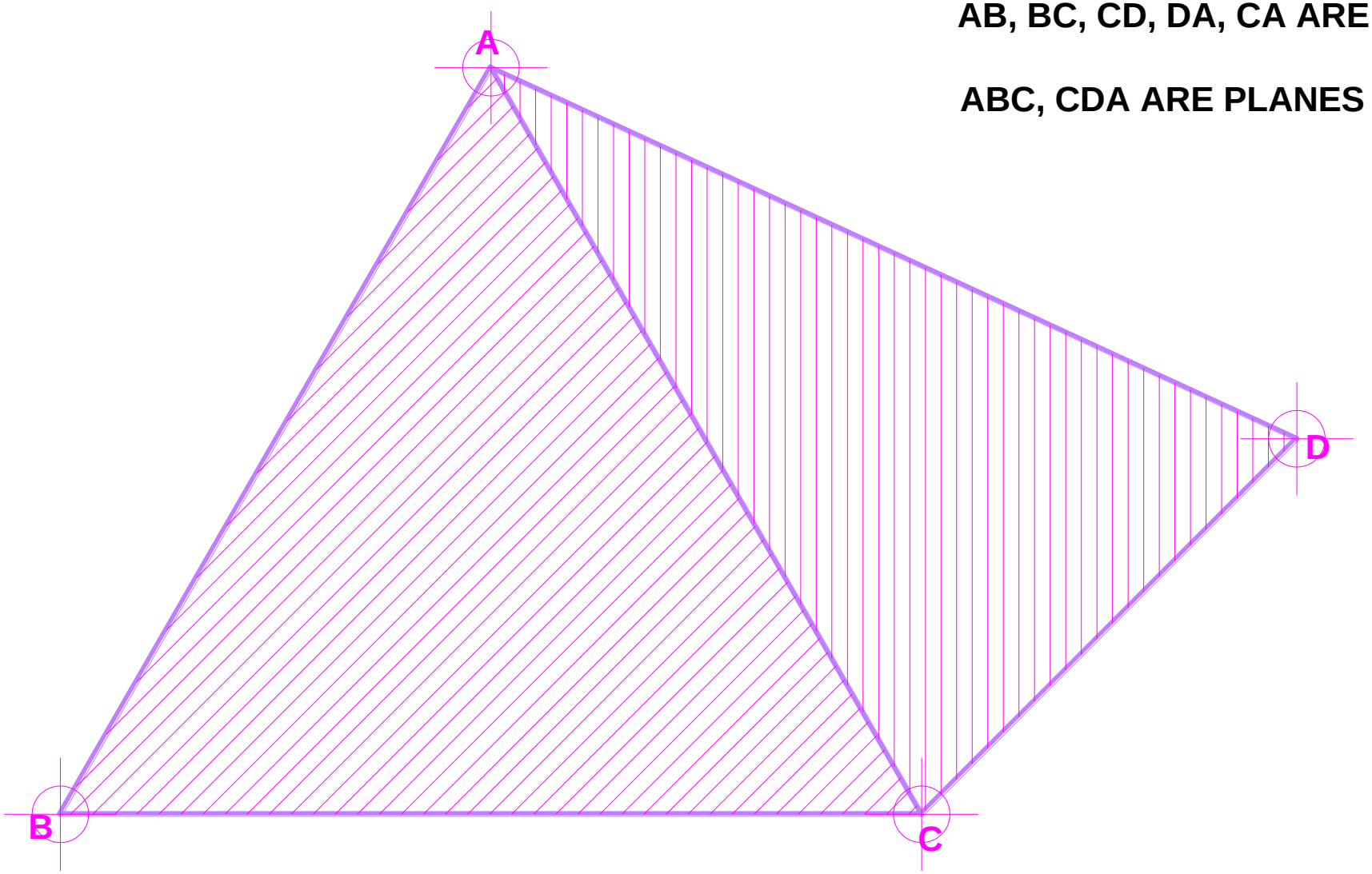


Content of the Course

A, B, C, D ARE POINTS

AB, BC, CD, DA, CA ARE LINES

ABC, CDA ARE PLANES



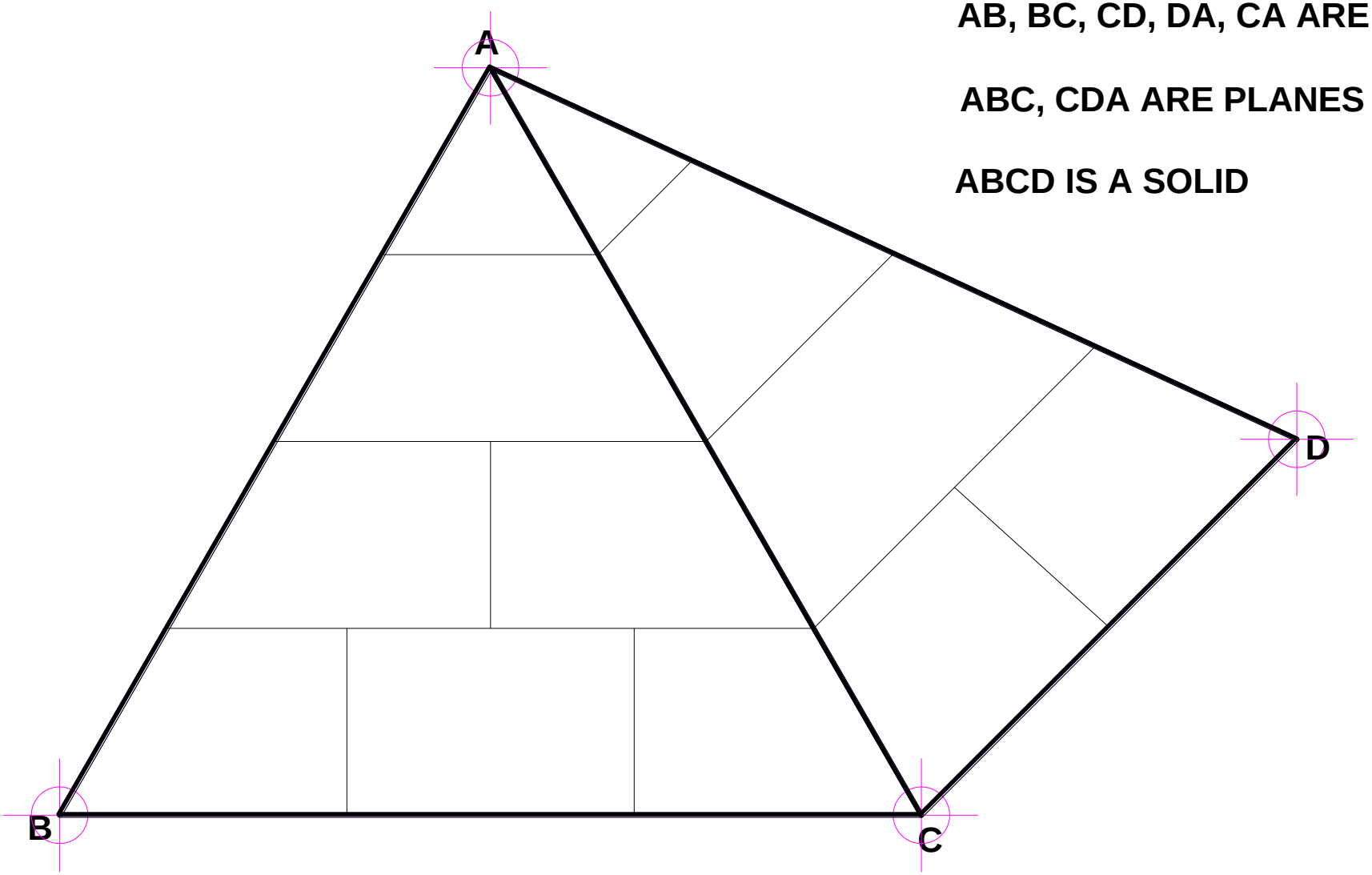
Content of the Course

A, B, C, D ARE POINTS

AB, BC, CD, DA, CA ARE LINES

ABC, CDA ARE PLANES

ABCD IS A SOLID



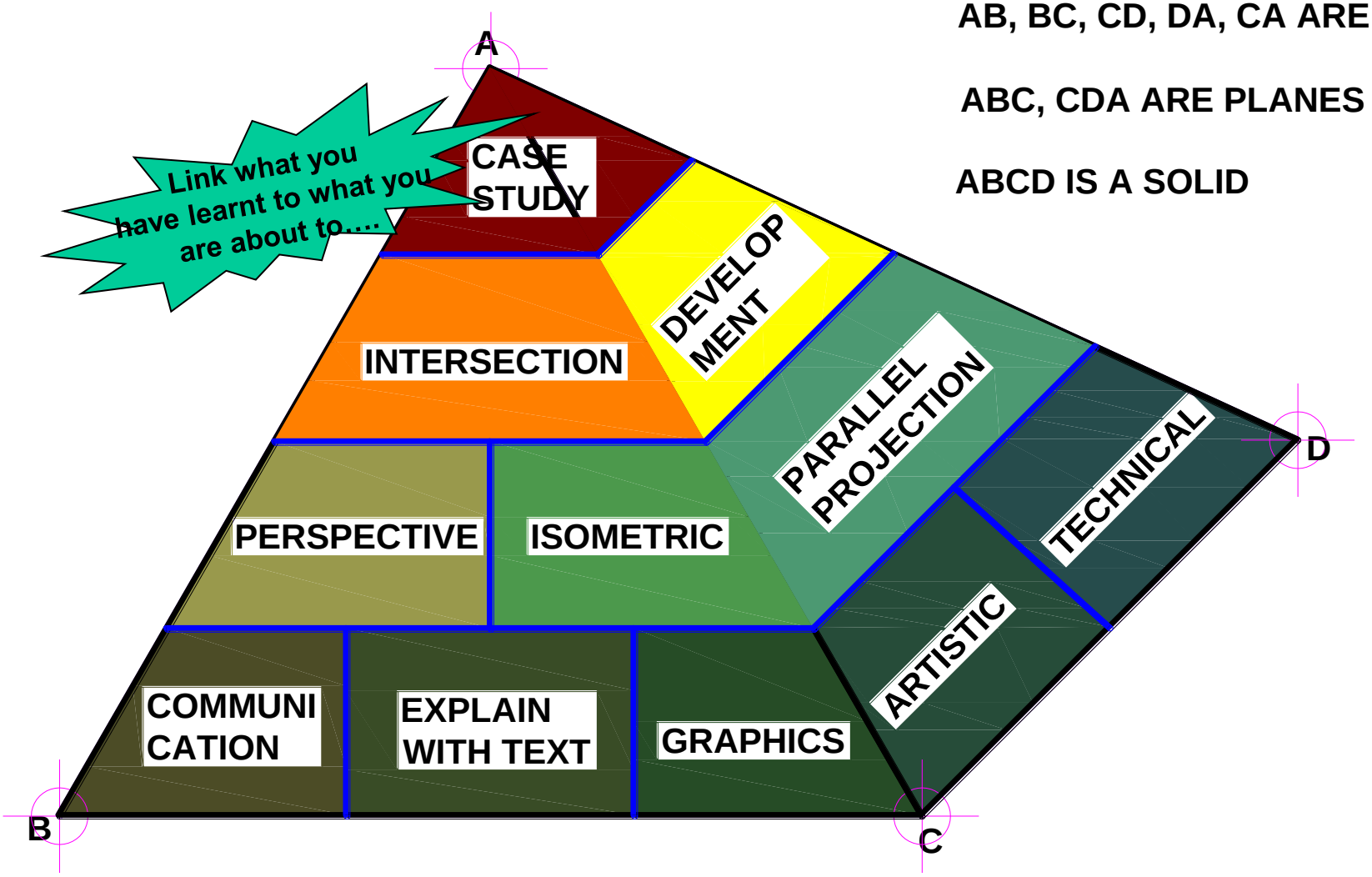
Content of the Course

A, B, C, D ARE POINTS

AB, BC, CD, DA, CA ARE LINES

ABC, CDA ARE PLANES

ABCD IS A SOLID



Mission of the Course

- Enables the students to learn the techniques and standard practices of technical graphics
- At the end of the lectures, one would be able to:
  - Read a working or assembly drawing (blueprint)
  - Represent mechanical components in multiview orthographic representation
  - Create conceptual design sketches
  - Create assembly drawings (limited)
  - Capability to use AutoCAD for 2-D representations

* The amount of acquired skills will be proportional to the capabilities, will and effort of the individuals

Main Objective of the Course

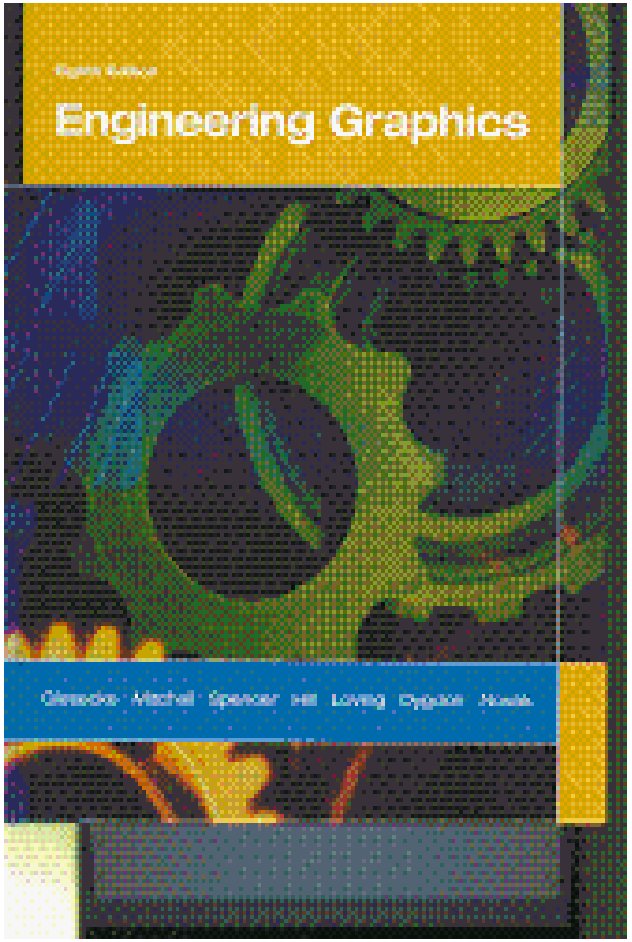
- To acquire essential skills that are part of the mechanical engineering practice
- To be able to communicate with other mechanical engineering professionals regardless their spoken language
- To be able to communicate with manufacturers of mechanical systems

Class Logistics

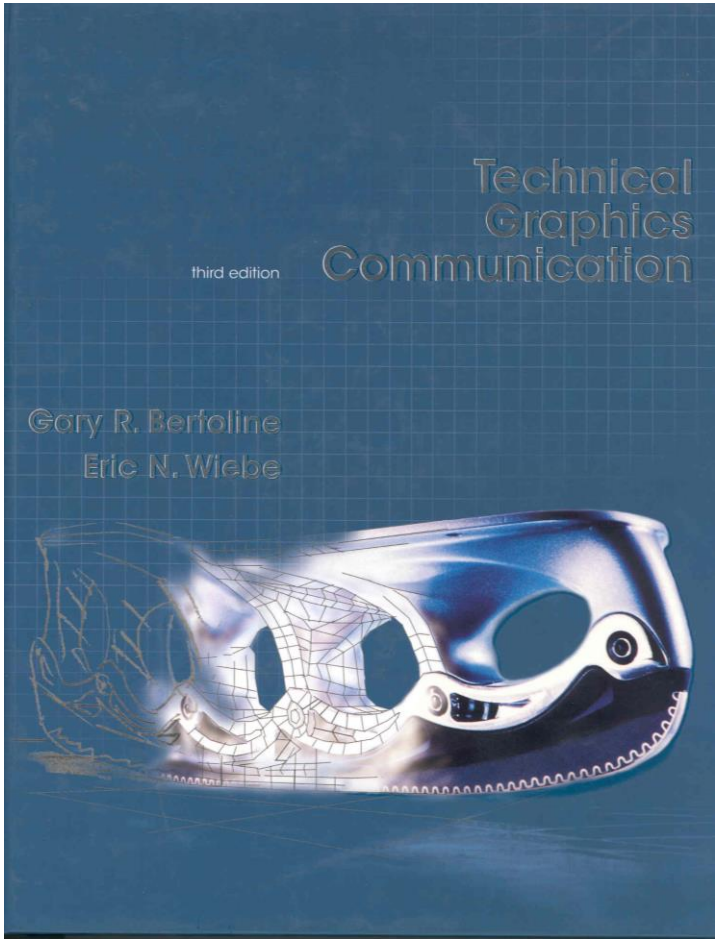
- 3 teaching hours/week M-W-- 10:15 –11:30
- 12 weeks and one Review week
- 2 hour of tutorial – following the class
- 4 hours of laboratory – every 4 Weeks
- 3 parallel sections

Class Materials

http://users.encs.concordia.ca/~nrskumar



Required textbook



Recommended textbook

Class Materials

- Tutorial materials – handed in during tutorial periods, also available on the web. Tutorials will be held in AUTOCAD labs and set of practicing drawings available on the web site to learn AUTOCAD
- Assignments: 8 – available on the internet
- Solutions to the assignments will be with PODs after assignment due date
- RECOMMENDATION: Attend the classes!

Class Materials

Lect #	Textbook Chapter	Description
1	1, 6	Introduction to graphic language and design, means and techniques, views of a geometric object, multiview projections, applications and examples -
2	2, 3, 4	Instruments, geometric constructions, CAD tools, demonstration examples -
3	5, 7, 8, 10	Sketching and shape description, shape generation, sectional and auxiliary views, examples and applications -
4	19	Descriptive Geometry– Points and lines, examples -
5	19	Descriptive Geometry – Points and lines, examples -
6	20	Descriptive Geometry – Parallelism & perpendicularity – examples -
7	21	Descriptive Geometry – Solids in space and Intersections – examples -
8*	21, 22	Descriptive Geometry – Intersections, examples,
9	22	Descriptive Geometry – Developments, examples, -
10	11, 12	Dimensioning and tolerancing, examples and applications -
11	13	Threads, fasteners, springs, gears, examples -
12	14	Design and working drawings – examples, Design case study -
13	----	Makeup class, Review–

* During the tutorial period of week # 8, the midterm test will be carried

PowerPoint presentation, - Material available on course website, Lecture to be done on board/screen

Class Instructor and Contacts

Instructor: Dr. S. Narayanswamy

Office: EV Building

Room: 004 –124

Phone: 848-2424 (**7923**)

Office Hours: _ _ _ J _ 10:00 –12:00 or by appointment

e-mail: nrskumar@encs.concordia.ca

Course Web Site: http://users.encs.concordia.ca/~nrskumar/

What you have to do

- Attend the lectures, laboratories and tutorials – try to understand the objectives as well as the procedures
- Use time at home to read and study the chapters in the book – use the material posted on the internet
- Do your home-work by yourself – consult only your colleagues, tutor, lab instructor or class instructor
- Submit on time your assignments
- Write the midterm test – this is a good measurement means for your performance in the class
- Write the final exam with confidence that you will do very well

Midterm Exams

- Scheduled for October 28th, 2013 and it will be conducted during the tutorial period.

- The midterm test is not mandatory but is recommended

- If the midterm result is better than the final, it will be counted for 10% towards final grade.

Laboratory

- There is lab component to this course
- You will be learning about few machineries
- There are four of them done in H-1067 once 4 weeks (4 hours a week).
- Safety is important and the details are available in the course outline.

Grading Scheme

- To pass, it is imperative to work during the term.
- The following grading scheme will be used for those who wrote the midterm and their grade is higher than the grade in the final:
  - Assignments: 16%
  - Midterm Examination: 10%
  - Laboratory 14%
  - Final Examination 60%
- who do not write the midterm or their midterm grade in below the final:
  - Assignments: 16%
  - Laboratory 14%
  - Final Examination 70%

"We've located the problem ... it's a defective user."

