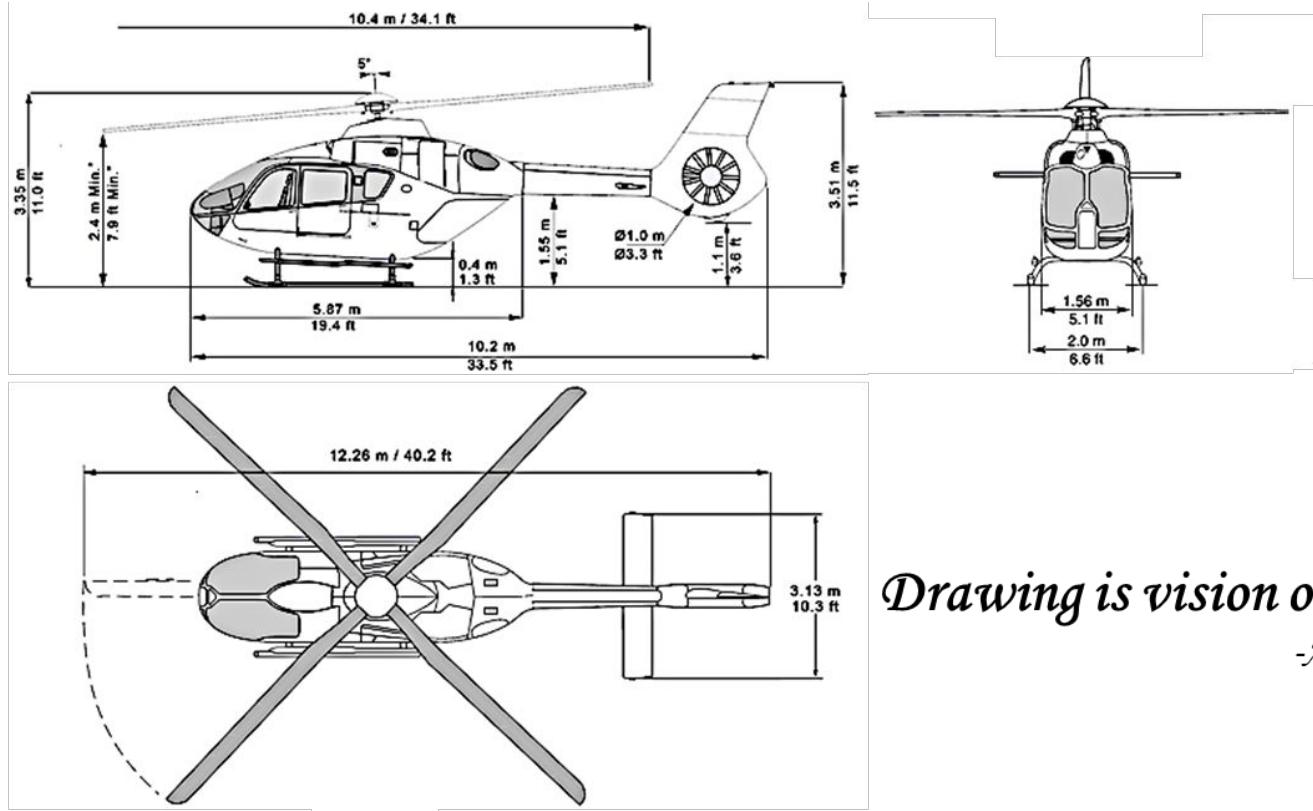


ES 101: Engineering Graphics



https://www.aiut-alpin-dolomites.com/english/technical_details.html

Drawing is vision on paper
-Andrew Loomis

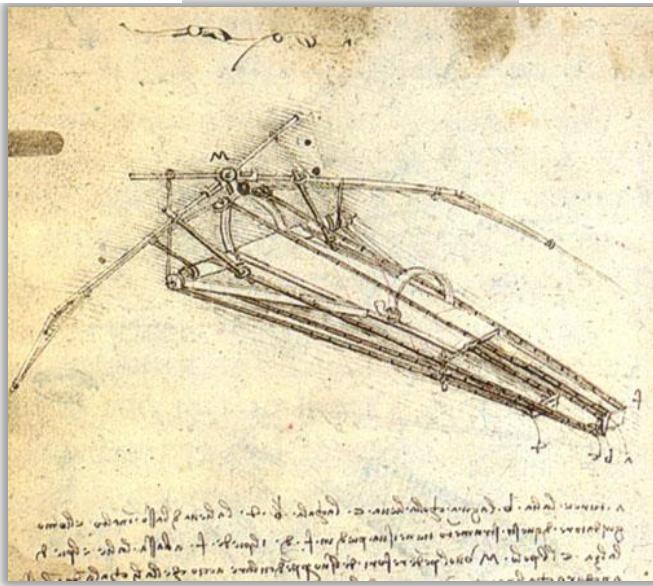
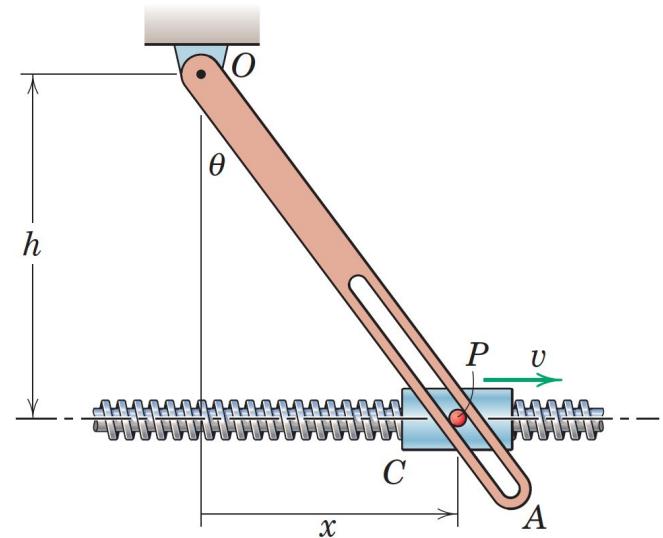
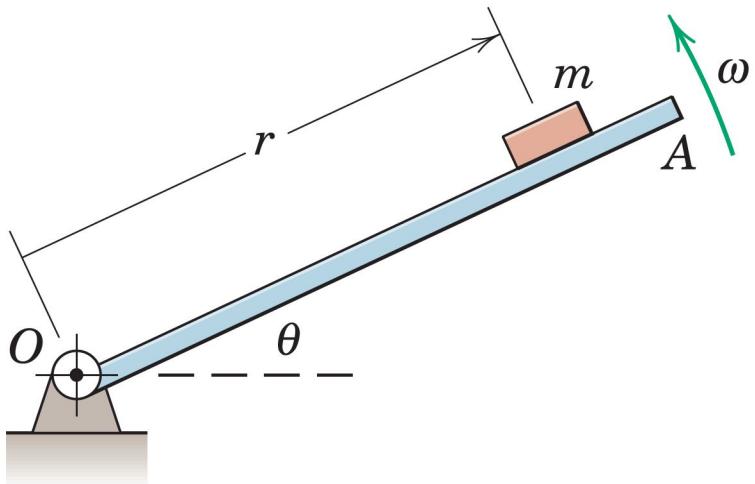
Class#1 - 21st August 2024