Content of the first lecture

- Graphics as communication means
- A bit of history
- Multiview representation and orthographic projections
- Technical procedures
- How to generate multi-view orthographic projection
- Representation rules

Mechanical components

Geometry

is a fundamental thing!

In Nature

In Human Need

- http://www.webshots.com/g/55.html

Introduction

to Graphic Language and Design

- Why graphics is necessary?
  - Communicate information that would not be possible to exchange in writing
- Why not use pictures to communicate visual information?
  - Usually, a drawing represents something that exists just at conceptual level
- Why not use pictorial representation?
  - The information contained in a drawing must be used to build an accurate component/system.

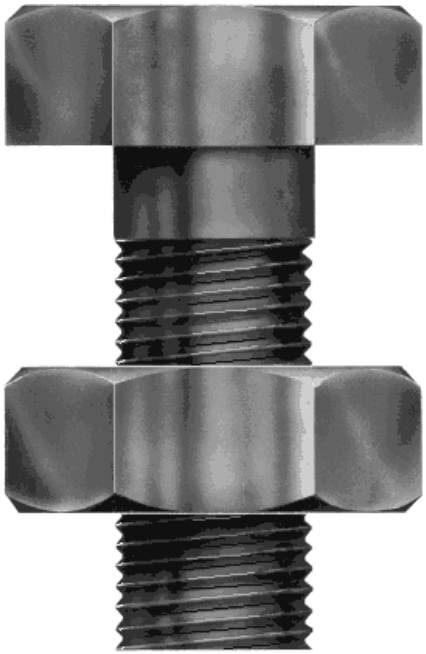
What is Drawing?

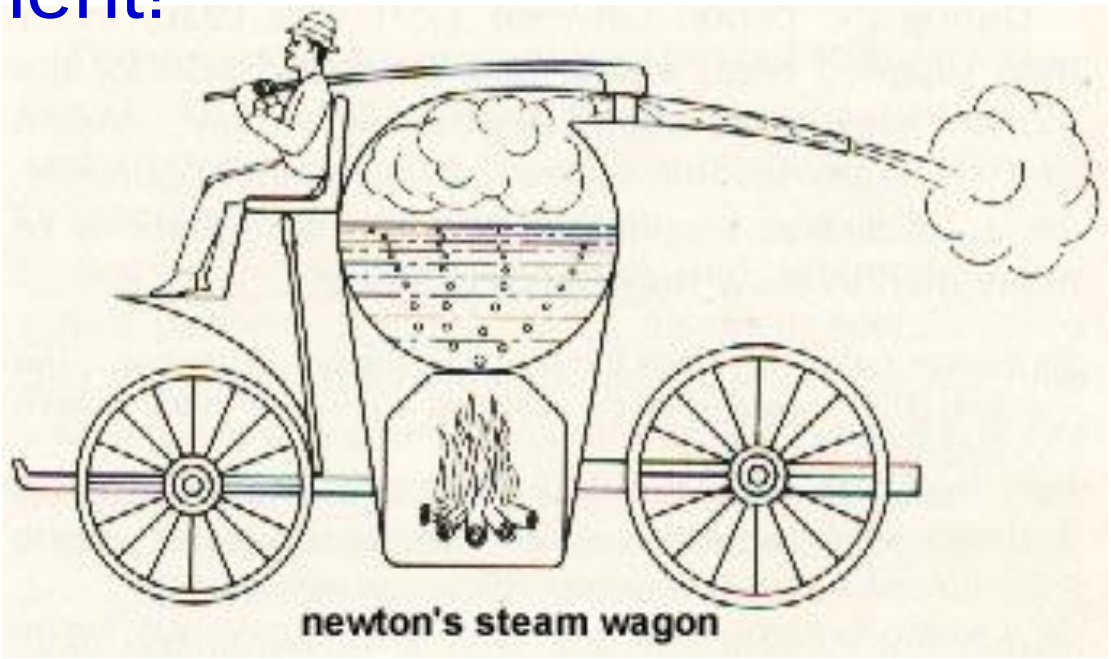
- Drawing is a graphic representation of a real thing, an idea, or a proposed design
- Why graphic representation?
- Graphic method of representation is a basic natural form of communication of ideas that is universal and timeless.
- It is impossible to explain things through text.

Graphic Language

A simple component!

- How hard to define in words?

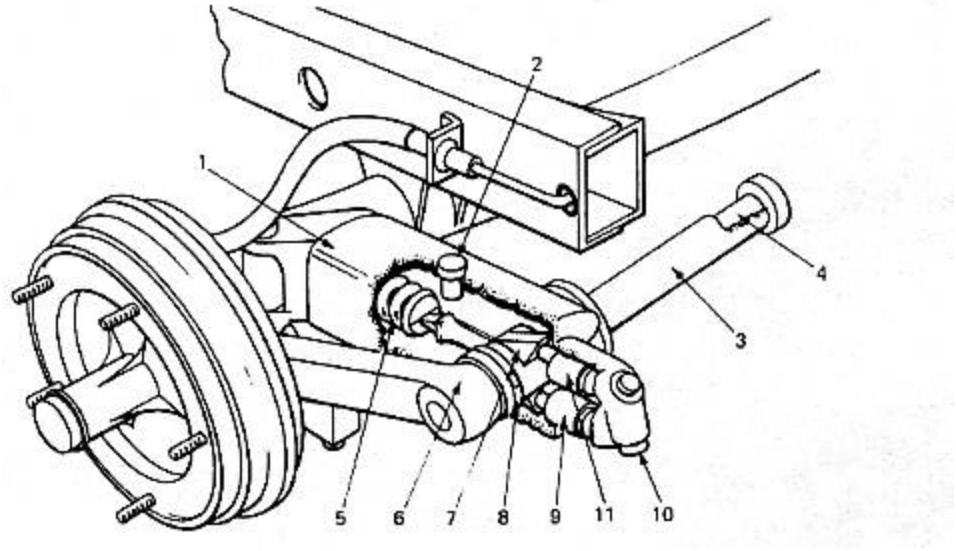




- Try to describe in words the following representation: A MECHANISM

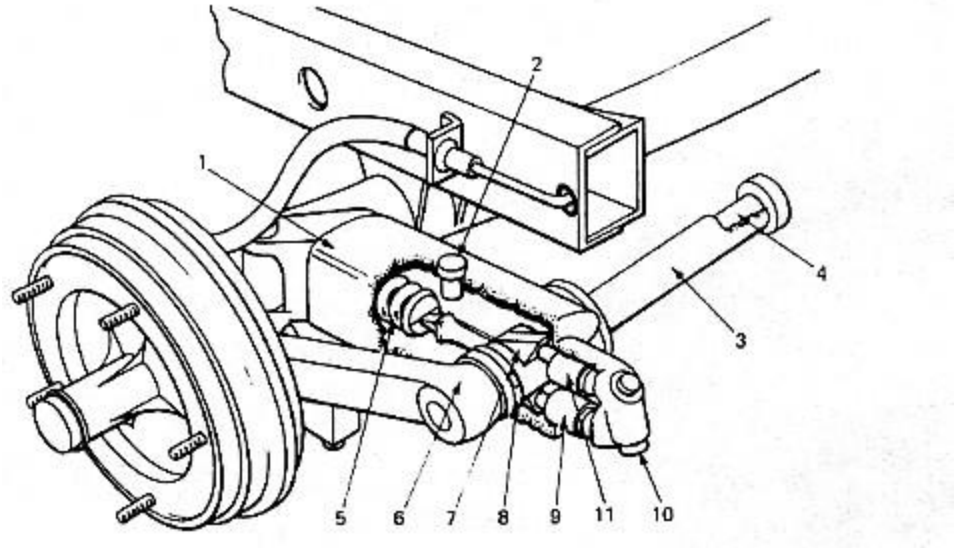
Graphic Language

- Graphics language is universal



Graphic Language

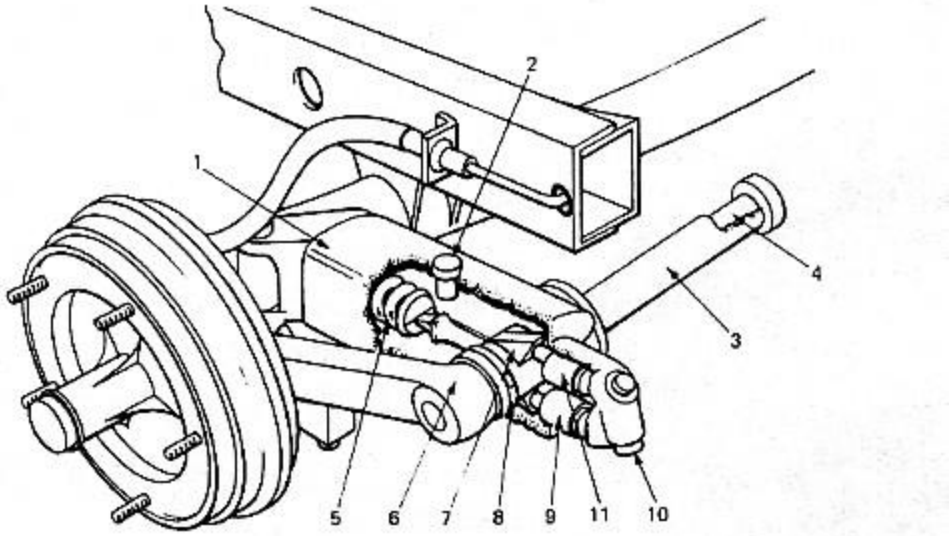
- The information can be conveyed regardless the spoken language



1. Ÿog¿®
2. ĐŷBţāĶĉ
3. ®@µ¶œƒ/
4. ™*$#! y²î‰※
5. Z´¶ $æÊ¿£ŠŠŠ
6. €¶¸¹ì±®wd]Ê !;8
7. Đ□}z^C êÑÒ¶³²²
8. š^?%ëŢŪụÍ Đ——
9. €ßu $*” éĐĐ
10. ™@¥¢ #®&¼
11. ※—‘…€ • 🗗

Graphic Language

- When spoken language is known, the information is more accurate



1 Suspension housing
2 Filler plug and bump-stop
3 Torsion tube
4 Torsion shaft
5 Compensating ring
6 Wheel carrier arm
7 Control lever
8 Oil seal assembly
9 Shock damper piston
10 Shock damper relief valve plug
11 Shock damper return piston spring

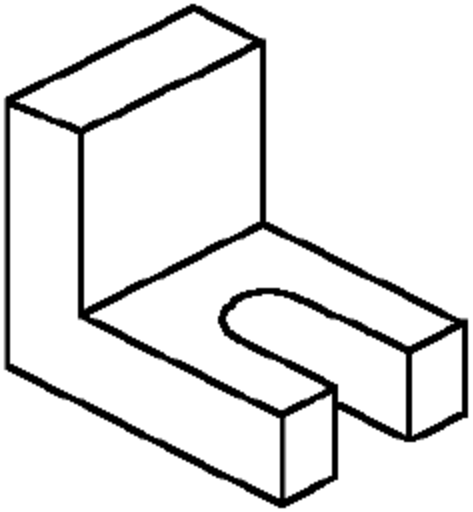
Essentials of a good drawing

- Should represent the concept/idea/geometry clearly
- Should be able to communicate with others with out doubt
- Should respect the manufacturing feasibility
- Should favor a lot standardization

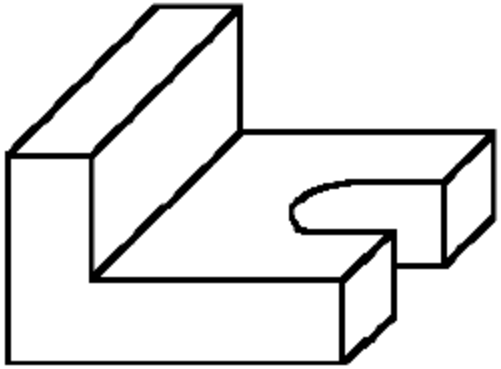
Let's see how to make a good mechanical drawing!

Views

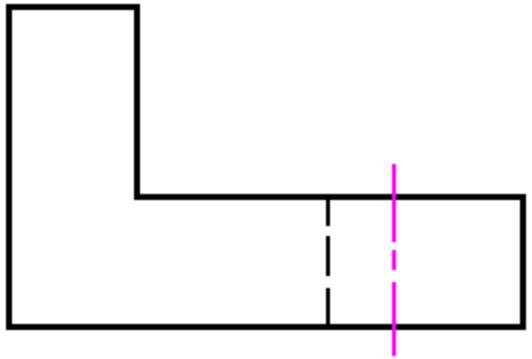
- An object could be represented in more ways:



Isometric



Oblique

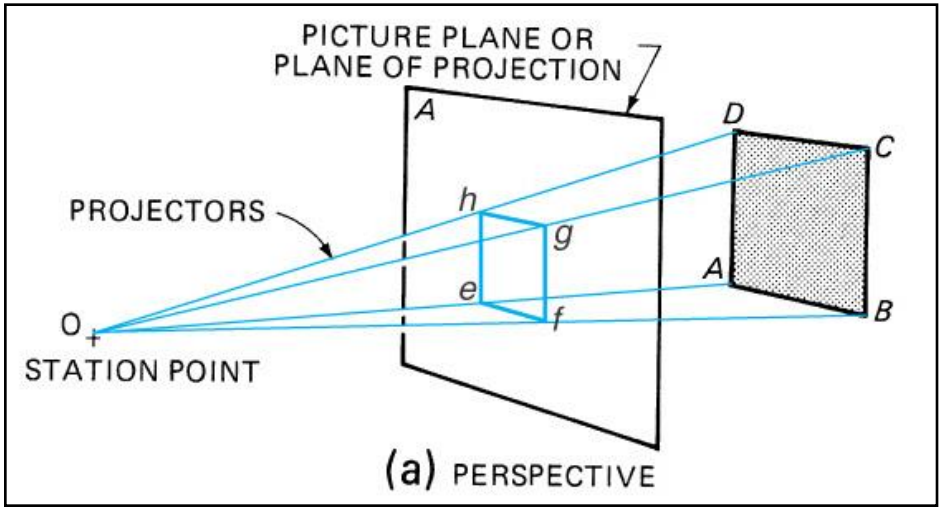


Multiview

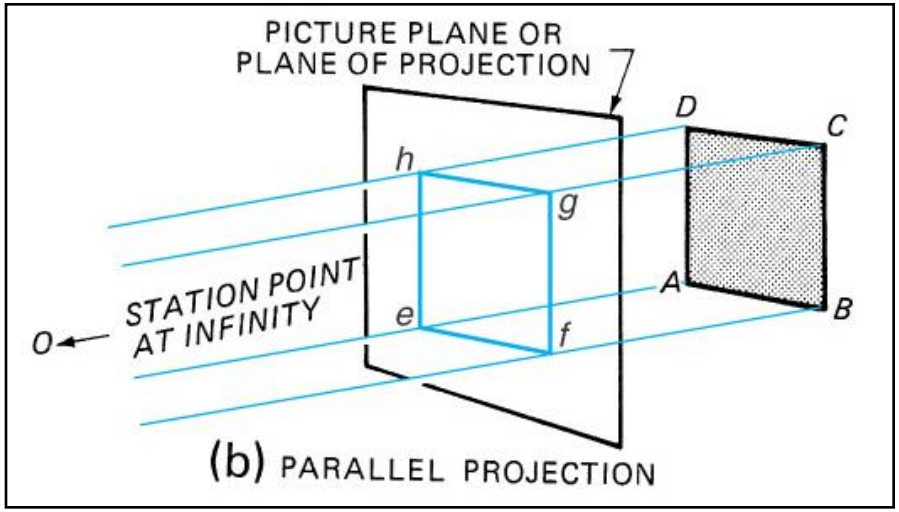
Projections/ Drawing Basics

- The way one is visualizing an object (Simple and sufficient)
- Two basic projection types – use parallel projection

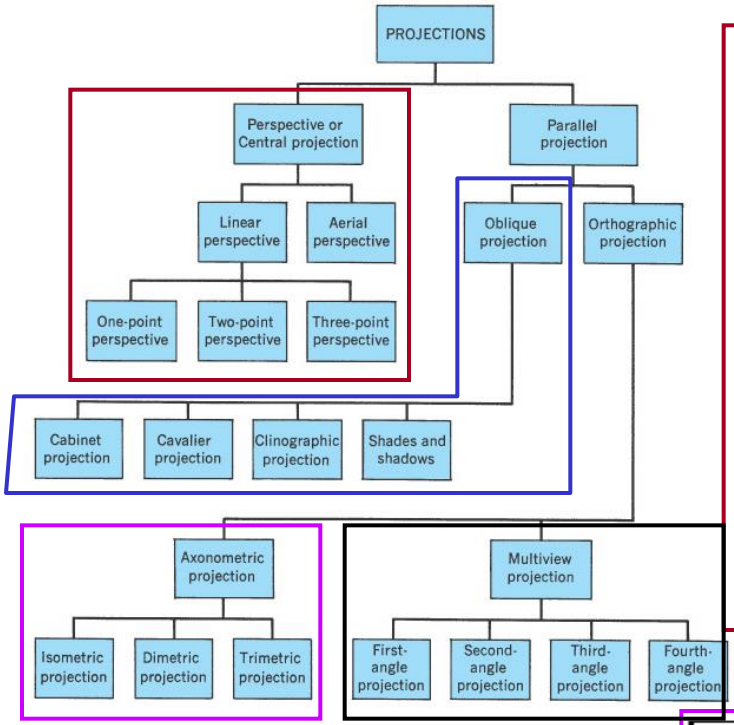
Perspective

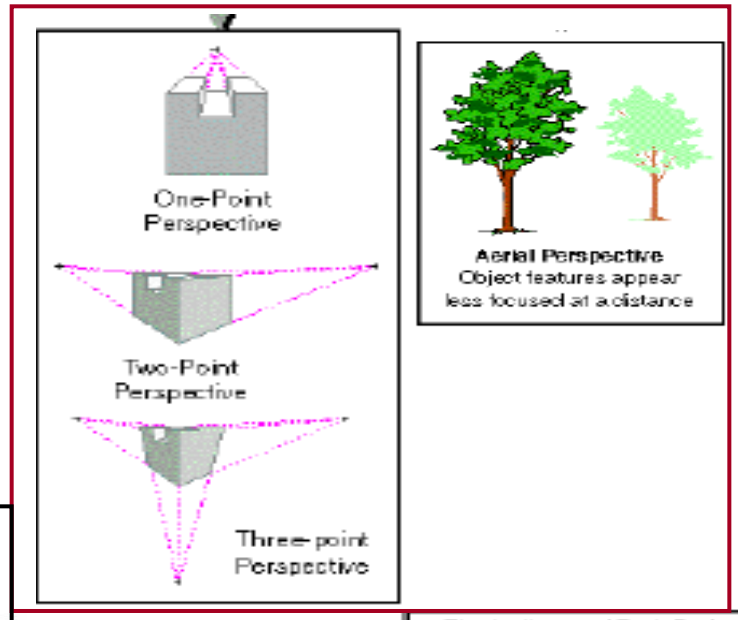


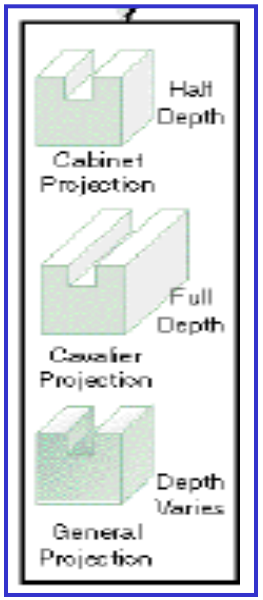
Parallel

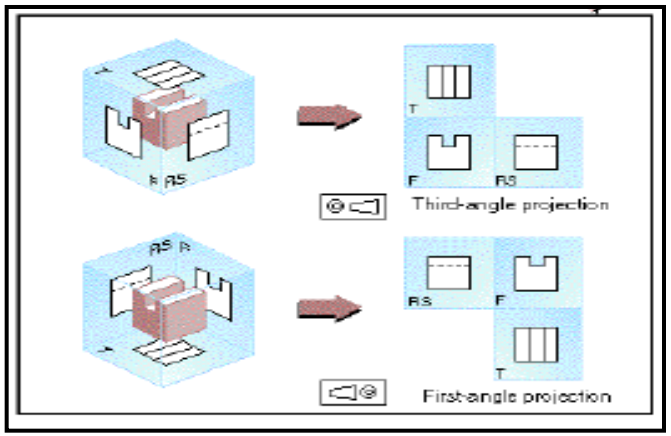


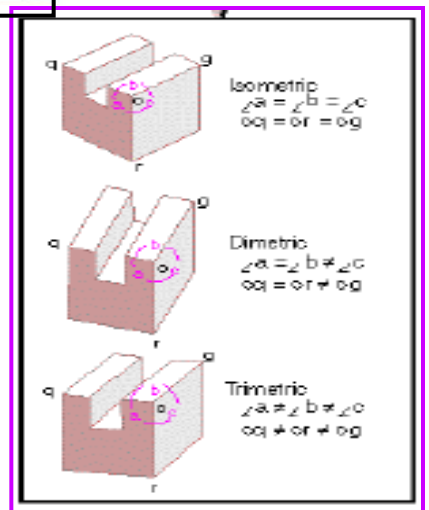
Projections and views (brief)









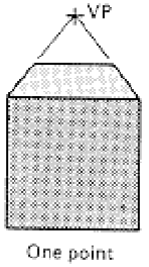


The Attributes of Each Projection Method

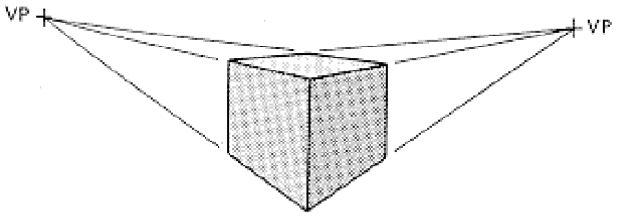
Projection Method	Lines of Sight	One principal plane parallel to plane of projection	Application
Linear Perspective -*One-Point* -*Two-Point* -*Three-Point*	Converging; inclined to plane of projection	Sometimes	Single view pictorial
Oblique Projection -*Cavalier* -*Cabinet* -*General*	Parallel; inclined to plane of projection	Always	Single view pictorial
Orthographic Projection *Axonometric* -*Isometric* -*Dimetric* -*Trimetric*	Parallel; normal to plane of projection	Never	Single view pictorial
Multiview Projection -*Third Angle (preferred)* -*First Angle*	Parallel; normal to plane of projection	For all principal views	Multiview drawings

What is perspective representation

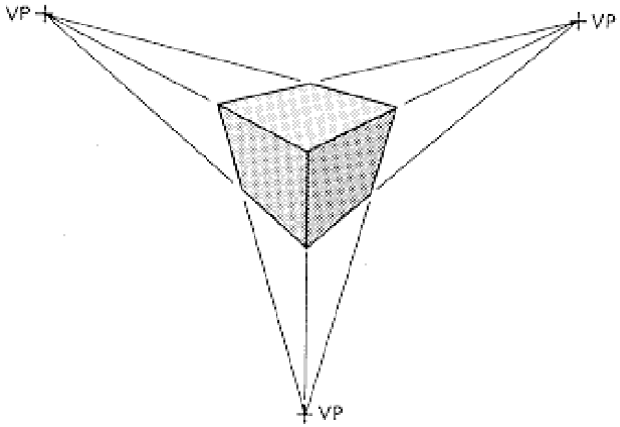
- Representation of objects based on the rule of distance: 2 identical object are seen different from different distances – shape is deformed too
- This type of representation is not used for technical purposes in Mechanical Engineering



One point



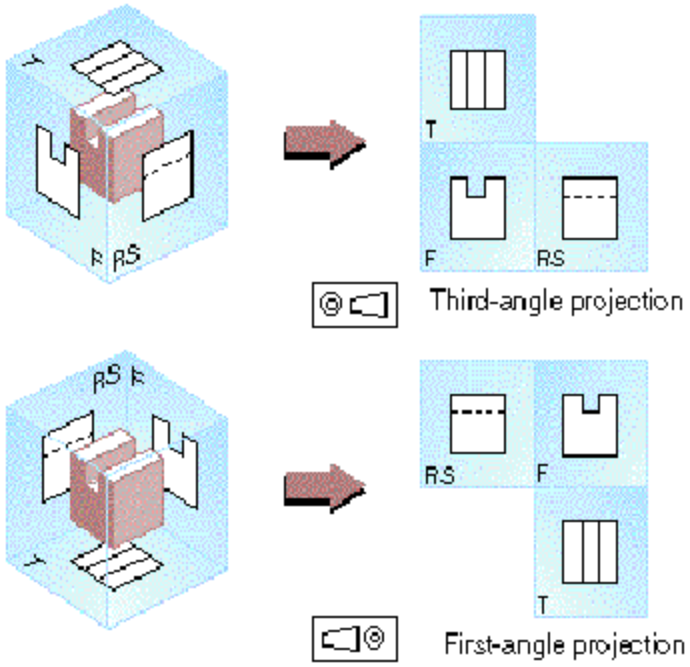
Two point

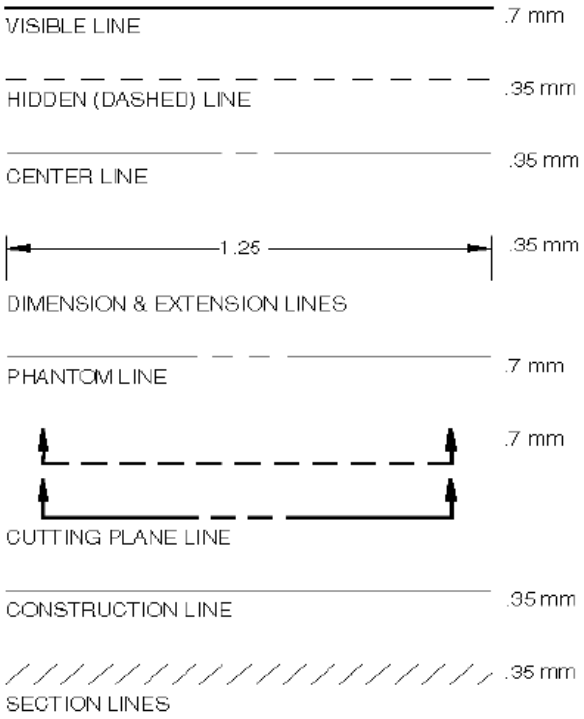


Three point

What should be drawn?

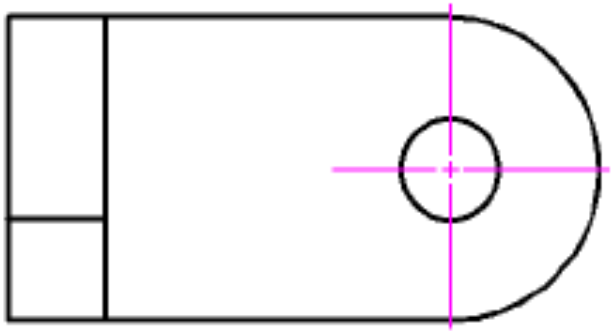
- What is seen – follow certain rules



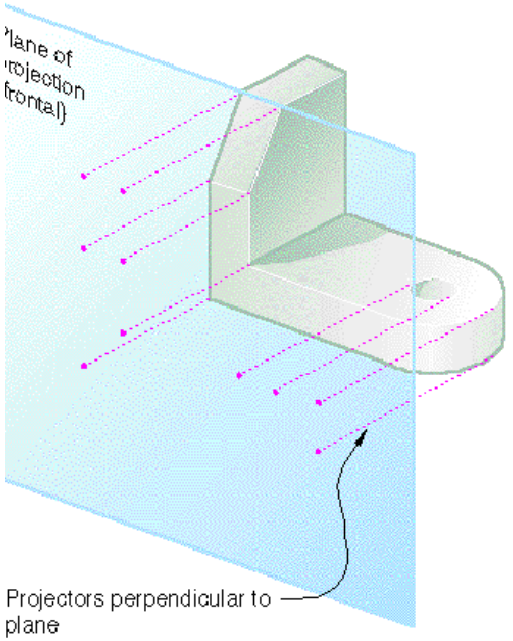


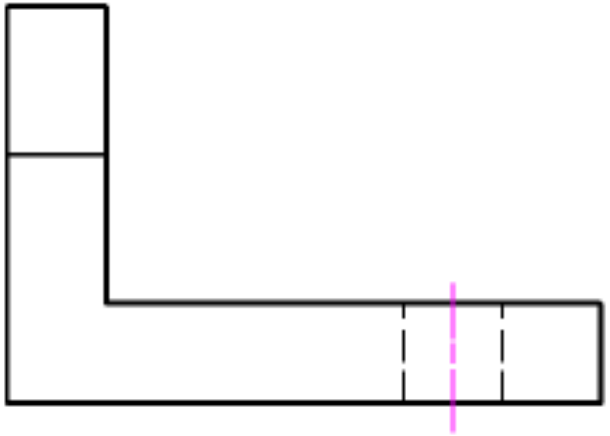
Views - Multi-view representation

Top view

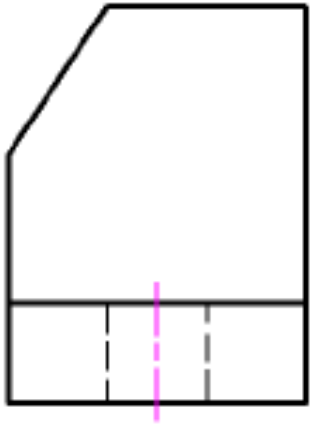


Project the visible and hidden edges/corners



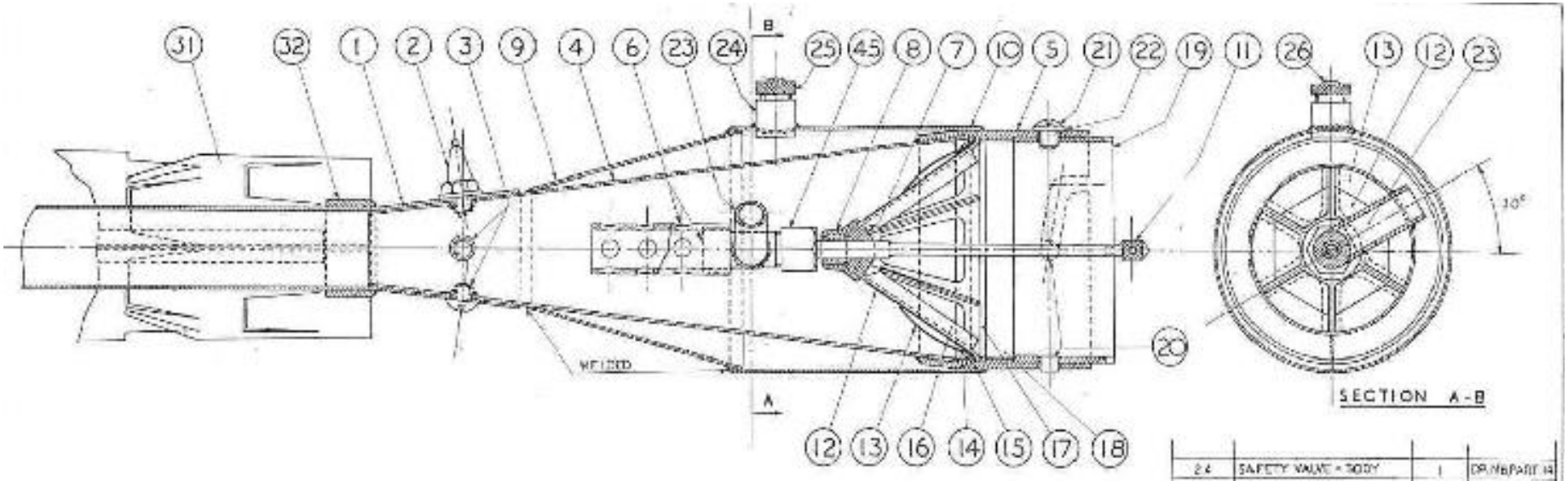


Front view



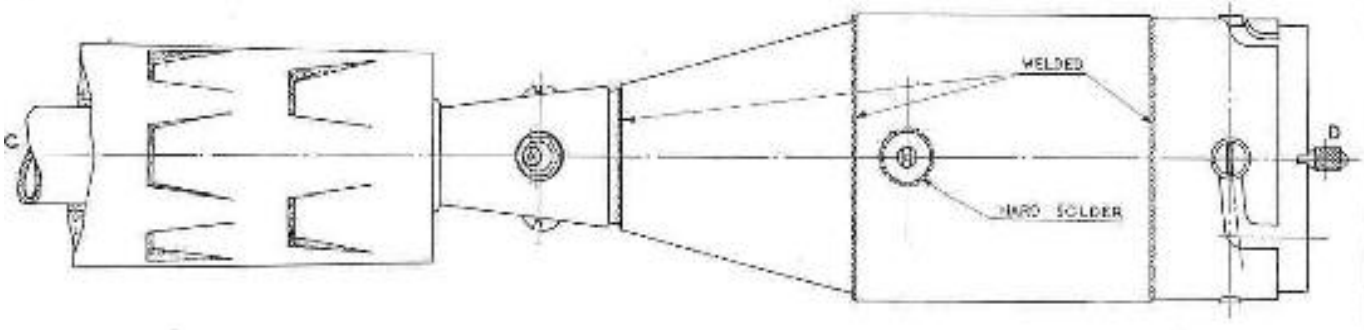
Right side view

Views - Multi-view representation



SECTION A-B

LONGITUDINAL SECTION C-D



GENERAL ASSEMBLY

PART Nº	NAME	Q.	REMARKS
24	SAFETY VALVE - BODY	1	DR.Nº3-PART 14
23	INLET TUBE	1	
22	SPRING WASHER	1	STAND.
21	BAYONET LUG LOCK SCR.	1	B.A. Nº 2
20	BAYONET LUGS	3	
19	LOCKING RETAINER	1	
18	FRONT SPACER RING	1	
17	INTAKE VALVE FRAME RING	1	
16	INTAKE VALVE FRAME ELEM.	6	
15	VALVE LEAF RETAINER	1	
14	REAR SPACER RING	1	
13	INTAKE VALVE LEAF STIFFEN.	6	
12	INTAKE VALVE LEAF	6	
11	NEEDLE	1	
10	FUEL JACKET-CYLINDER	1	
9	FUEL JACKET-CONE	1	
8	VALVE LOCK NUT	1	
7	VALVE BODY	1	
6	INJECTOR	1	DR.Nº3-PART 6
5	FRONT RING	1	
4	MOTOR BODY	1	
3	SCREW-ROUND HEAD	3	5/16" DIA.
2	SPARK PLUG	1	STAND.MOD.
1	EXHAUST TUBE	1	

JET MOTOR MODEL Z.M.E.

DR. BY	CHECKED	APPR.BY	SCALE: FULL	DATE 3/20/46

AIRCRAFT-JET & ROCKET CORP. DR. Nº 1.

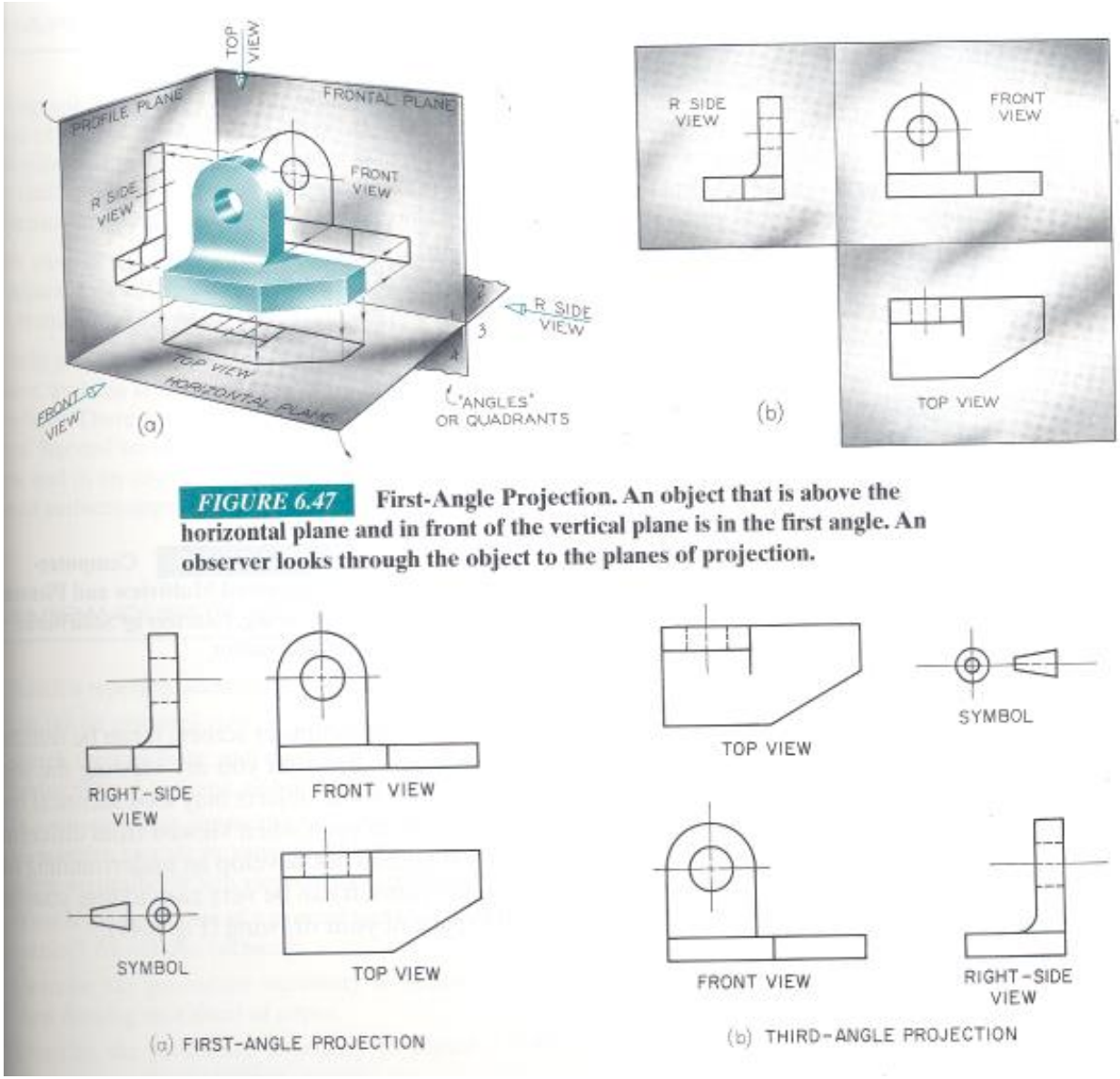
45	LOCK NUT	1	DR.Nº3-PART 5
32	RETAINING RING	2	
31	MELOT NOZZLE	2	
26	SAF.VALVE SPRING RETAIN.	1	
25	SAFETY VALVE PLUG	1	