Sameer Patel
Assistant Professor
Civil Engineering & Chemical Engineering
IIT Gandhinagar

ES101: Course schedule and policy

Google Classroom page has up to date information

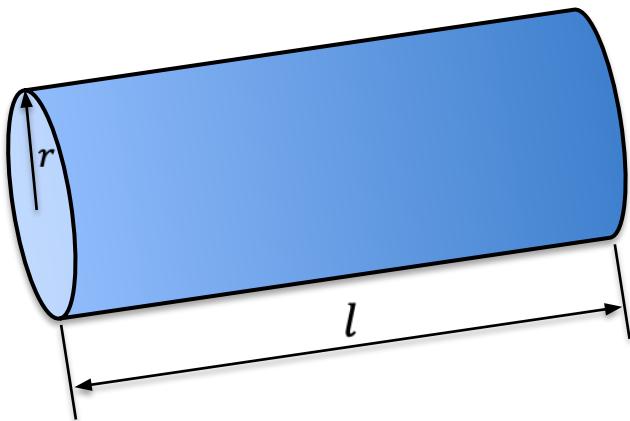
How often do you find yourself drawing to explain stuff to others?



Flying machine by Leonardo da Vinci (https://en.wikipedia.org/wiki/Leonardo_da_Vinci)

Geometry and its representation

$$x^2 + y^2 \leq r^2 \forall 0 \leq z \leq l$$

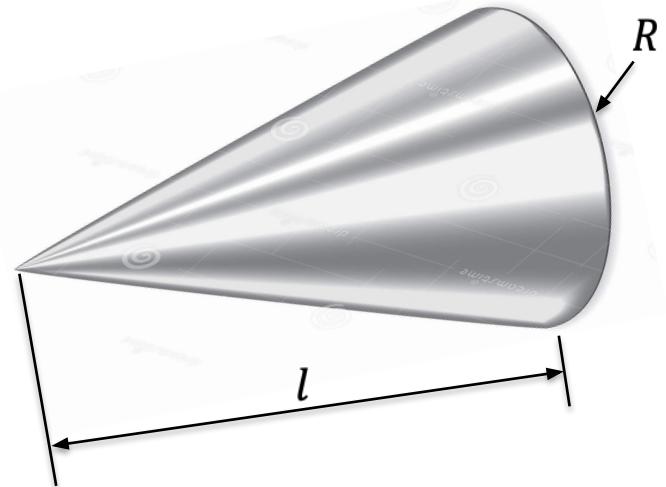


$$r_i^2 \leq x^2 + y^2 \leq r_o^2 \forall 0 \leq z \leq l$$



$$x^2 + y^2 \leq r(z)^2 \forall 0 \leq z \leq l$$

$$r(z) = \frac{Rz}{l}$$



Geometry and its representation



Mathematical equations to represent complex geometry would be very difficult and sometimes impossible



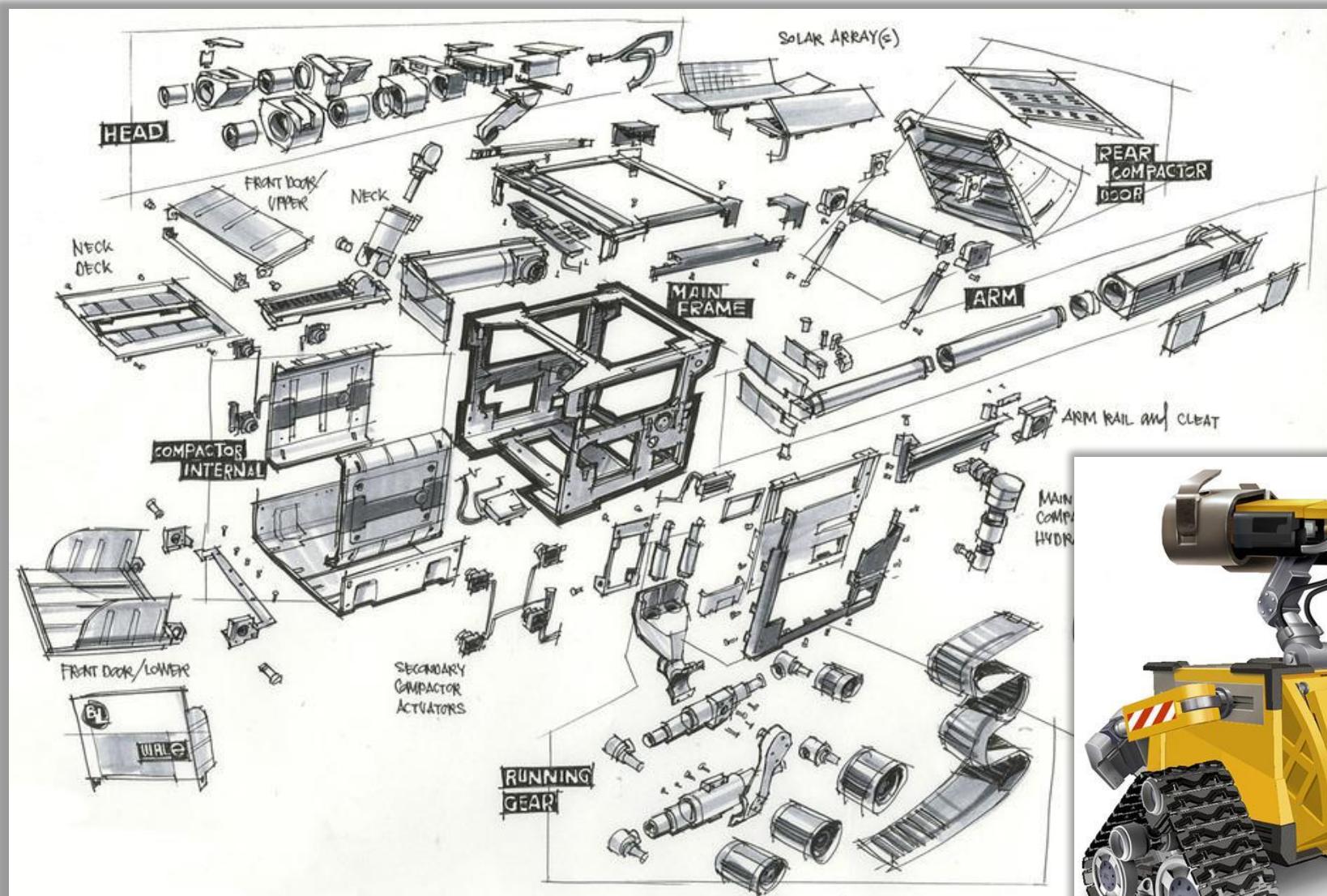
Try explaining a model by using only words