PART Nº	NAME	Q.	REMARKS

Multi-views

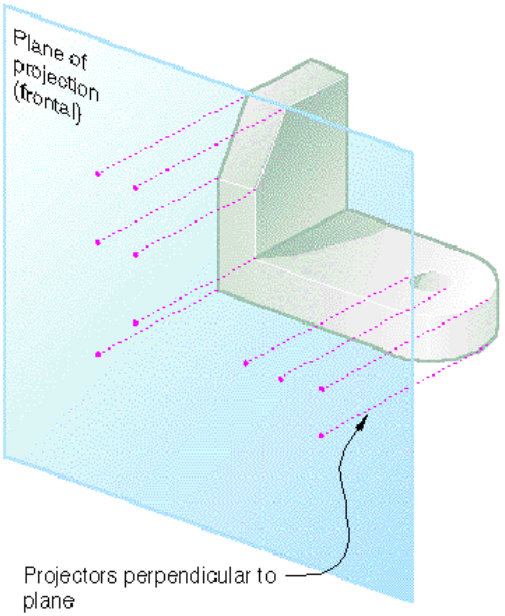
- A part is represented in multiple views (a single part is seen as more than one part)
- The representation makes the user to fully understand the shape of the part, to perceive the relative proportions of the geometric features and to position the features one with respect to another
- The parallel projection principle and the alignment of the features is used in the representation

Type of Projections

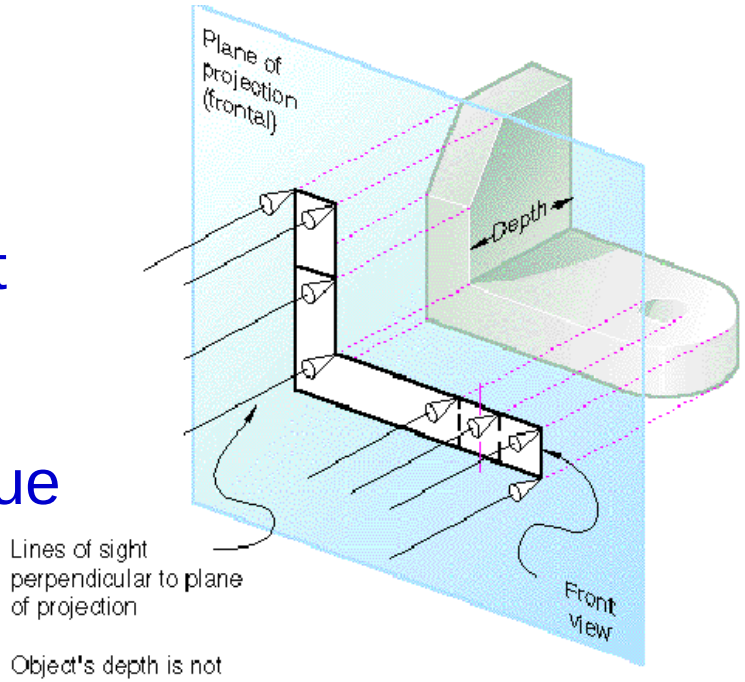


Projection planes

- The component is aligned with respect to the principal projection planes
  - Top (T) or Horizontal (H)
  - Front (F) or Vertical (V)
  - Side (S) or Profile (P)
- The projection is carried such that each feature parallel to the projection planes to be seen as true length

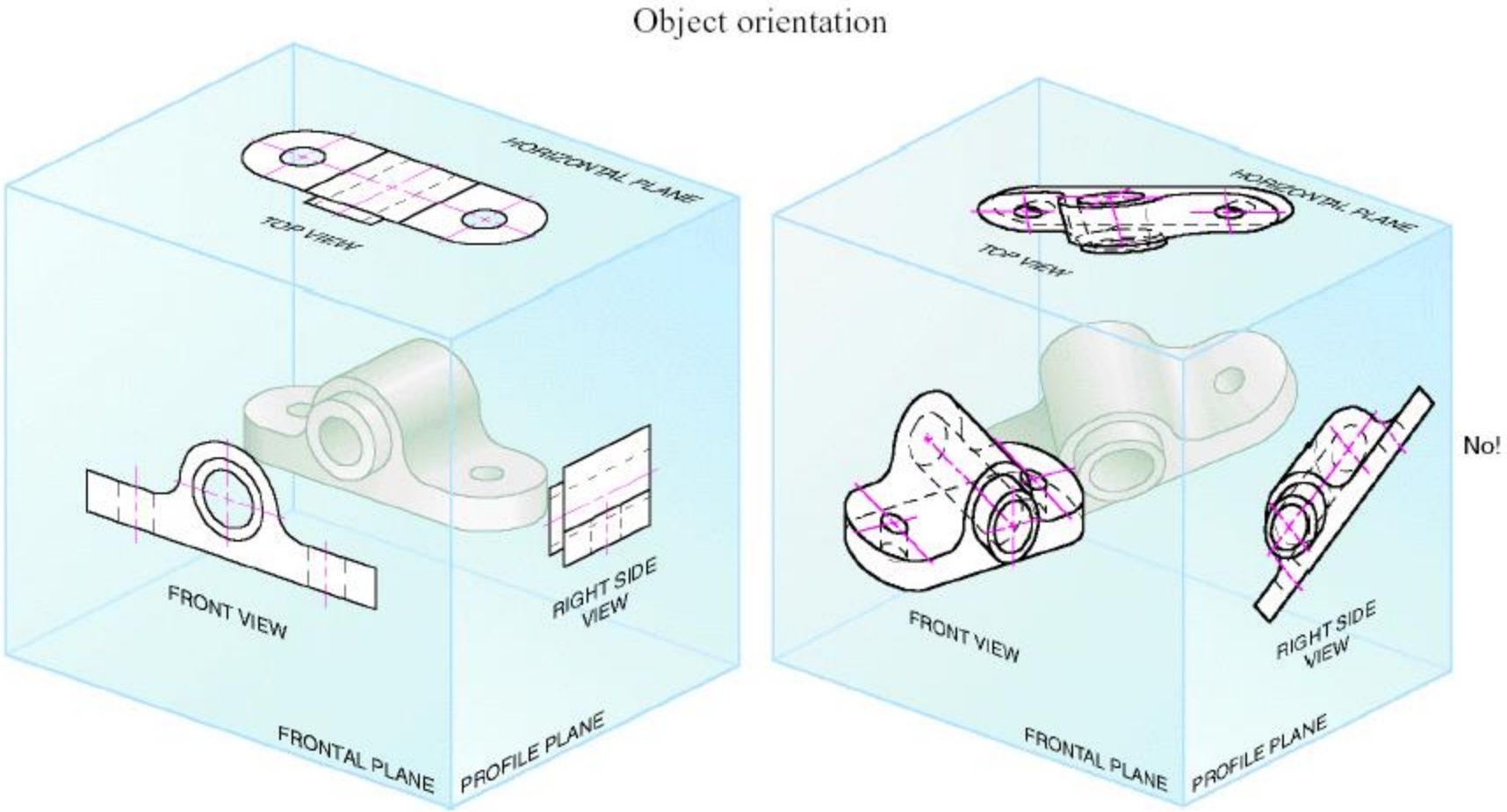


(A)

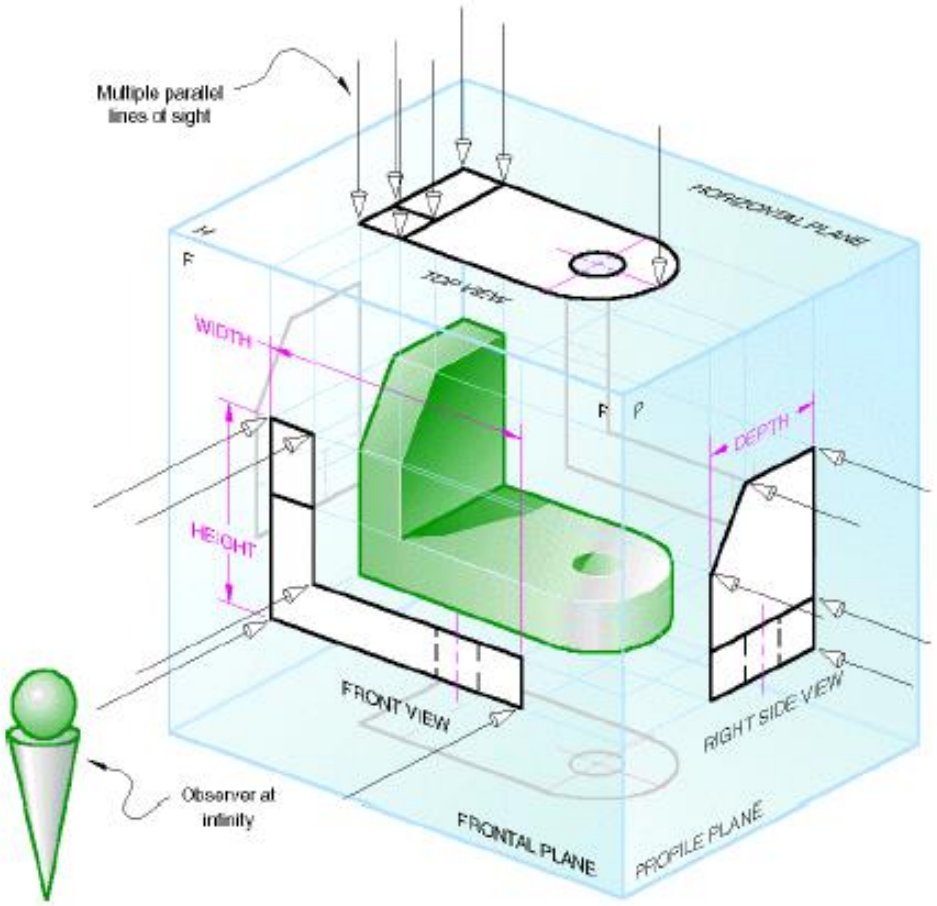


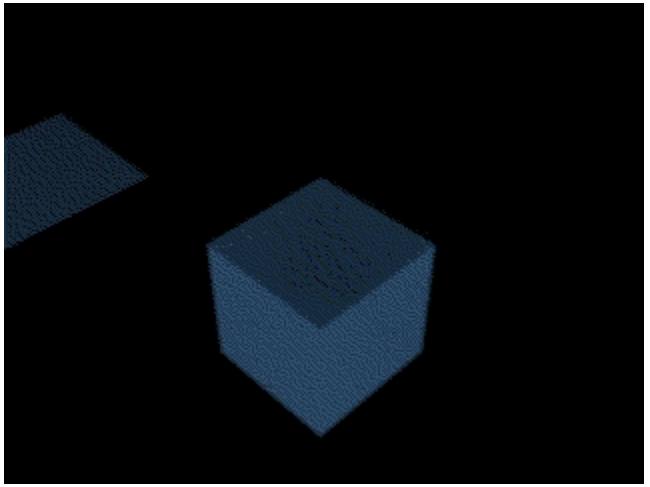
(B)

Object orientation

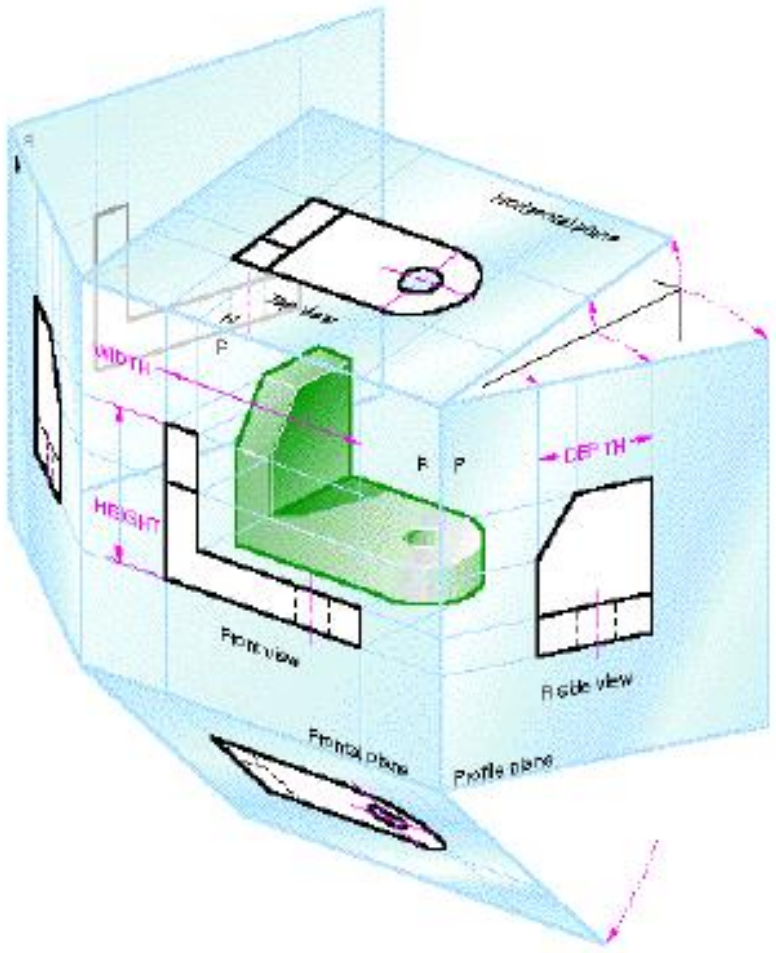


Projection principles

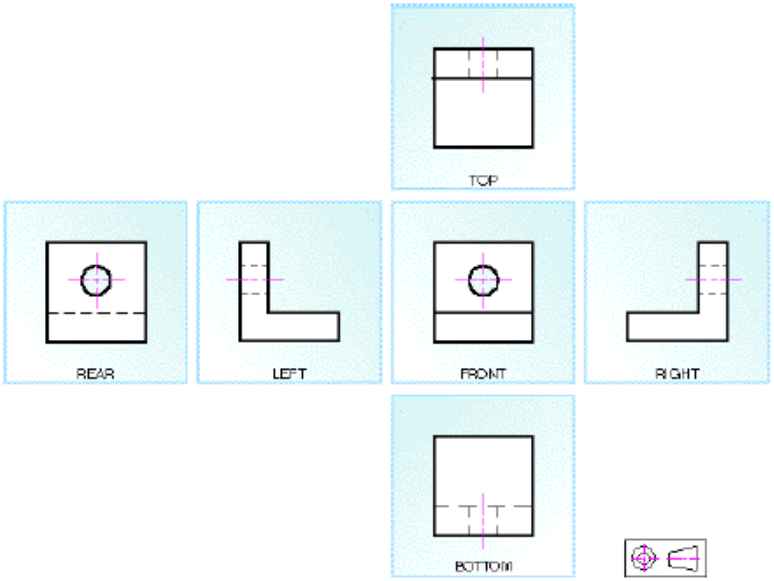




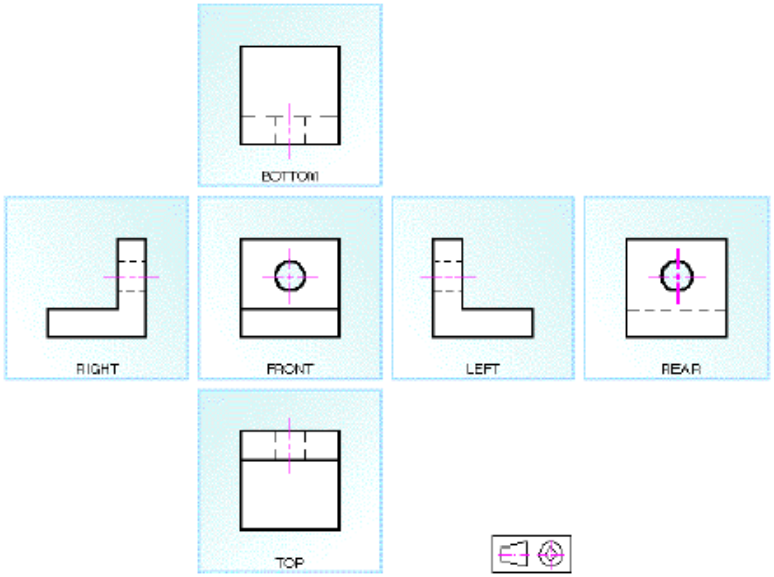
Projection principles



Projection Types



(A) U.S. Standard



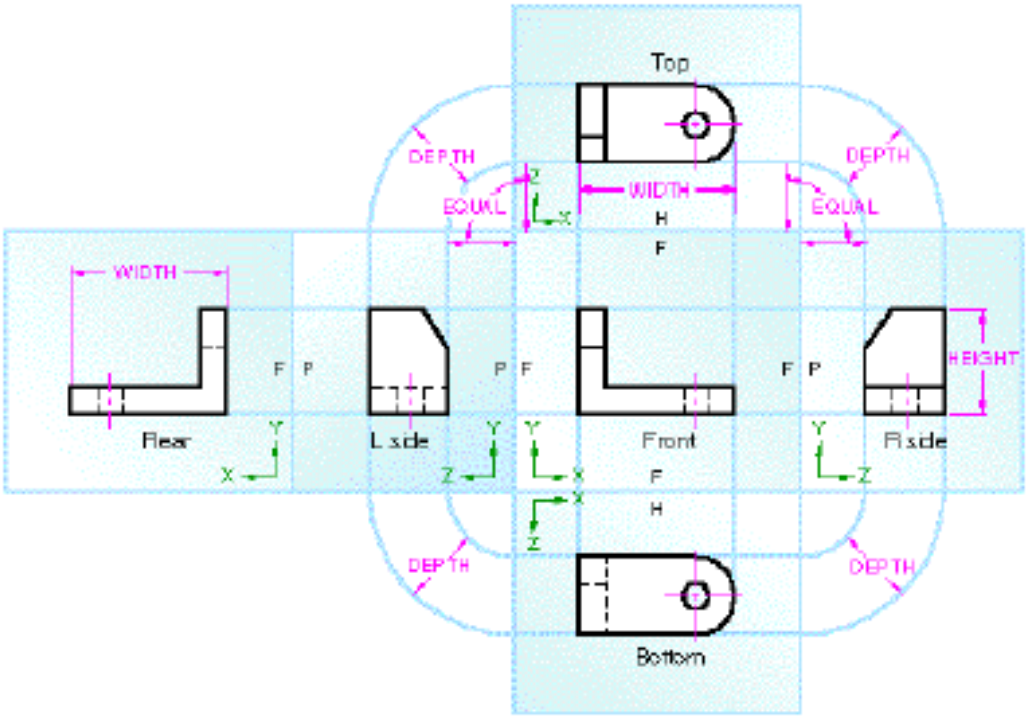
(B) European Standard

Third angle projection

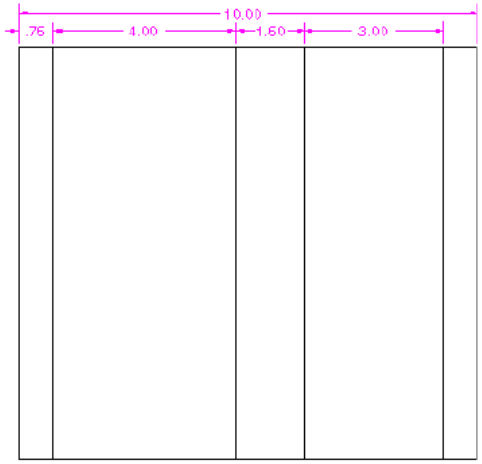
First angle projection

Relative position of the views

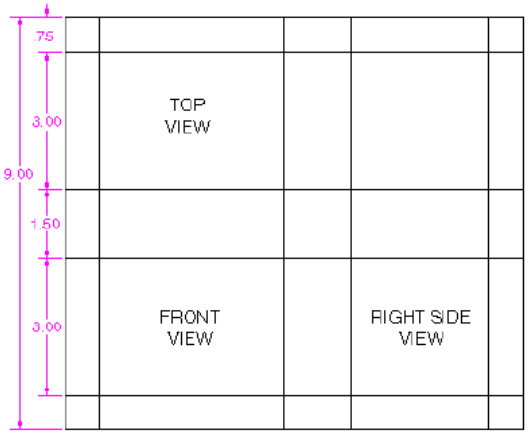
- All views must be aligned with respect to each other – feature to feature



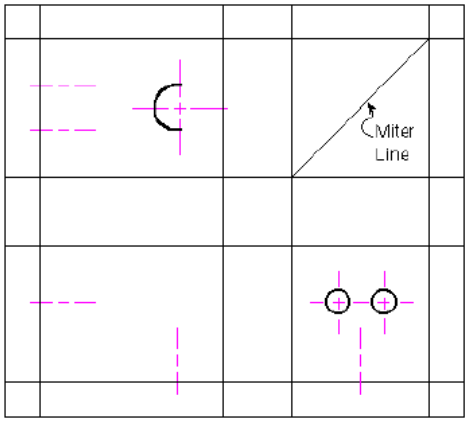
Drafting strategies (3 view)



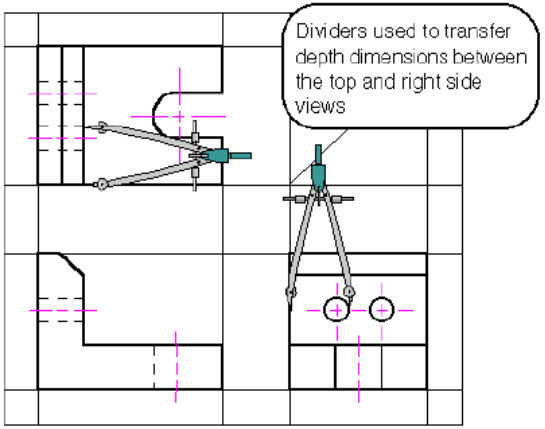
(A)



(B)



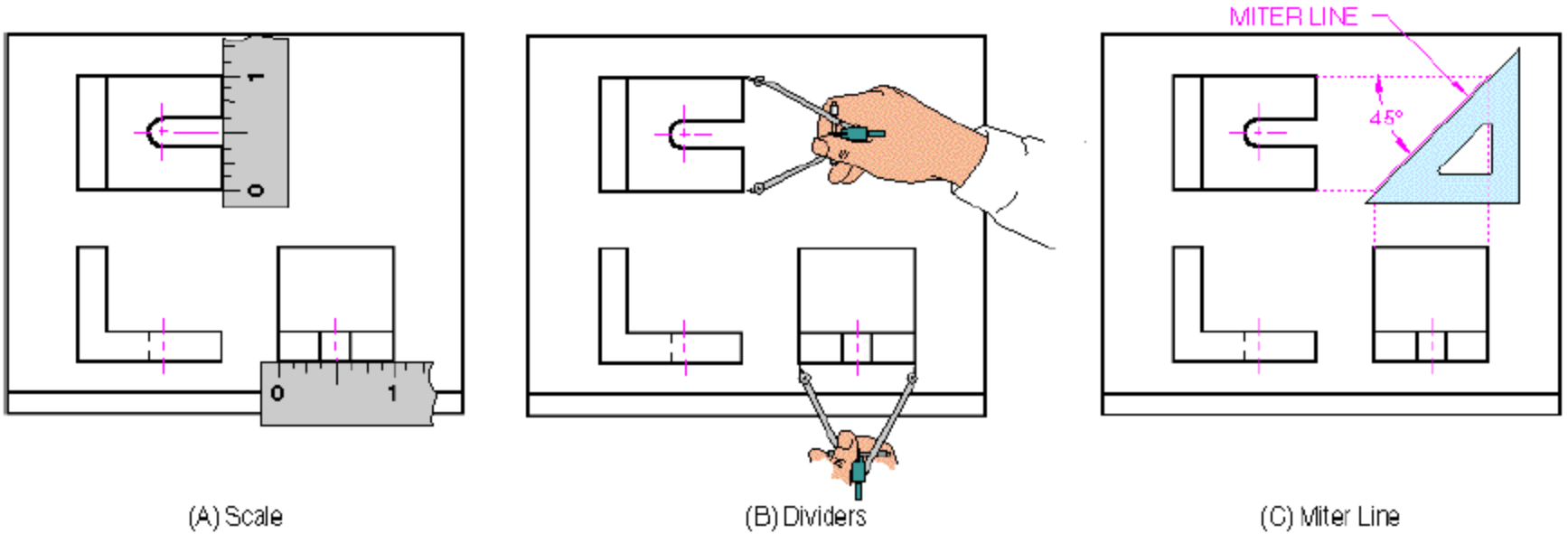
(C)



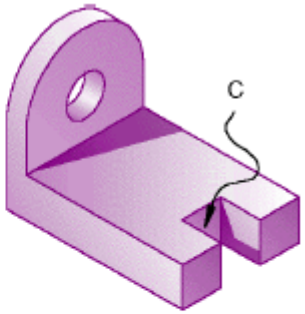
(D)

Technical procedures

- When representing the third view, scale, divider of miter line is used to ensure the alignment of the three views



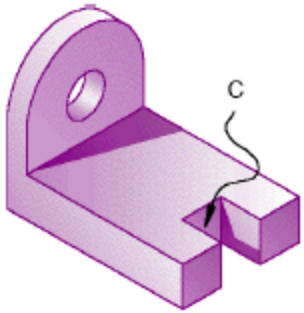
Example

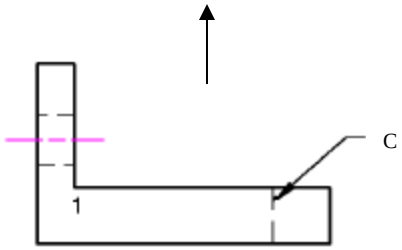


- Represent the shown component using multiple view representation

Example

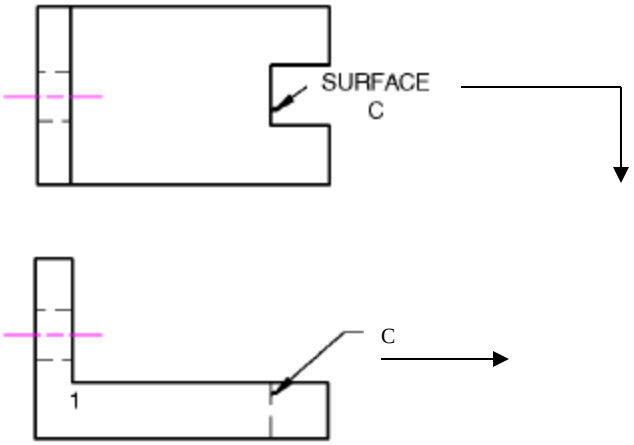
- Start with the front view
- The edge C cannot be seen but is represented by a dashed line (hidden feature)

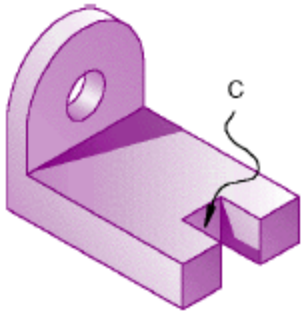




Example

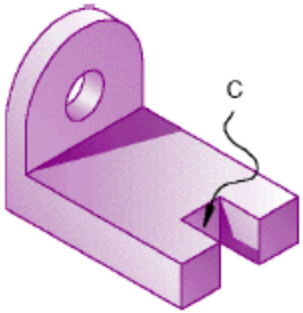
- Align the top view with respect to the front view

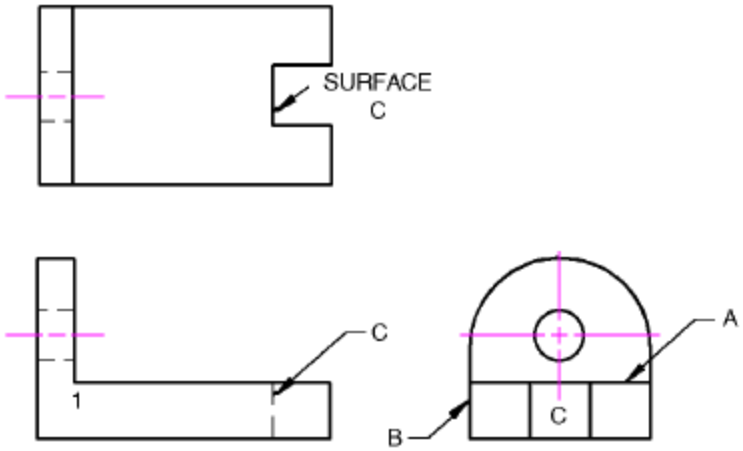




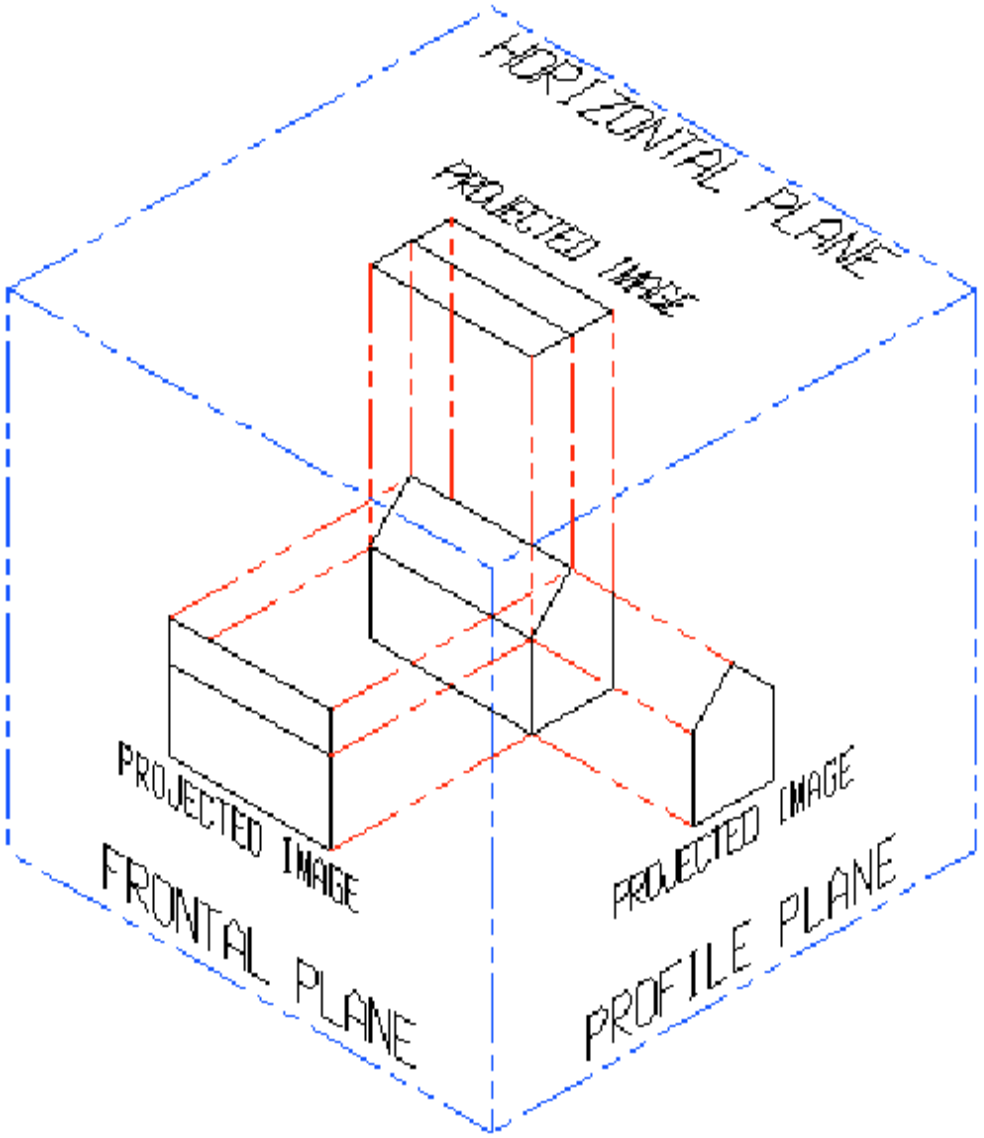
Example

- Complete the representation
- Later, dimensioning and comments will be added to the drawing



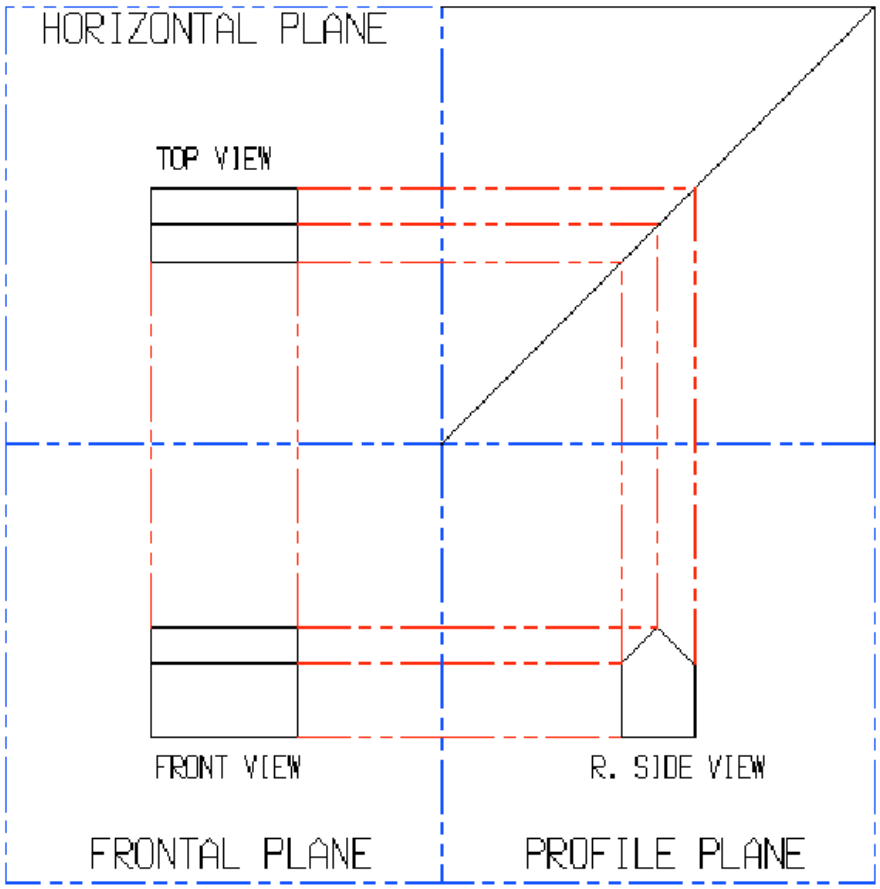


The principal projection planes



- The object should be aligned with respect to the projection planes

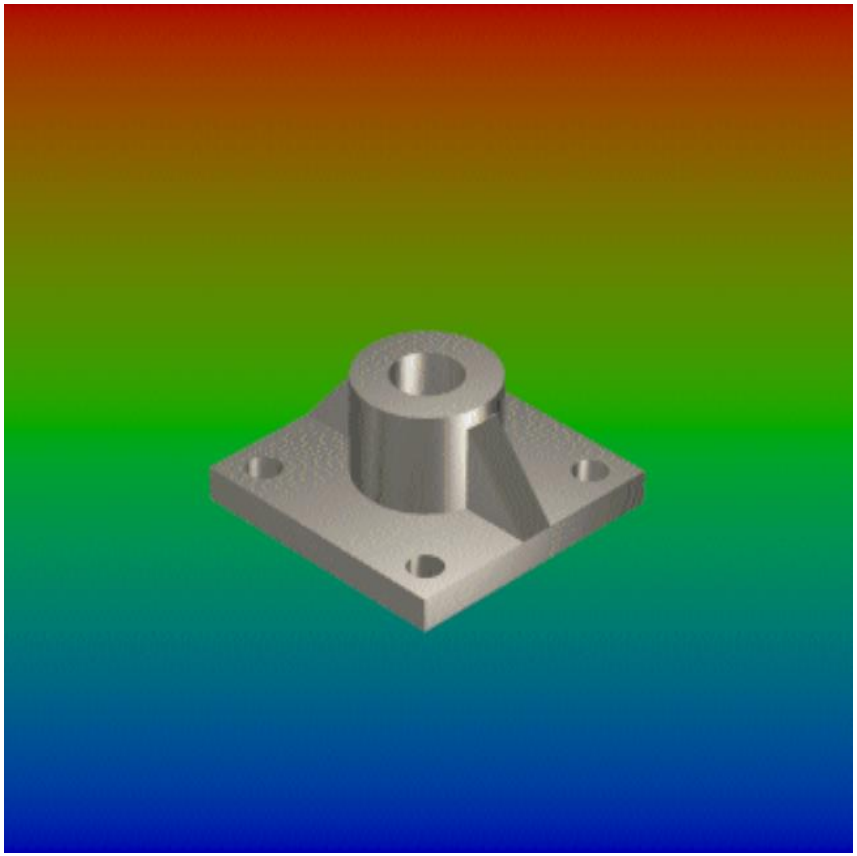
The principal projection planes
- unfolded



- Notice the relationship between the features
- The depth – distance from the front to the object is measured in the Horizontal and Profile

Multi-view Projection Drawing

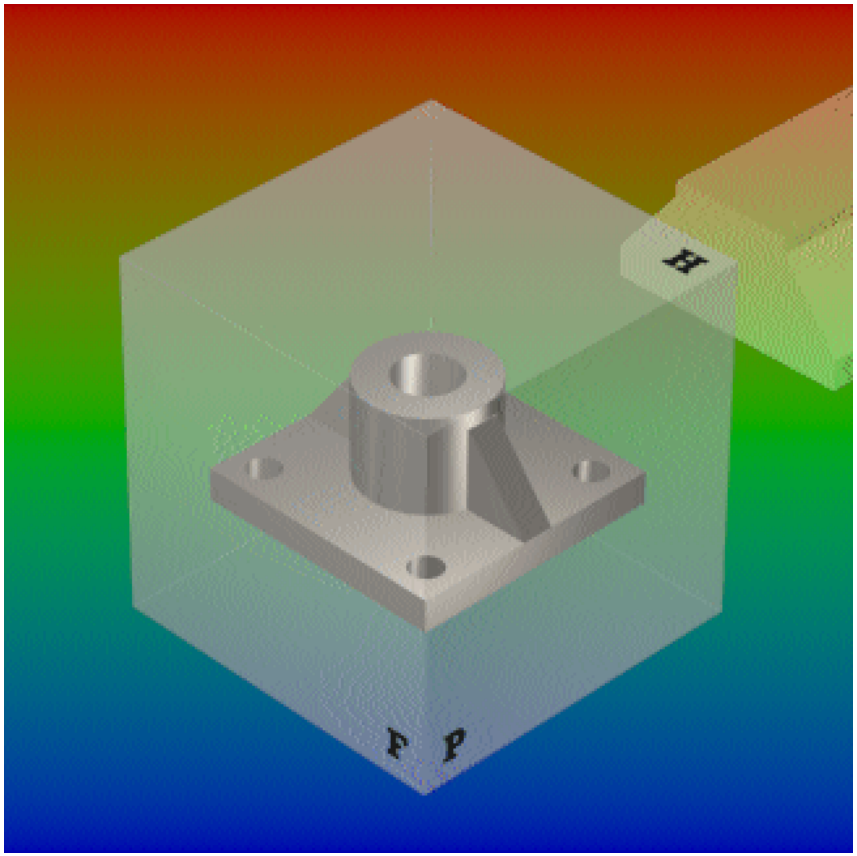
How to generate



- Assume the given part as shown besides.
- Position the part in a convenient way, to simplify the representation as much as possible