Waste Allocation Load Lifter Earth-class

Pixar.com

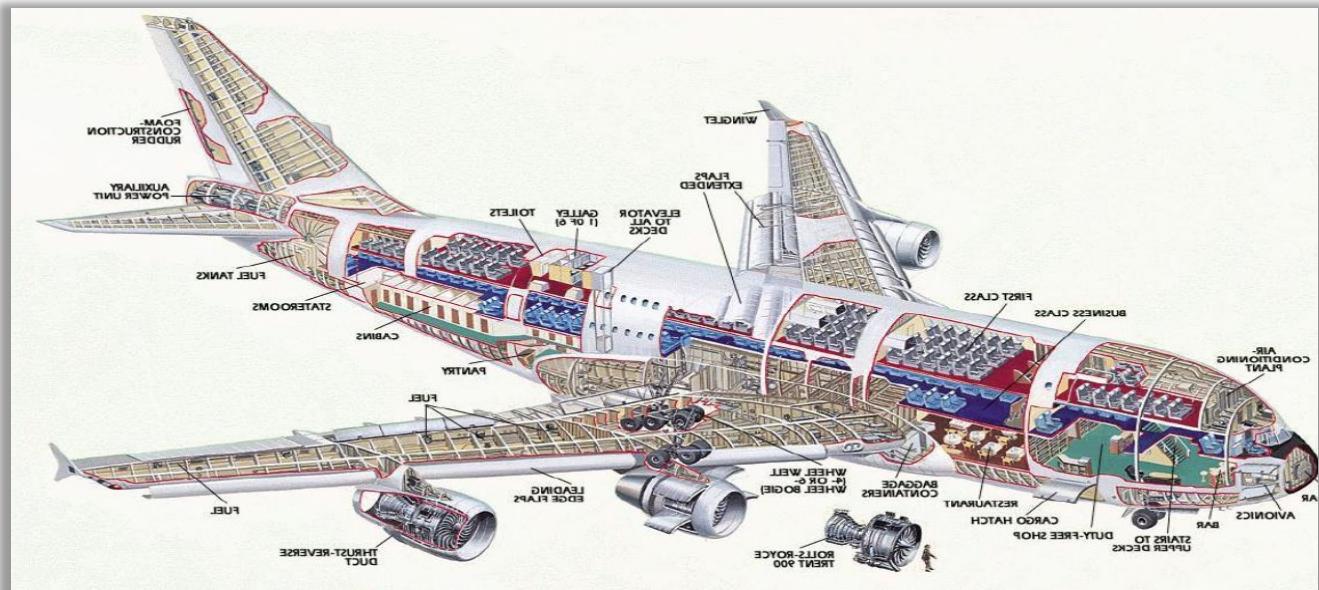
What if you want to show how the object looks from inside?



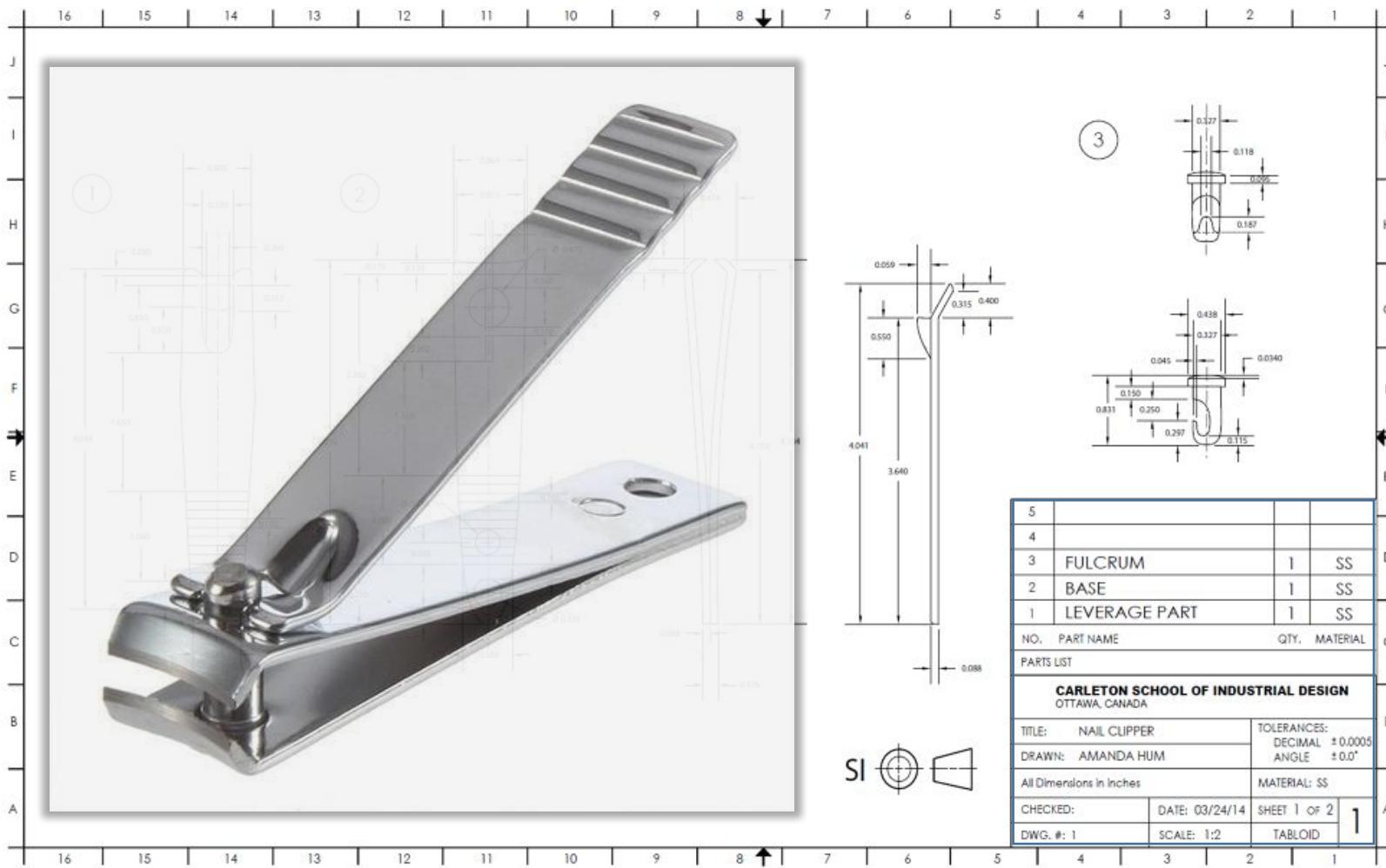
Pixar.com



What if you want to show how the object looks from inside?