Multi-view Projection Drawing

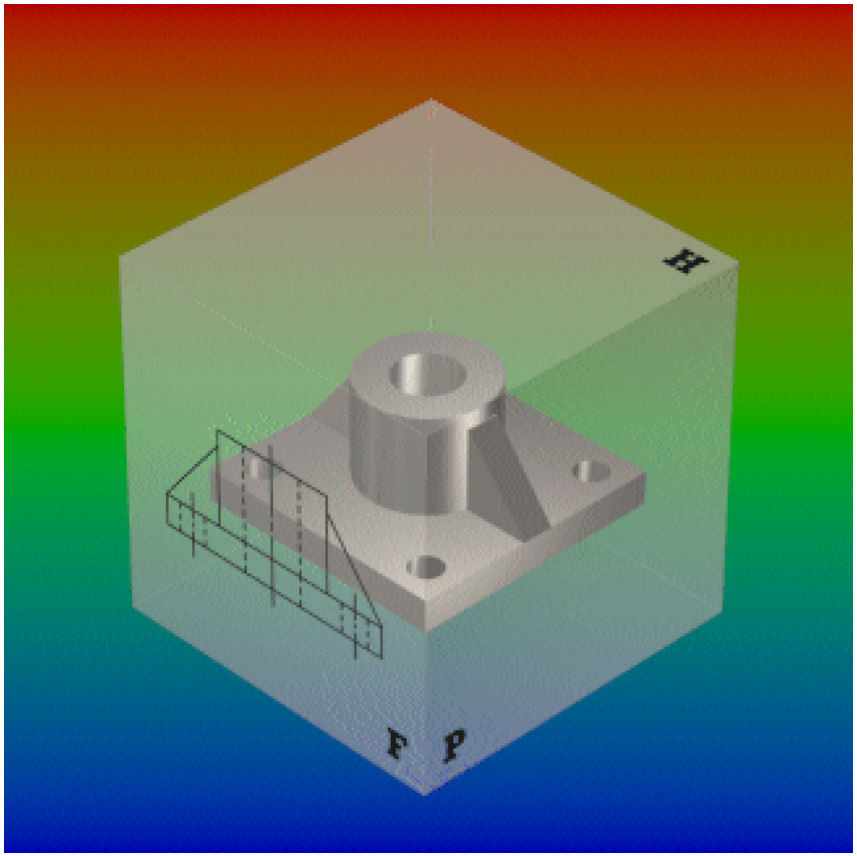
How to generate



- Select the position of the projection planes
- Start with one of the projections – usually the front view
- Each edge is represented based on the principle of the parallel projection

Multi-view Projection Drawing

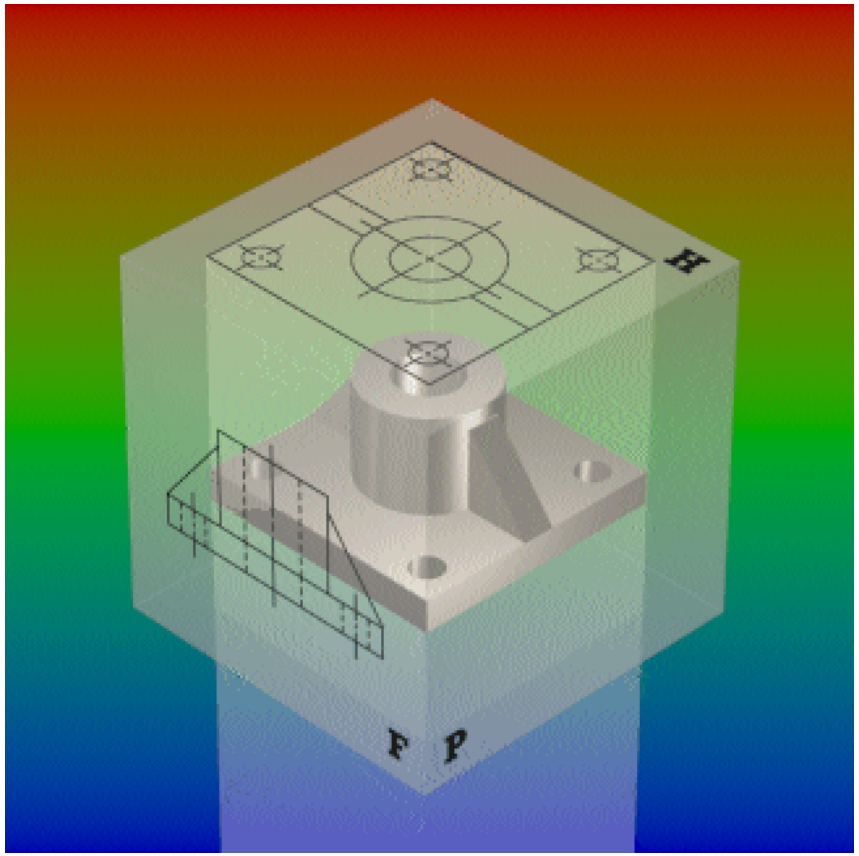
How to generate



- Complete the first view.
- Use the basic representation Principles:
- visible edge is seen as a full line
- non-visible feature is represented by a dash-line
- axes of symmetric features are represented by dash-dot lines

Multi-view Projection Drawing

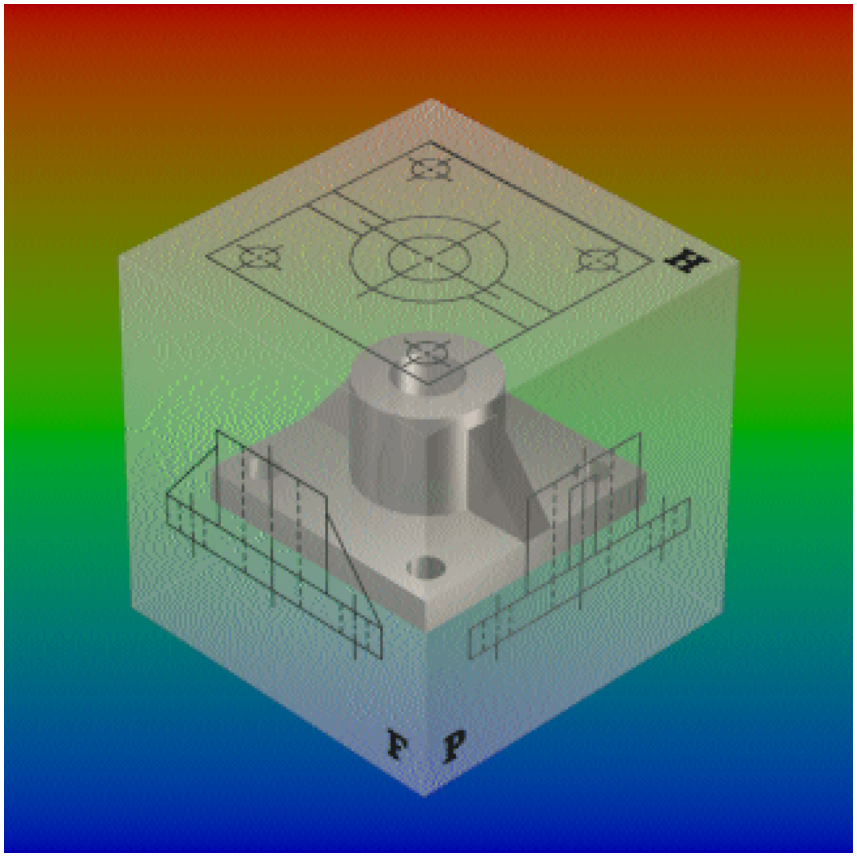
How to generate



- Continue with the second view
- Make sure that you have accurately align the two views.
- Use the same rules for representation.
- The alignment lines must be perpendicular to the edge of the projection planes
- (The lines of sight are always perpendicular to the fold line).

Multi-view Projection Drawing

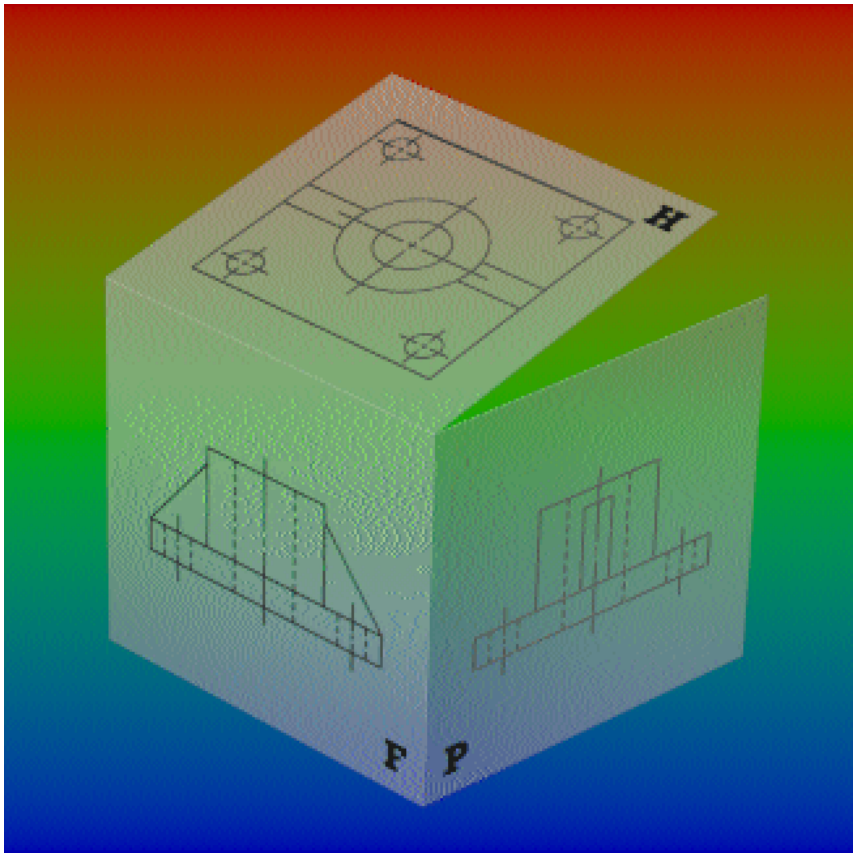
How to generate



- Continue with the third view
- Make sure that you have accurately align all views.
- Use the same rules for representation.
- The alignment lines must be perpendicular to the edges of the projection planes
- (The lines of sight are always perpendicular to the corresponding fold lines).

Multi-view Projection Drawing

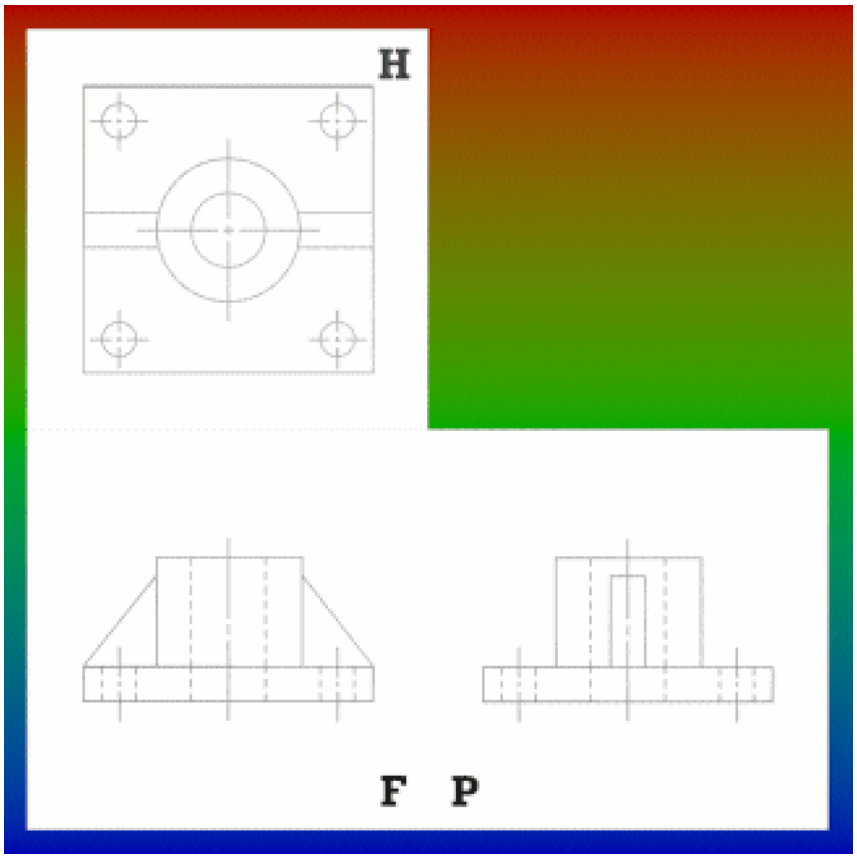
How to generate



- Complete the representation
- Separate the top from the profile view along the edge (fold line)
- Unfold the three views to lay them on the same plane

Multi-view Projection Drawing

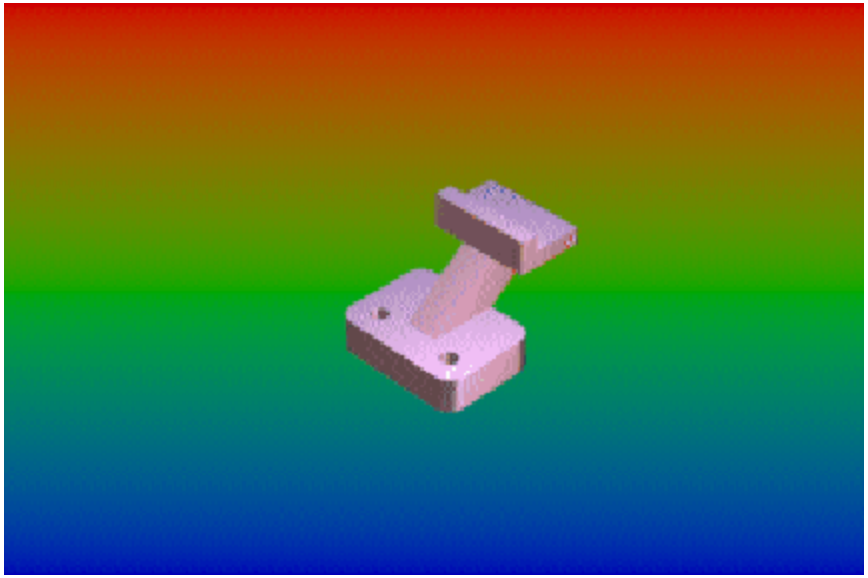
How to generate



- This is the **3-view** orthographic representation of the selected part (FLANGE)

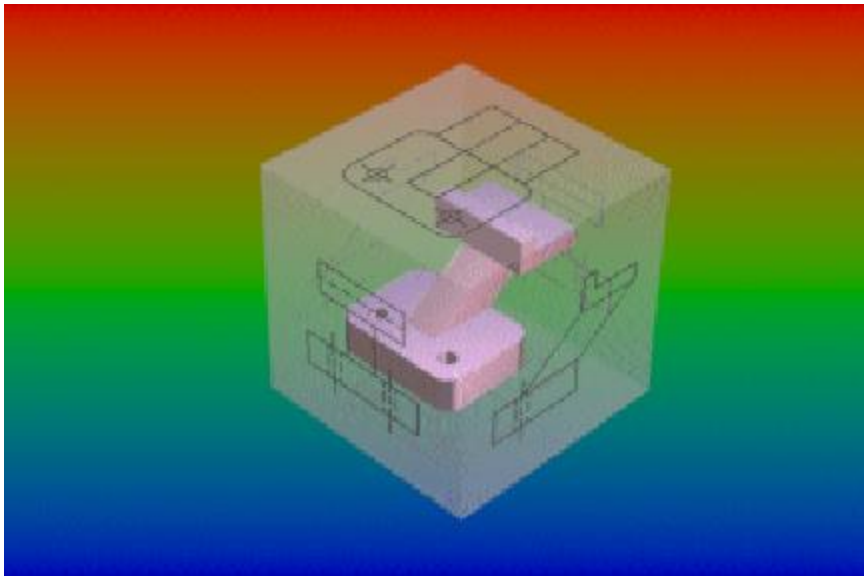
- *** Do not erase any of the lines when writing a test**

Orthographic multi-view

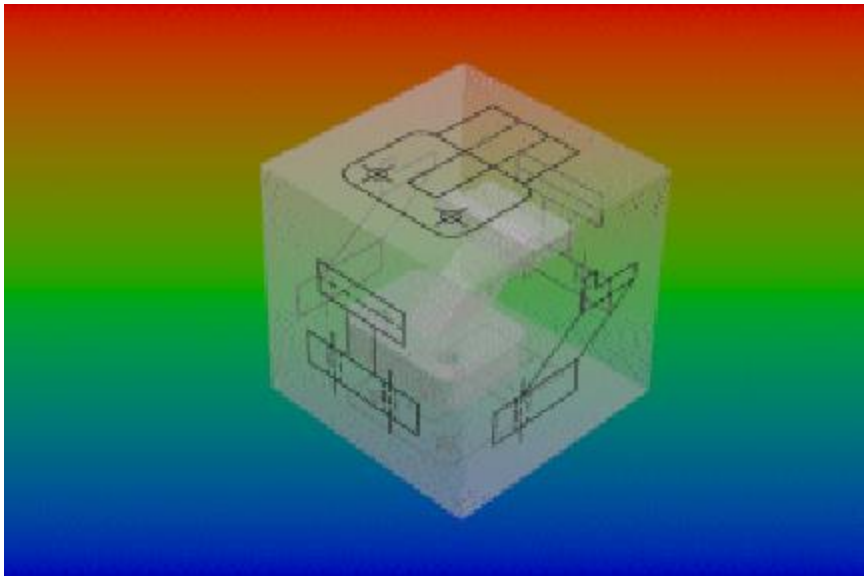


- The above part will be projected on all 6 projection planes

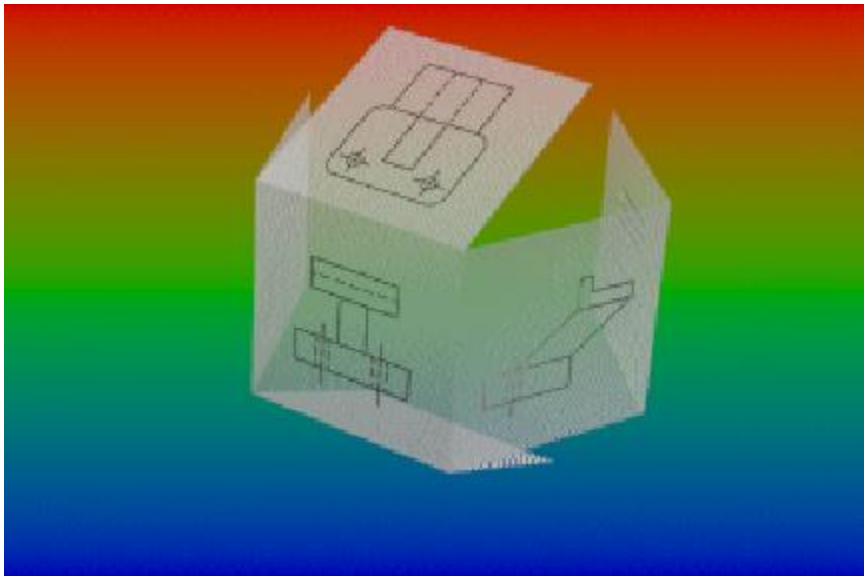
Orthographic multi-view



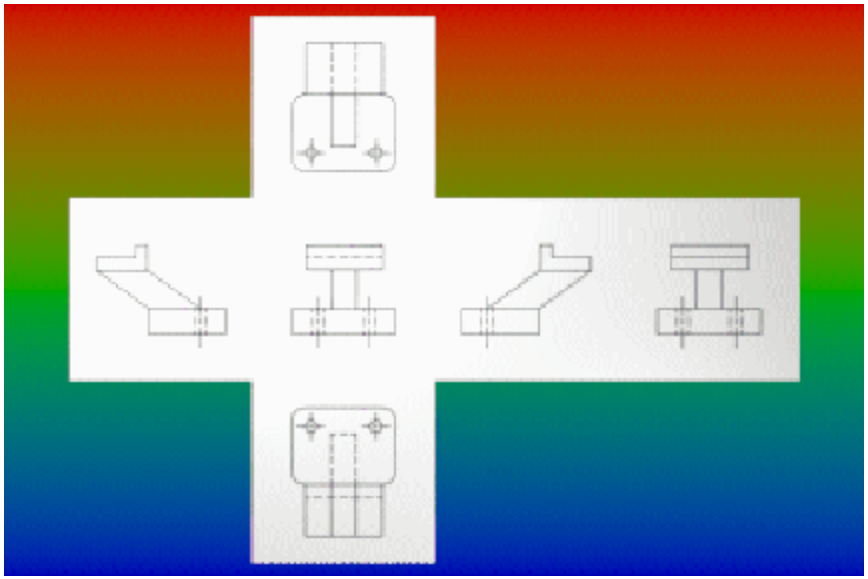
Orthographic multi-view



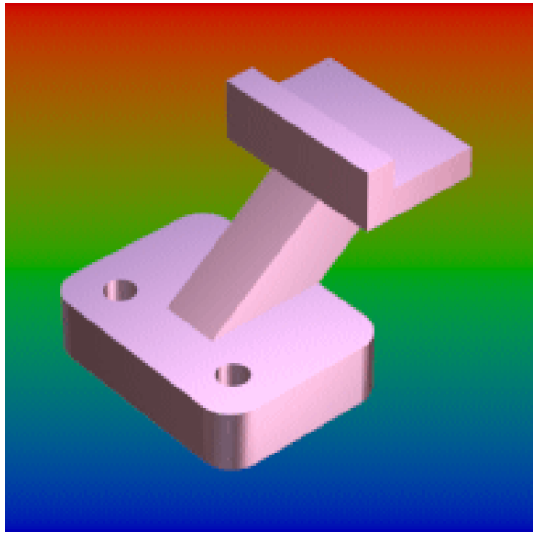
Orthographic multi-view



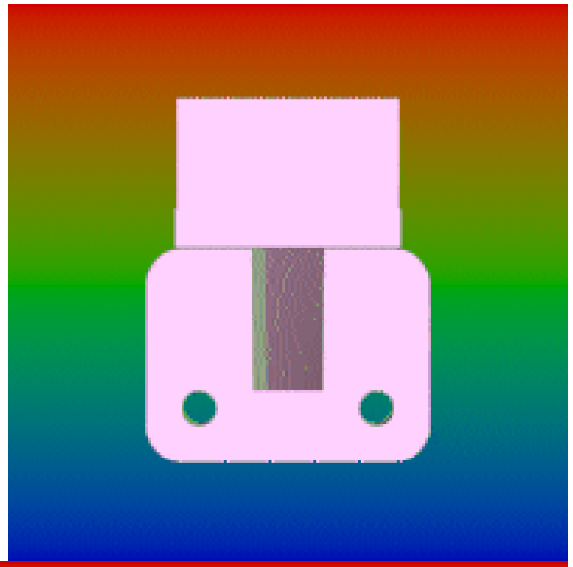
Orthographic multi-view

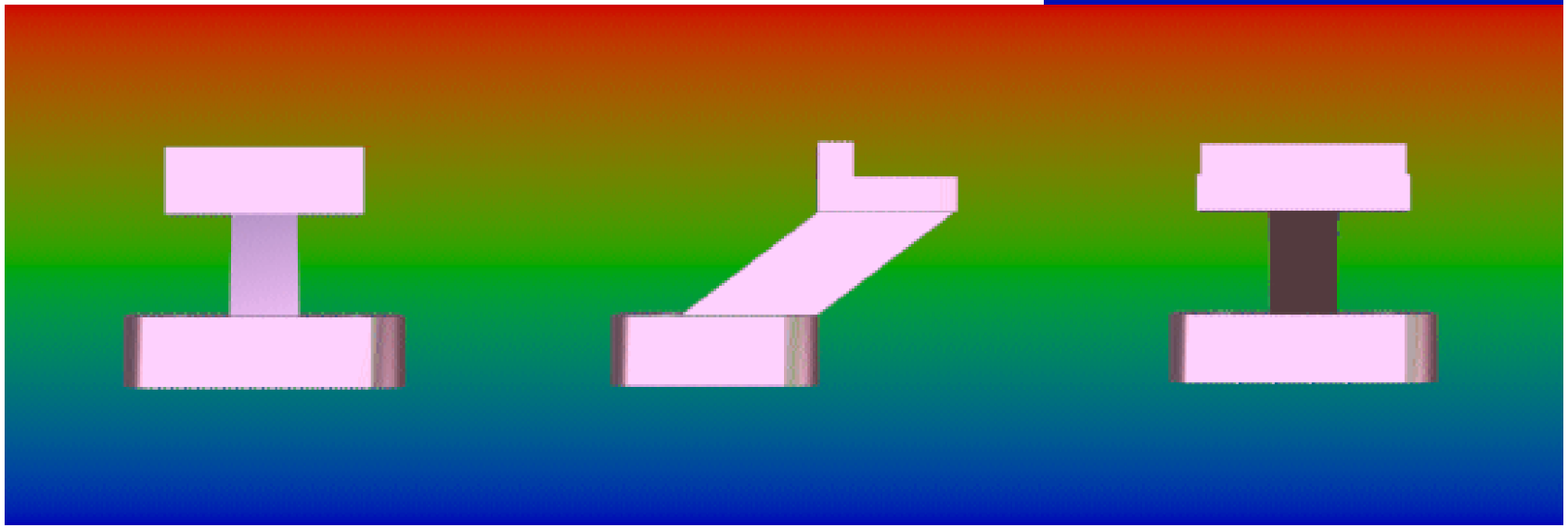


Orthographic multi-view



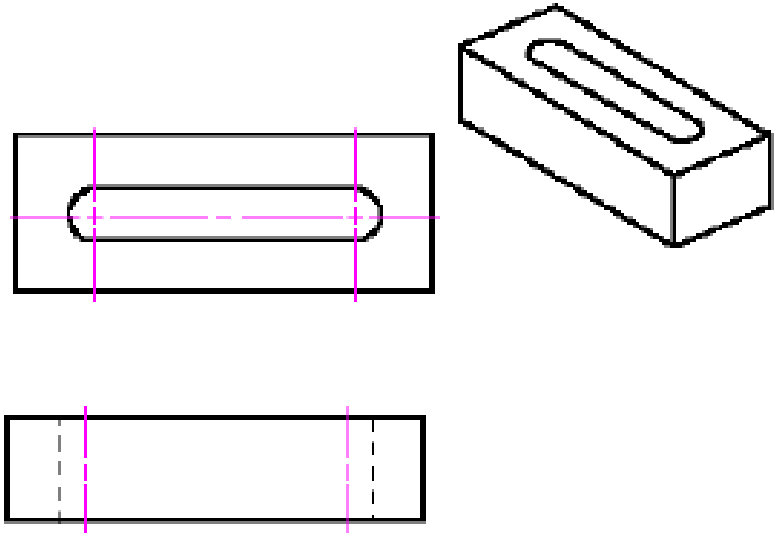
Solid models





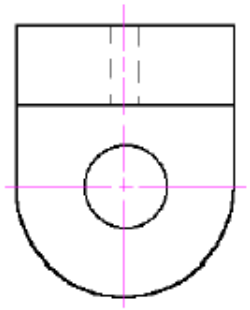
Minimum number of views

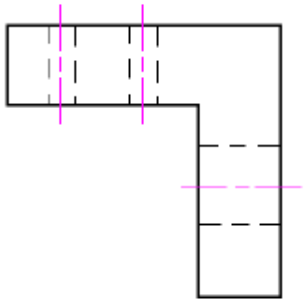
- Certain shapes could be described in less number of views
- One must use the minimum number of views for representation

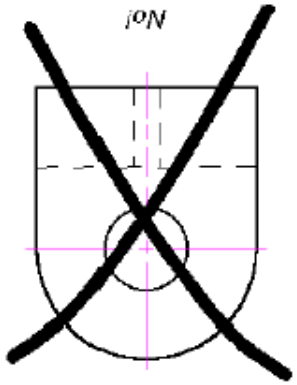


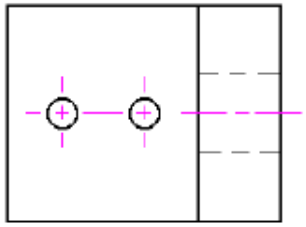
Minimum number of views

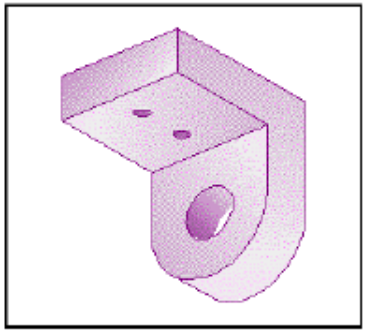
- Do not produce more views than necessary





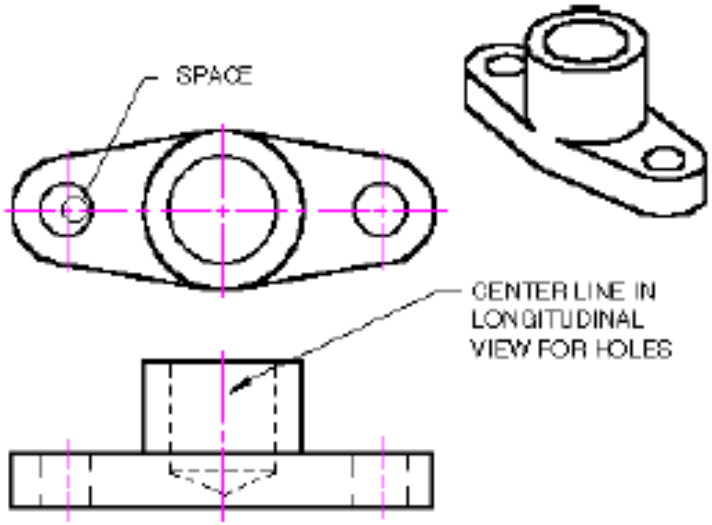






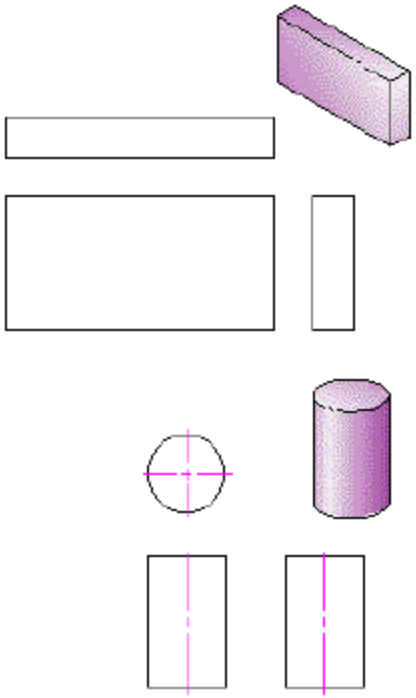
Centerline

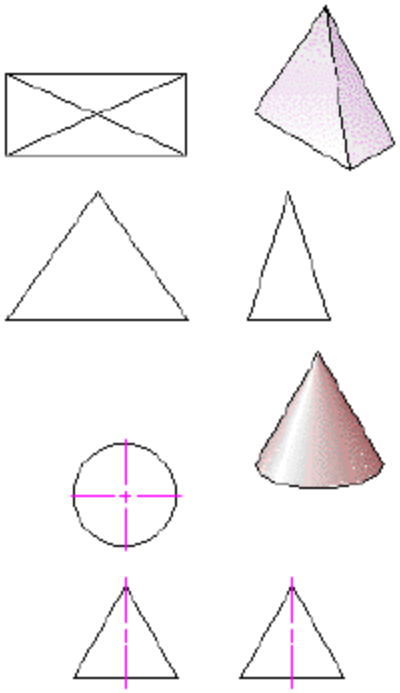
- Axi-symmetric features are indicated with a dash-point line - CENTERLINE

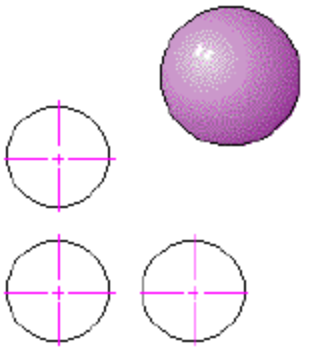


Hints on understanding shapes

- Try to “see” the way a solid is created out of primitives

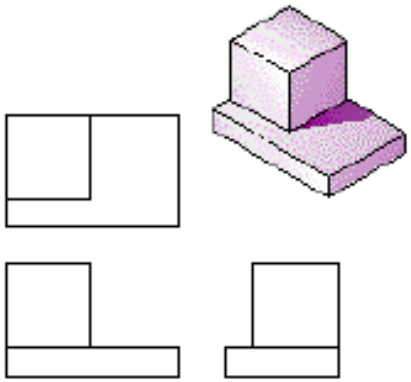


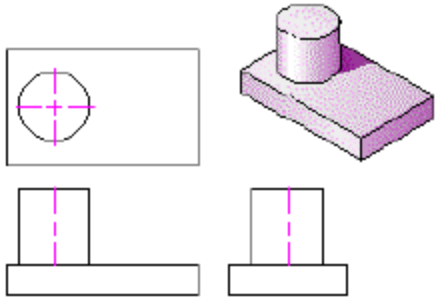


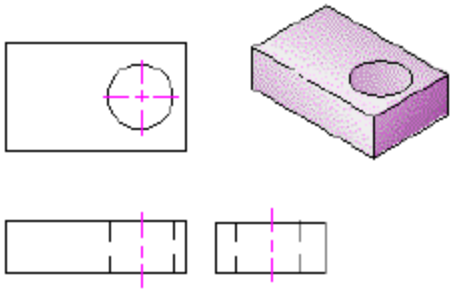


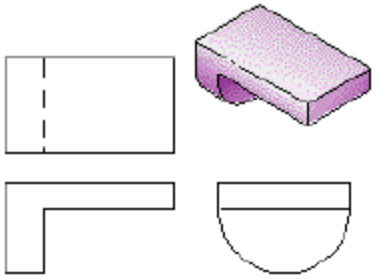
Hints on understanding shapes

- Complex shapes could be generated using Boolean operations

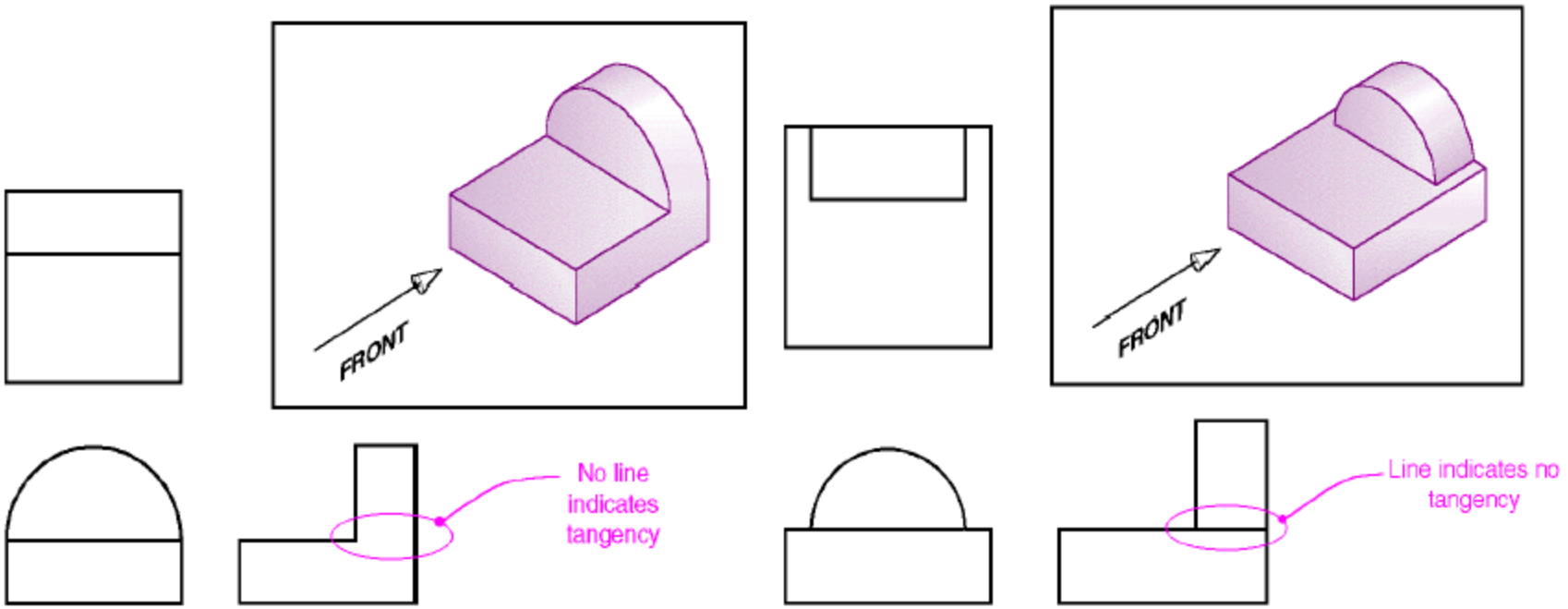




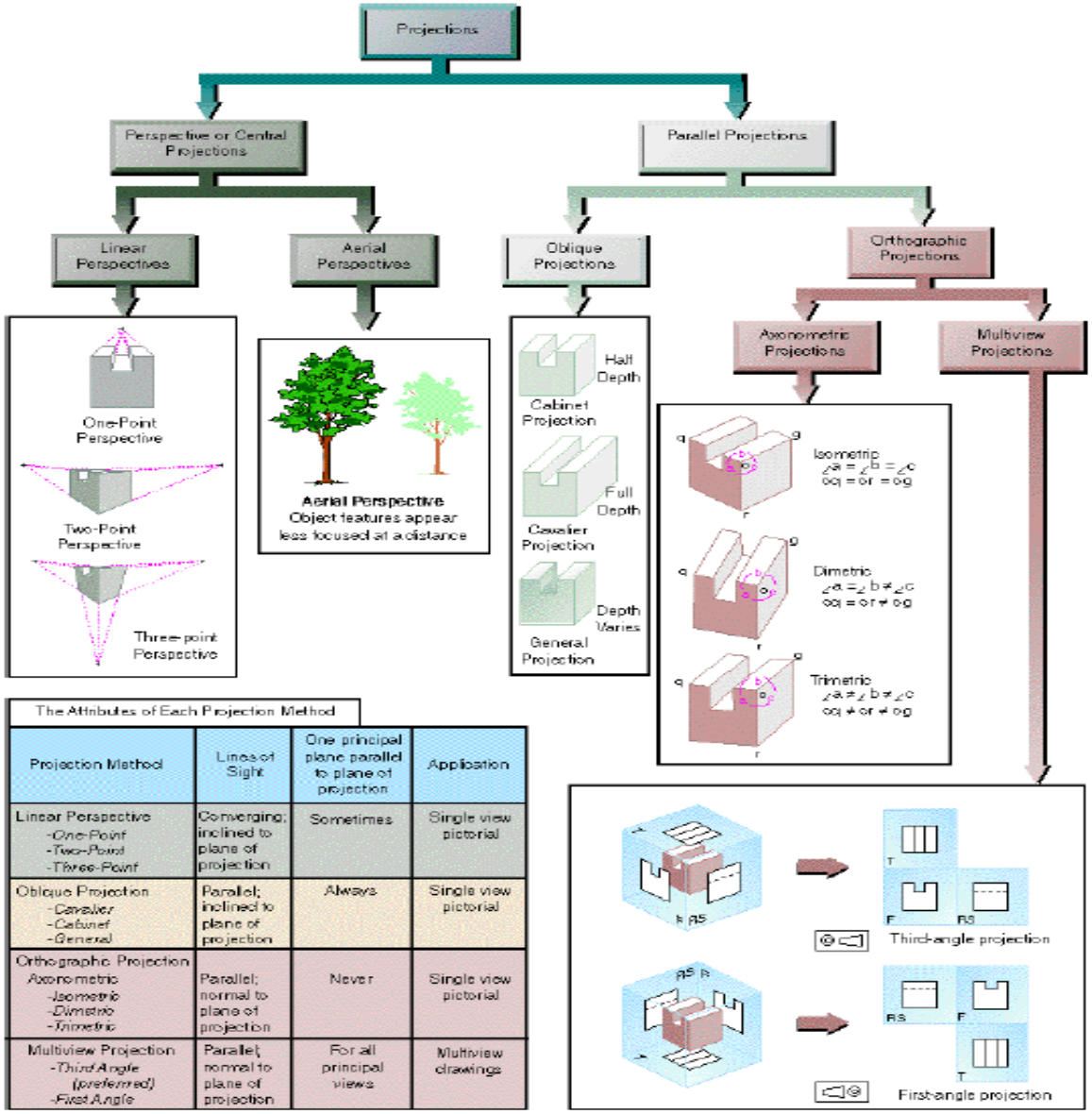




Pay attention to edges



Projections and views (brief)



The Attributes of Each Projection Method

Projection Method	Lines of Sight	One principal plane parallel to plane of projection	Application
Linear Perspective -*One-Point* -*Two-Point* -*Three-Point*	Converging; inclined to plane of projection	Sometimes	Single view pictorial
Oblique Projection -*Cavalier* -*Cabinet* -*General*	Parallel; inclined to plane of projection	Always	Single view pictorial
Orthographic Projection *Axonometric* -*Isometric* -*Dimetric* -*Trimetric*	Parallel; normal to plane of projection	Never	Single view pictorial
Multiview Projection -*Third Angle (preferred)* -*First Angle*	Parallel; normal to plane of projection	For all principal views	Multiview drawings

Where drawing is used?