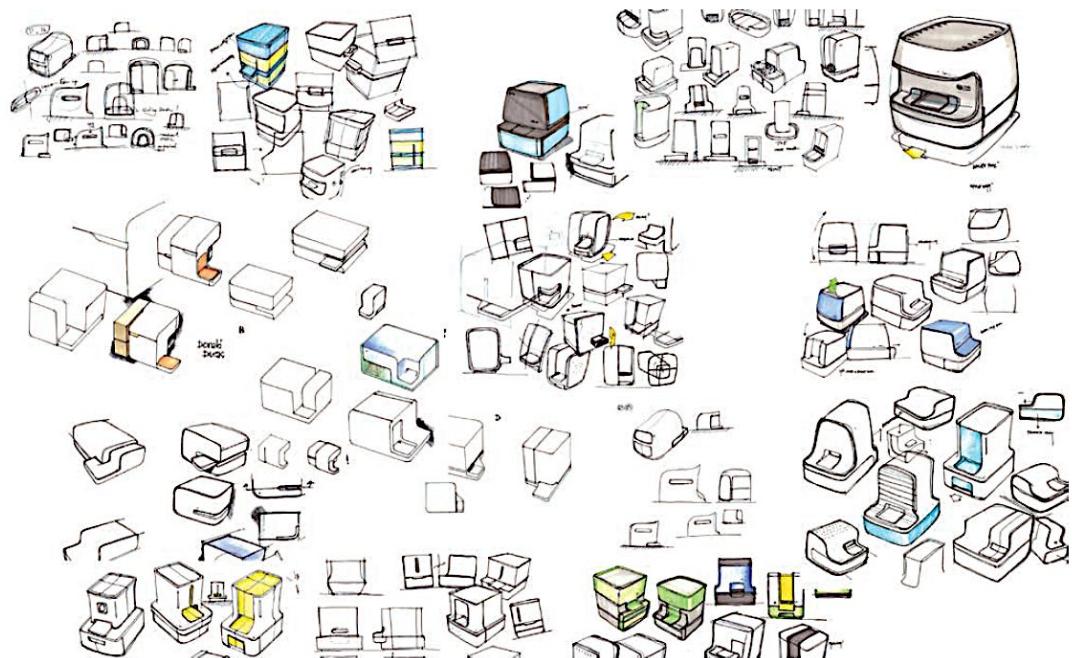
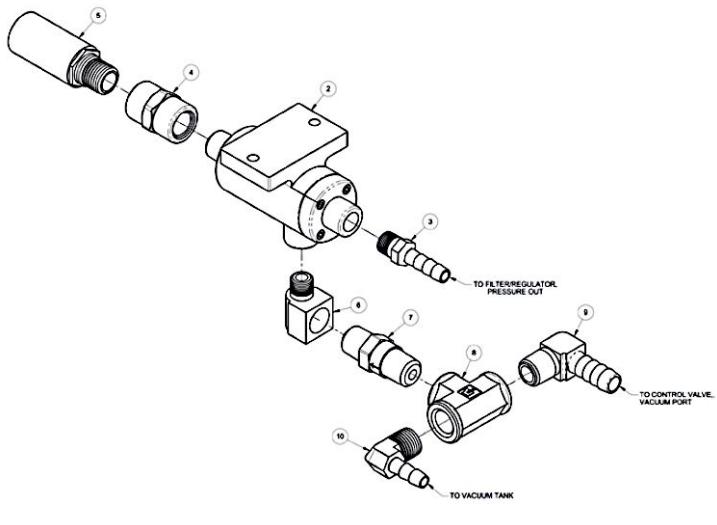
Did you try to imagine how an object looks in real world just by looking at a drawing?



<https://cargocollective.com/amandahum/HINGE-Technical-Drawing>
<https://www.indiamart.com/proddetail/nail-cutter-19851228297.html>

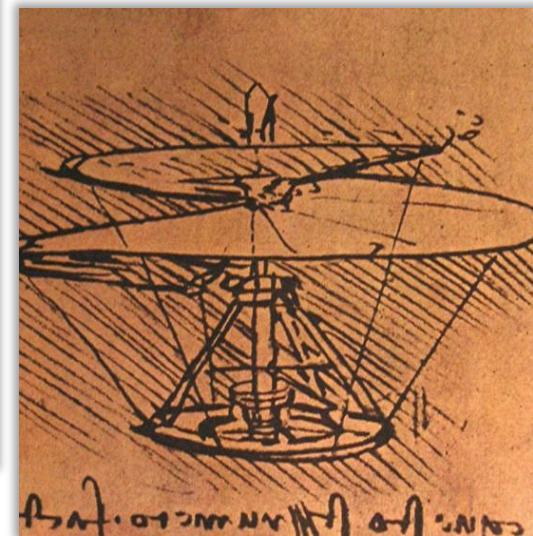
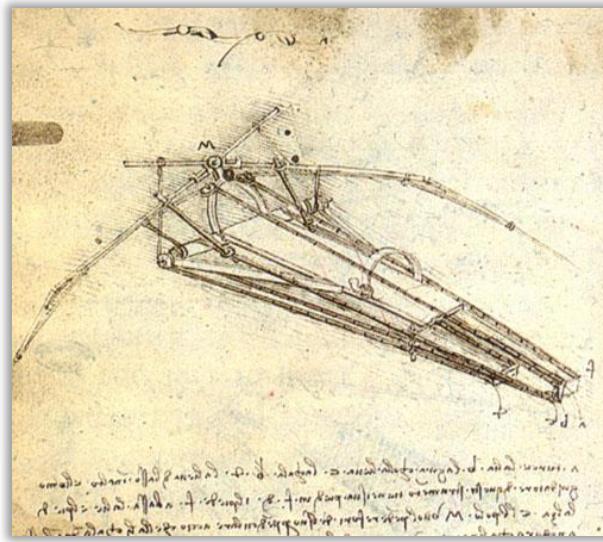
Drawing a part of problem solving

- To stimulate the design
- To analyse the design and assembly
- To detect mistakes in the design
- To check completeness
- To communicate ideas to the manufacturing personnel