- It is important to know the rationale of drawing
- Drawing is an international communication language
- Fast way to convey certain type of information
- Limited number of concepts are better represented by drawing, but not all

The design process

- Drawings are created to represent parts that do not exist yet
- The designed parts are intended to be manufactured
- The drawings must carry all the necessary information that enables the fabrication of the part

The design process

- Design involves constrained creation
- Constraints:
  - Technology limits
  - Human and environment concerns
  - Durability and reliability
  - Cost
  - Market requirements
  - Etc.

The design process

- REPRESENTATION
- PERCEPTION
- KNOWLEDGE
- INTUITION
- CONCEPT
- PURE CONCEPT
- EMPIRICAL CONCEPT
- NOTION
- IDEA

Basic requirements to be able to perform a design

All the above interacts in your judgment even if you are not aware of it

You have to train your judgment to be able to perform solution-solving based thinking

The graphic helps you to do so

The design process

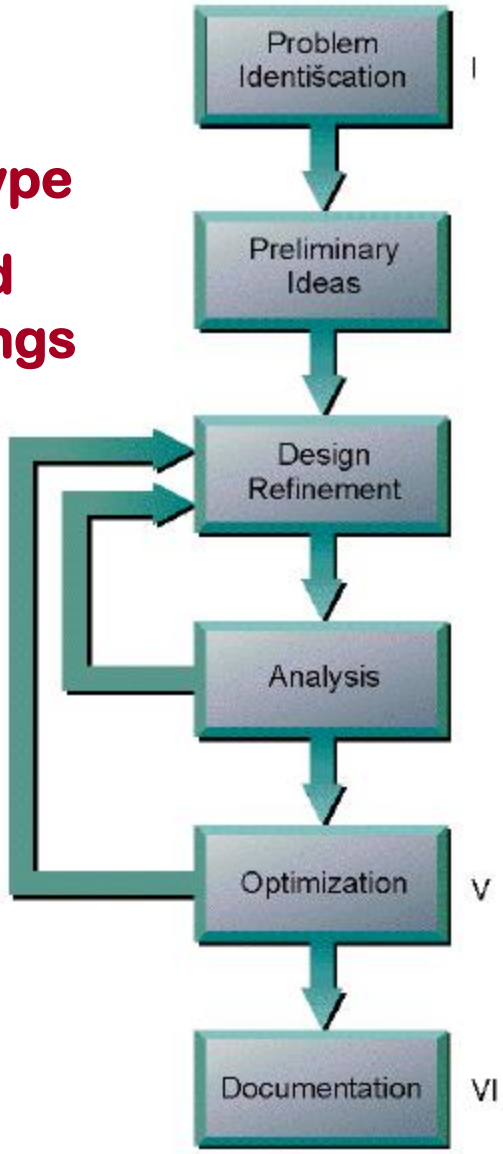
- A design is created after analysis, full understanding of requirements and constraints and synthesis
- Two individuals may not come with the same solution to the same problem
    - Example: Connect two straight pipes ND 4” to avoid leaking of the gas and to permit easy maintenance of the segment

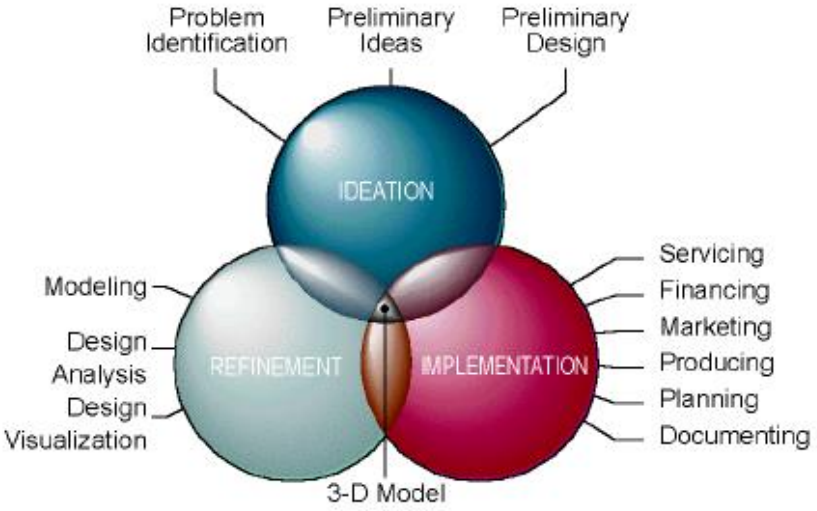
Solutions to the problem

- Multiple: flanges, clips, clamps, seals, etc.

The design process

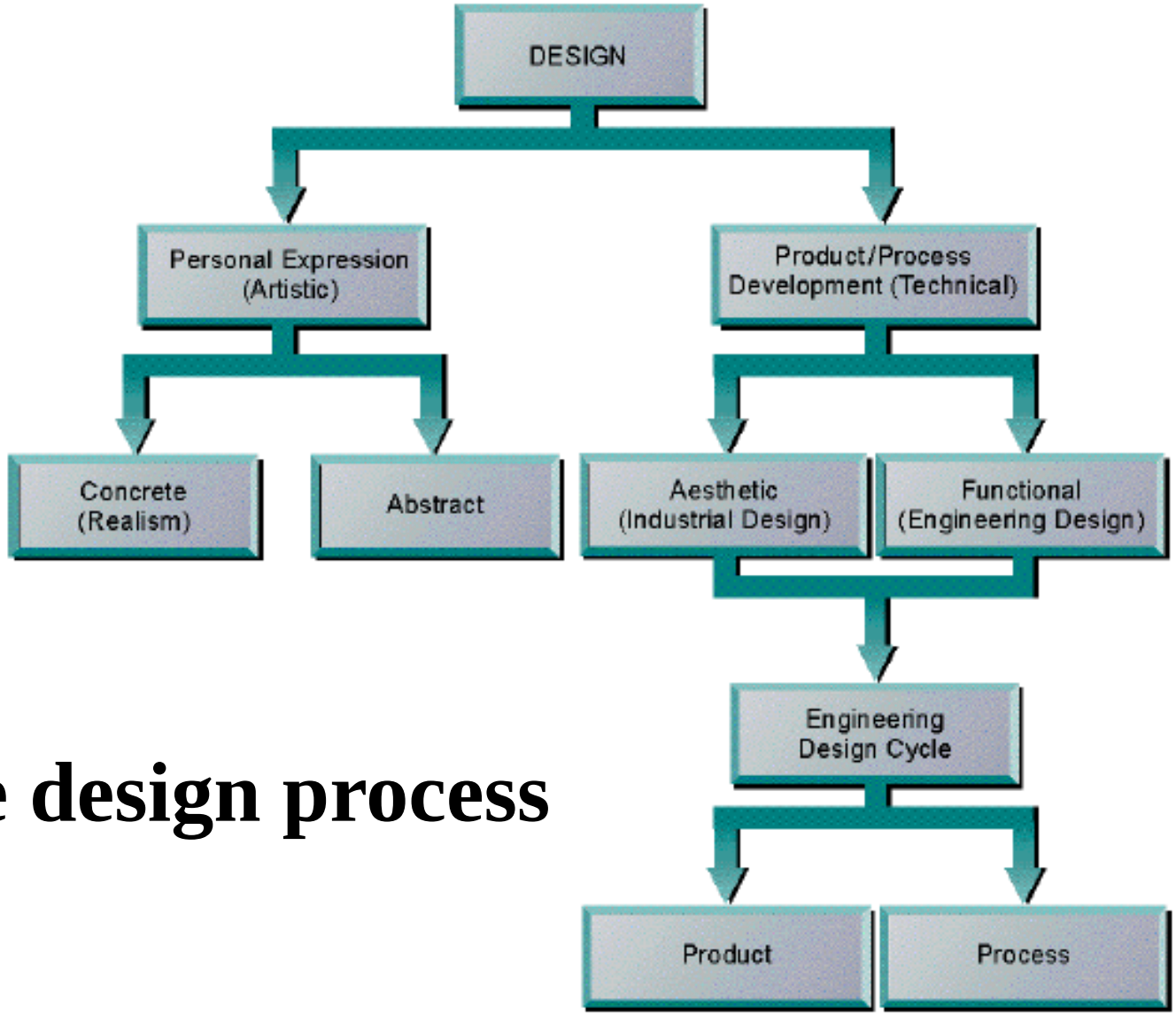
1. **Problem Defn.**
2. **Concept and ideas**
3. **Solutions**
4. **Models/Prototype**
5. **Production and working drawings**



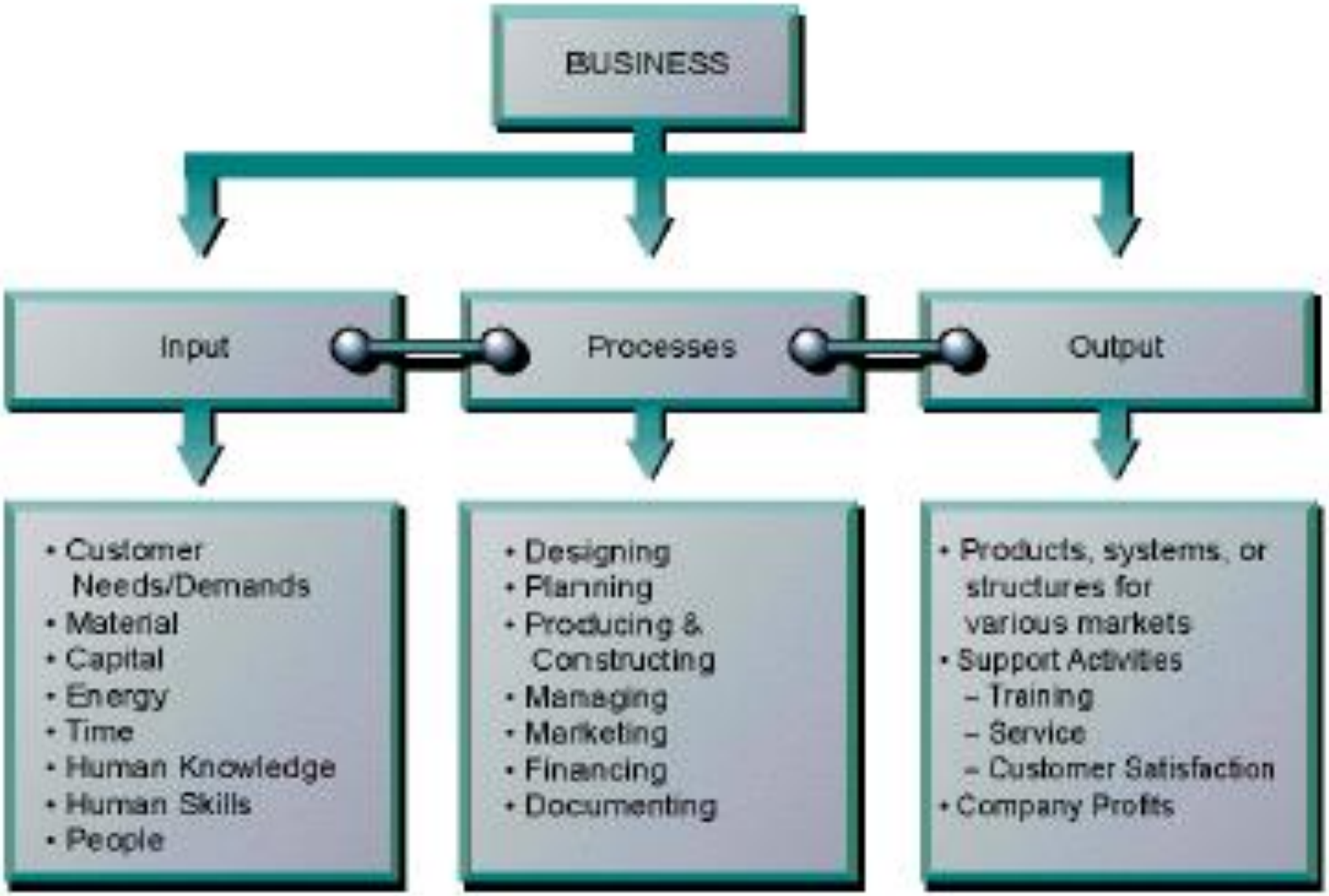


Concurrent engineering approach

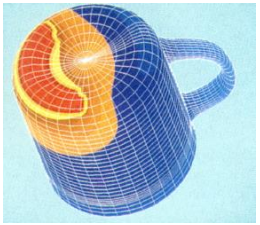
The design process

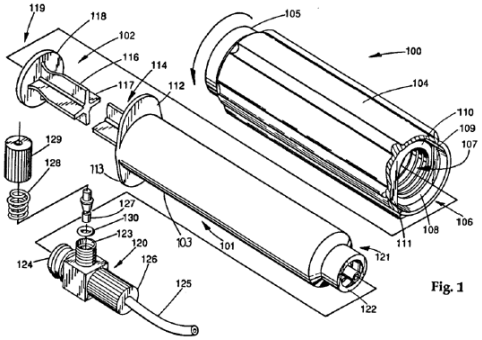


The design process



Drawings in product development





Designer

Sketches

Functional Drawings

Vendors/ Customers

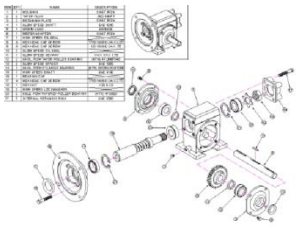
Mechanical Engineer

Prod. drawings

Production Shops

Assembly Drawings

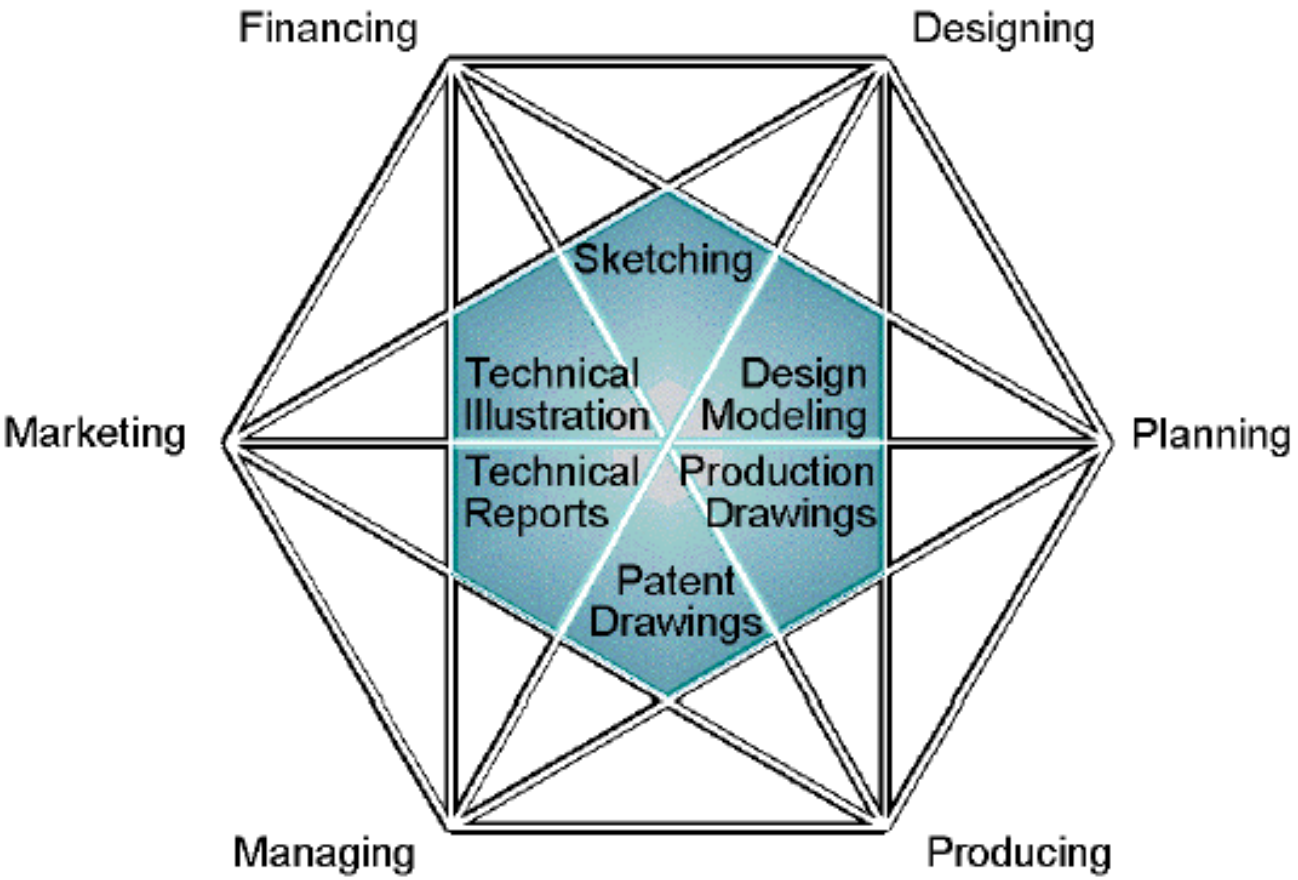
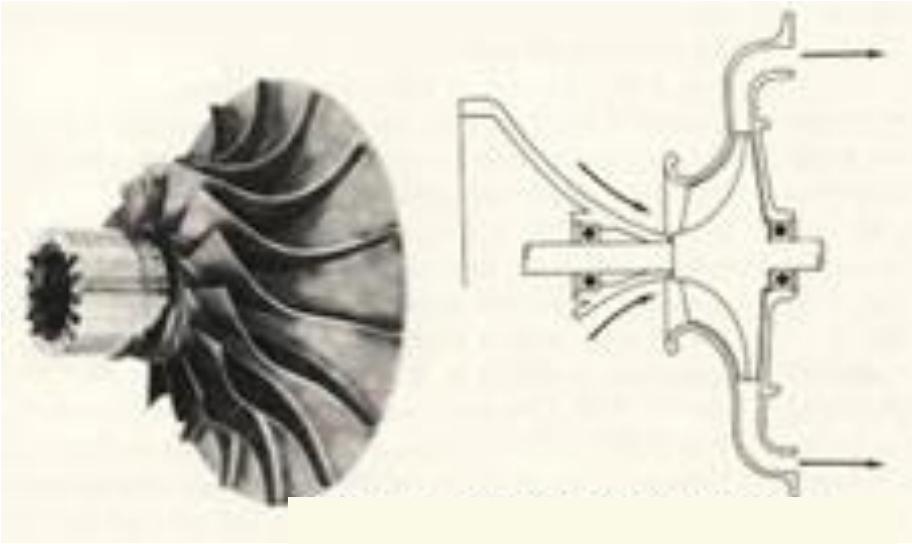
Assembly Drawings



Quality Assurance

Assembly

Drawings in product development



A Component !