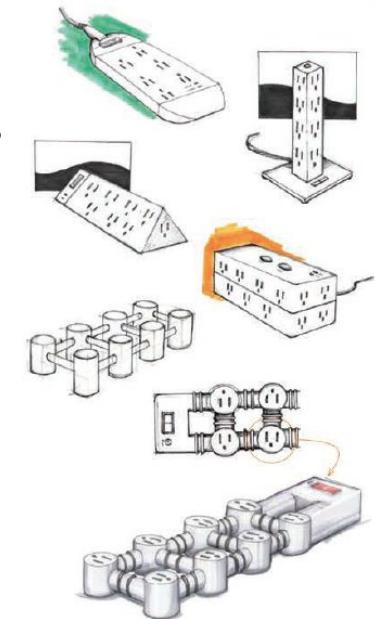
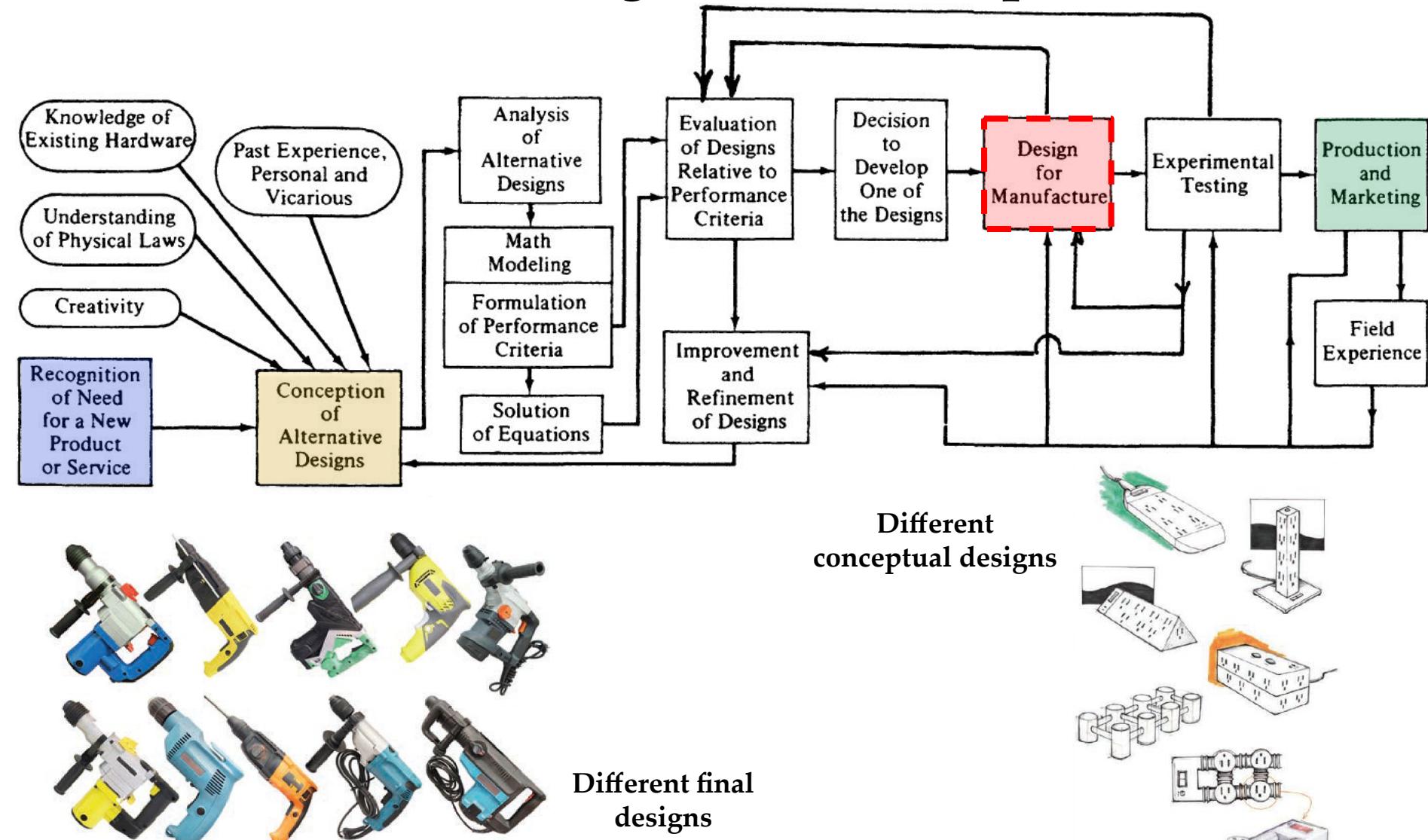


Engineering Drawing

- Engineering drawings have existed for centuries, for example, the drawings of Leonard da Vinci
- Modern engineering drawing, the conventions, nomenclature has its origin in France during the time of industrial revolution
- Organizations like ISO (International Organization of Standardization), ASME (American Society of Mechanical Engineers), ASCE (American Society of Civil Engineers) etc provide general rules, standards, best practices for generating



Product Design and Development



E. O. Doebelin, *System Dynamics*, Marcel and Dekker, 1998
F. E. Giesecke et al., *Technical Drawing*, Prentice Hall, 15th Ed., 2016

Design,
analysis,
prototyping,
testing,

Manufacturing
plant and
assembly line

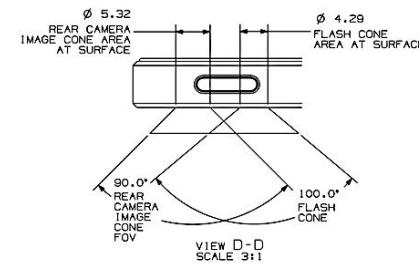
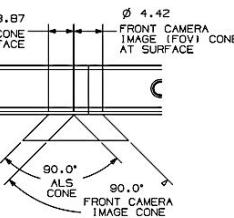
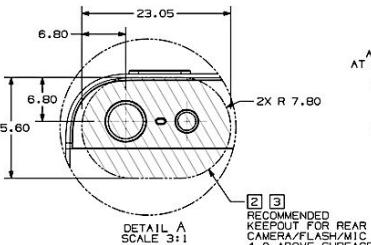
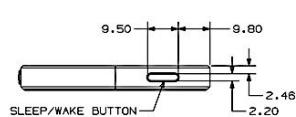
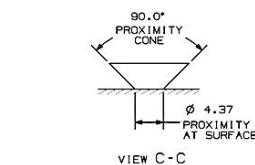




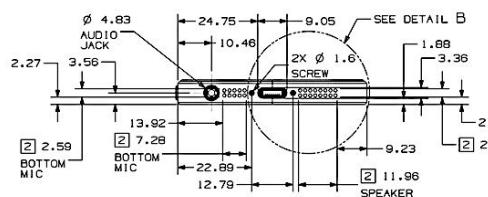
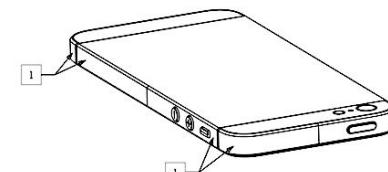
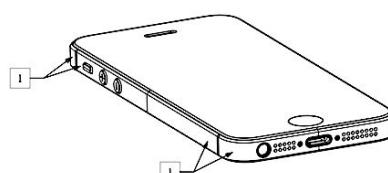
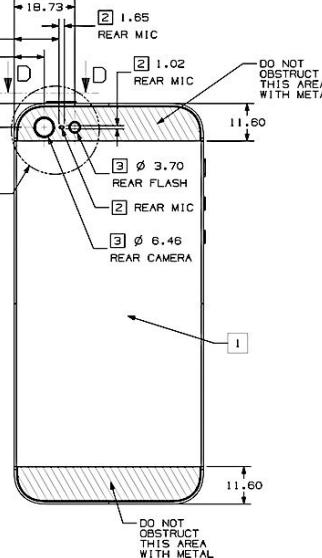
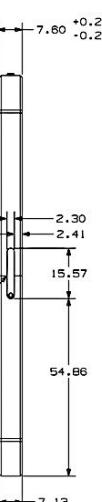
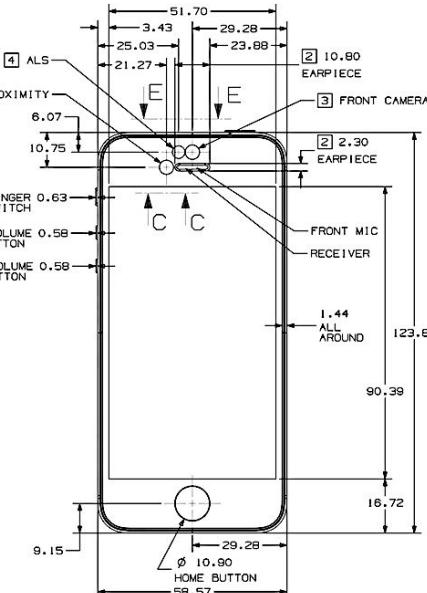
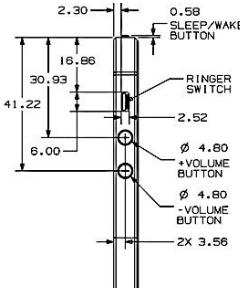
<https://www.behance.net/gallery/14392965/iPhone-explosion>

•NOTES•

- 1 NO METAL CONTACT WITH iPhone 5 METAL.
- 2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, EARPICE, AND SPEAKER.
- 3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
- 4 DO NOT OBSTRUCT THE PROXIMITY SENSOR OR ALS (AMBIENT LIGHT SENSOR).



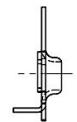
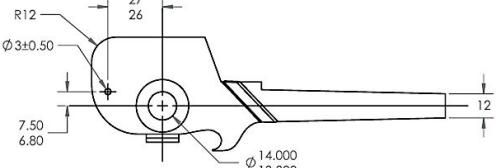
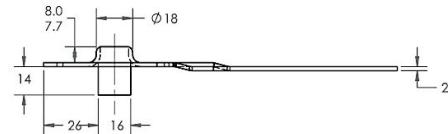
VIEW D-D SCALE 3:1
 ϕ 4.29 FLASH CONE AREA AT SURFACE
100.0° FLASH CONE



DETAIL B SCALE 2:1



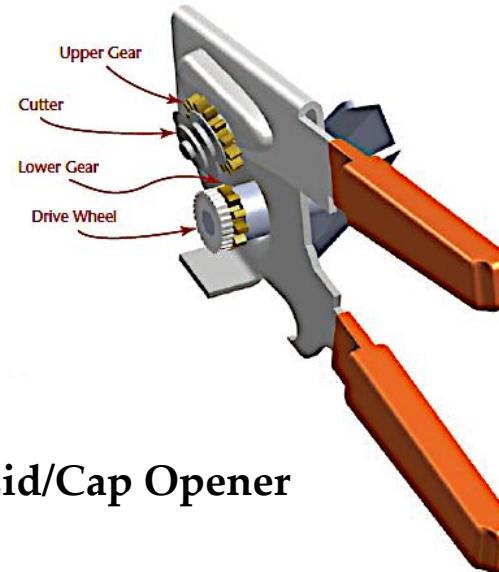
METRIC	Apple Inc.
DESIGNED BY	DATE 09/12/12
DESIGNED BY	DATE 09/12/12
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. ALL RIGHTS RESERVED. APPLE, THE APPLE LOGO, AND IPHONE ARE TRADEMARKS OF APPLE INC., REGISTERED IN THE USA AND OTHER COUNTRIES.	
DIMENSIONS ARE IN MILLIMETERS	
TOLERANCES	
X.X ±0.4	
X.XX ±0.20	
X.XXX ±0.100	
ANGLES ±0.5°	
DO NOT SCALE DRAWINGS	
THREE ANGLE PROJECTION	
SIZE D	
DRAWING NUMBER	
REV. I	
IPHONE 5	
SH. 1 OF 1	



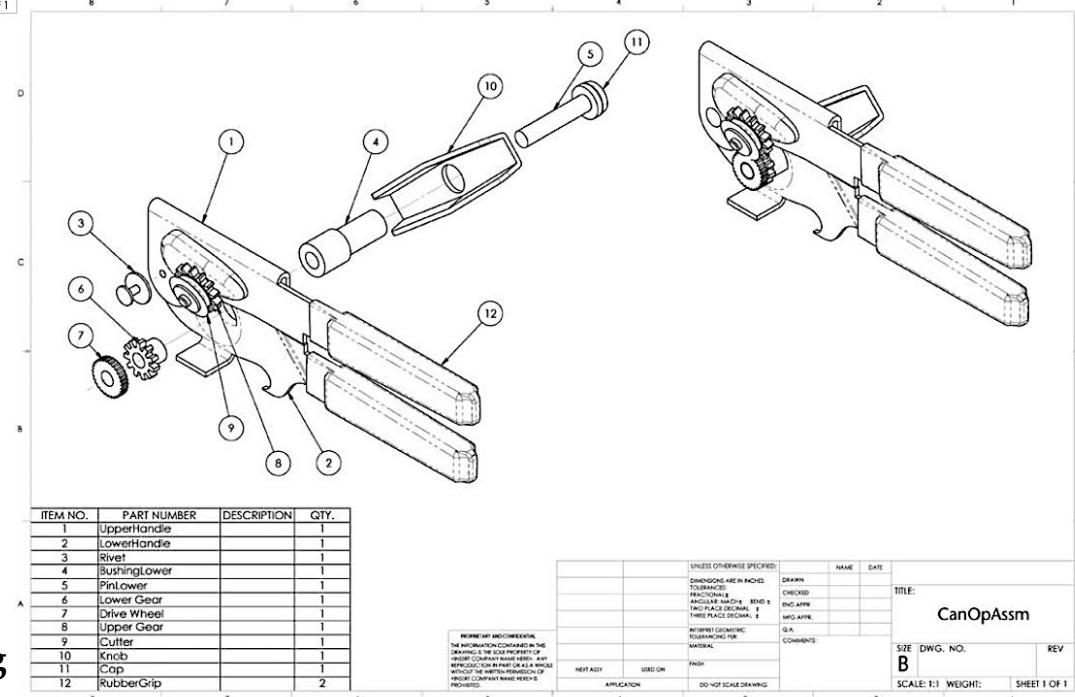
		UNLESS OTHERWISE SPECIFIED:		DRAWN	NAME	DATE
		DIMENSIONS ARE IN INCHES		CHECKED		
		TOLERANCES: ± 0.5		ENG APPR.		
		FRANZ: MACH 1.5 MND 1.5		MFG APPR.		
		ANGULAR: MACH 1.5° MND 1.5°				
		TWO PLACES DECIMAL: ± 0.05				
		THREE PLACE DECIMAL: ± 0.005				
		INTERPRET GEOMETRIC TOLERANCING PER		Q.A.		
		MATERIAL		COMMENTS:		
PRINTING AND DRAWING NO.		TITLE:				
NEXT ASSY		LOWER HANDLE				
USED ON						
APPLICATION						
FINISH						
DO NOT SCALE DRAWING						
		SIZE DWG. NO.				
		A 957852				
		REV				
		SCALE: 1:1.5 WEIGHT: SHEET 1 OF 1				

PRINTING AND DRAWING NO. THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF <INSERT COMPANY NAME HERE>. ANY REPRODUCTION OR USE OF THIS DRAWING IN WHOLE OR IN PART WITHOUT THE WRITTEN PERMISSION OF <INSERT COMPANY NAME HERE> IS PROHIBITED.

Detailed drawing



Lid/Cap Opener



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	UpperHandle		1
2	LowerHandle		1
3	Rivet		1
4	BushingLower		1
5	PinLower		1
6	Lower Gear		1
7	Drive Wheel		1
8	Upper Gear		1
9	Cutter		1
10	Knob		1
11	Cap		1
12	RubberGrip		2

		UNLESS OTHERWISE SPECIFIED:		DRAWN	NAME	DATE
		DIMENSIONS ARE IN INCHES		CHECKED		
		TOLERANCES		ENG APPR.		
		FRANZ: MACH 1.5 MND 1.5		MFG APPR.		
		ANGULAR: MACH 1.5° MND 1.5°				
		TWO PLACES DECIMAL: ± 0.05				
		THREE PLACE DECIMAL: ± 0.005				
		INTERPRET GEOMETRIC TOLERANCING PER		Q.A.		
		MATERIAL		COMMENTS:		
PRINTING AND DRAWING NO.		TITLE:				
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USED ON						
APPLICATION						
FINISH						
DO NOT SCALE DRAWING						
		SIZE DWG. NO.				
		B				
		REV				
		SCALE: 1:1 WEIGHT: SHEET 1 OF 1				

Assembly drawing

Engineering drawing as a language

- A fully developed language in its own right
- A graphical language that engineers all over the world understand regardless of their native tongue
- Used to describe physical objects (existing or yet to be created) via drawings and renderings
- Has rules (just like any other language) – alphabets, grammar, vocabulary

Scientists study the world as it is; engineers create the world that has never been. — Theodore von Kármán

Interpreting and conveying

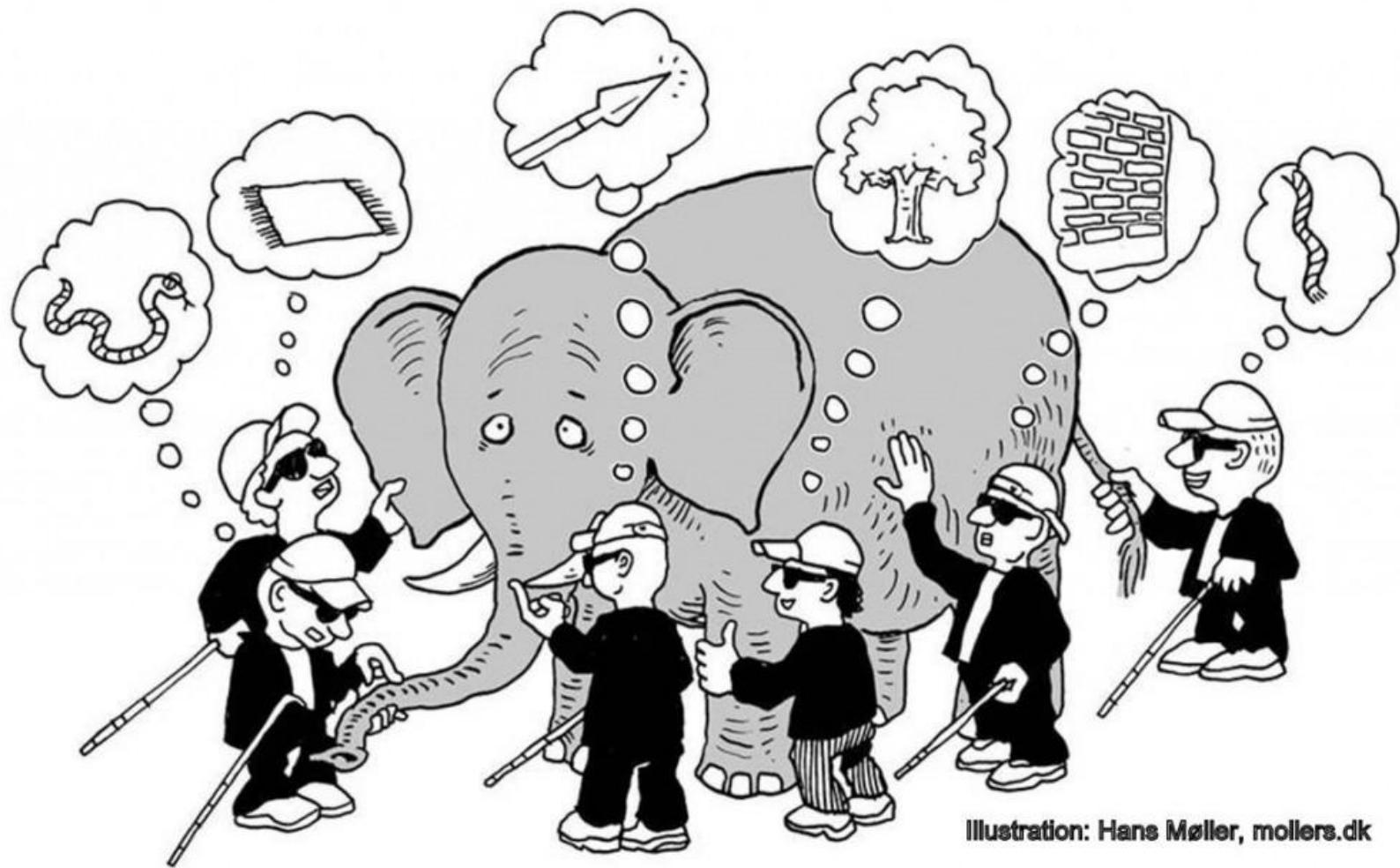
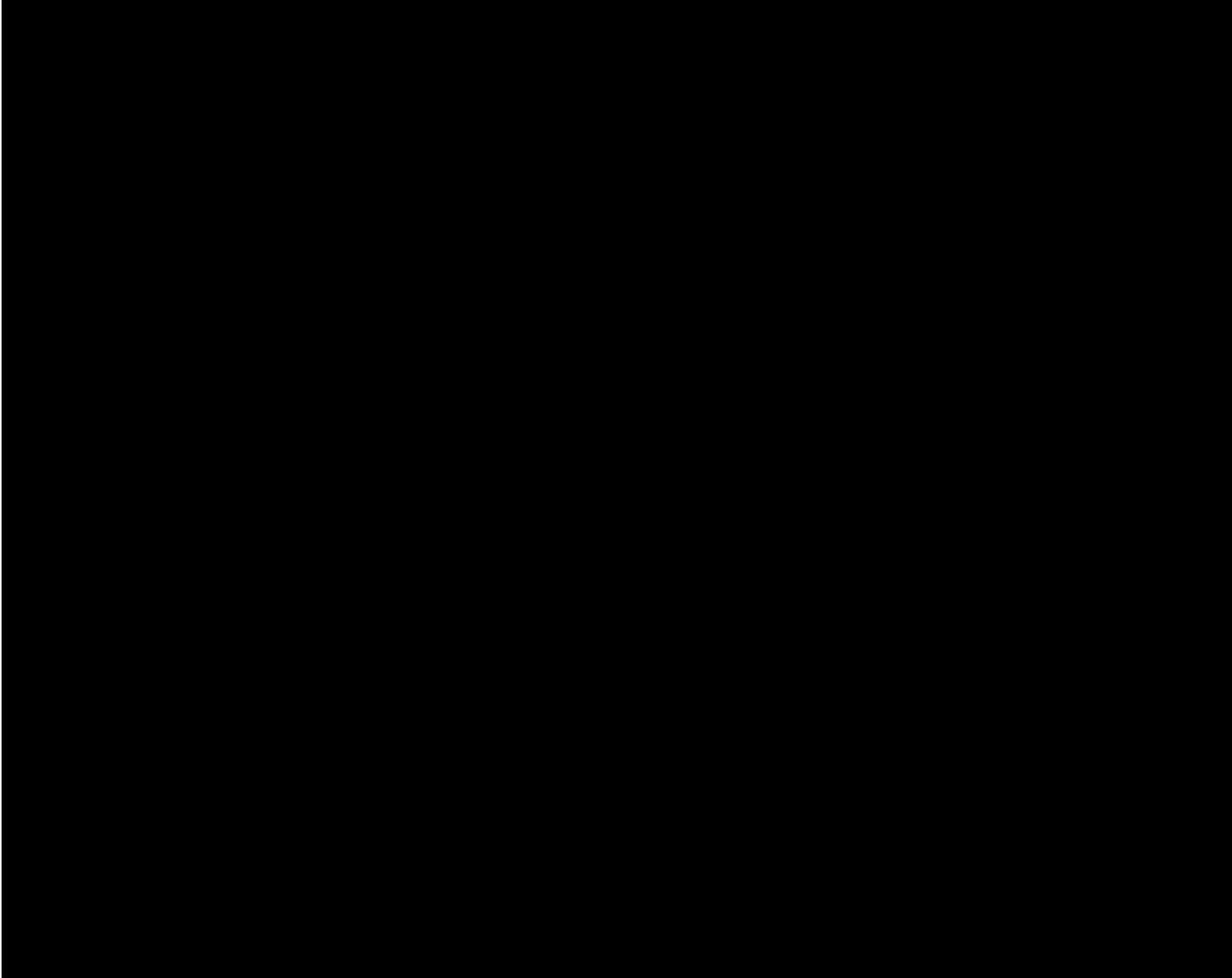
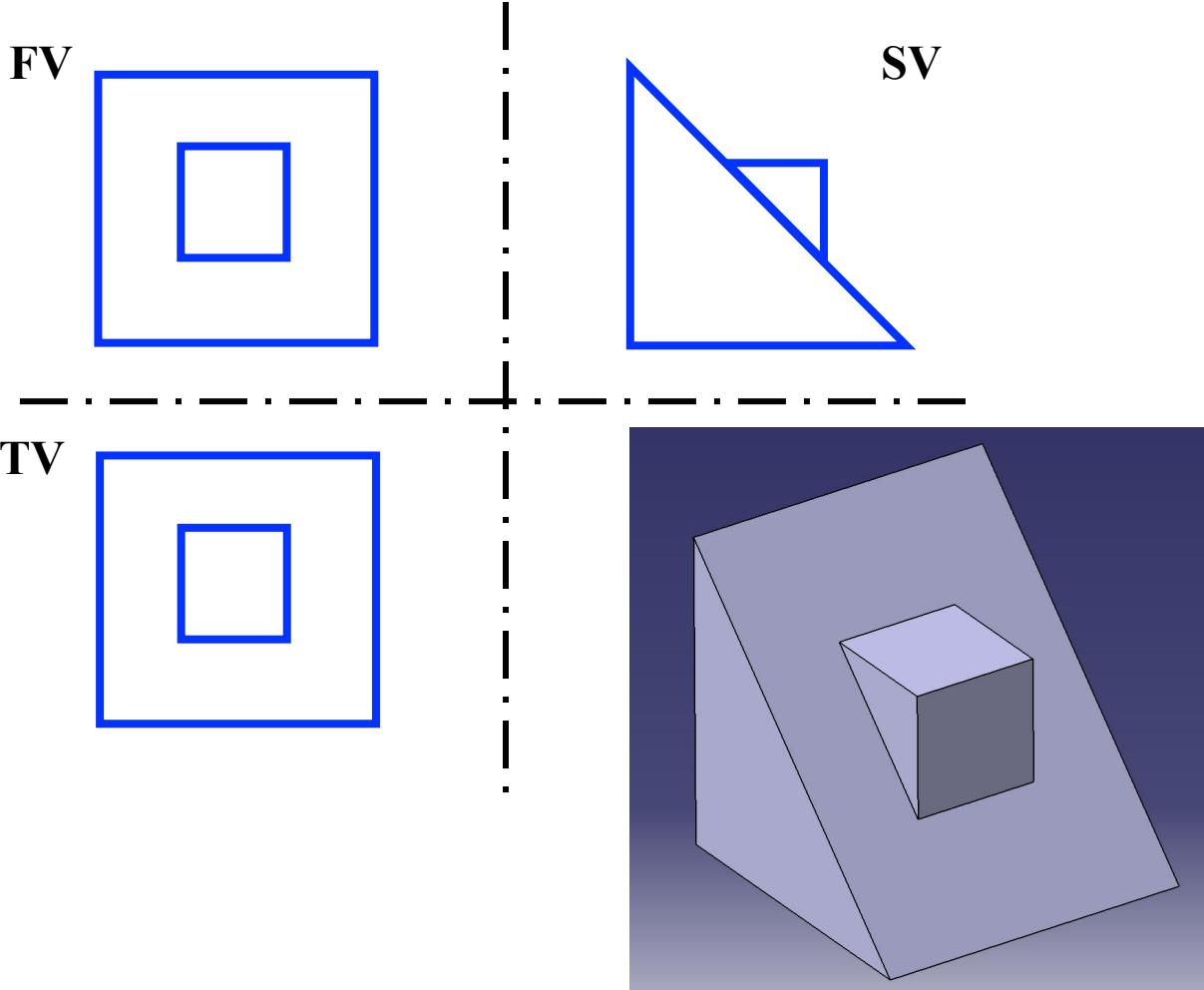


Illustration: Hans Møller, mollers.dk

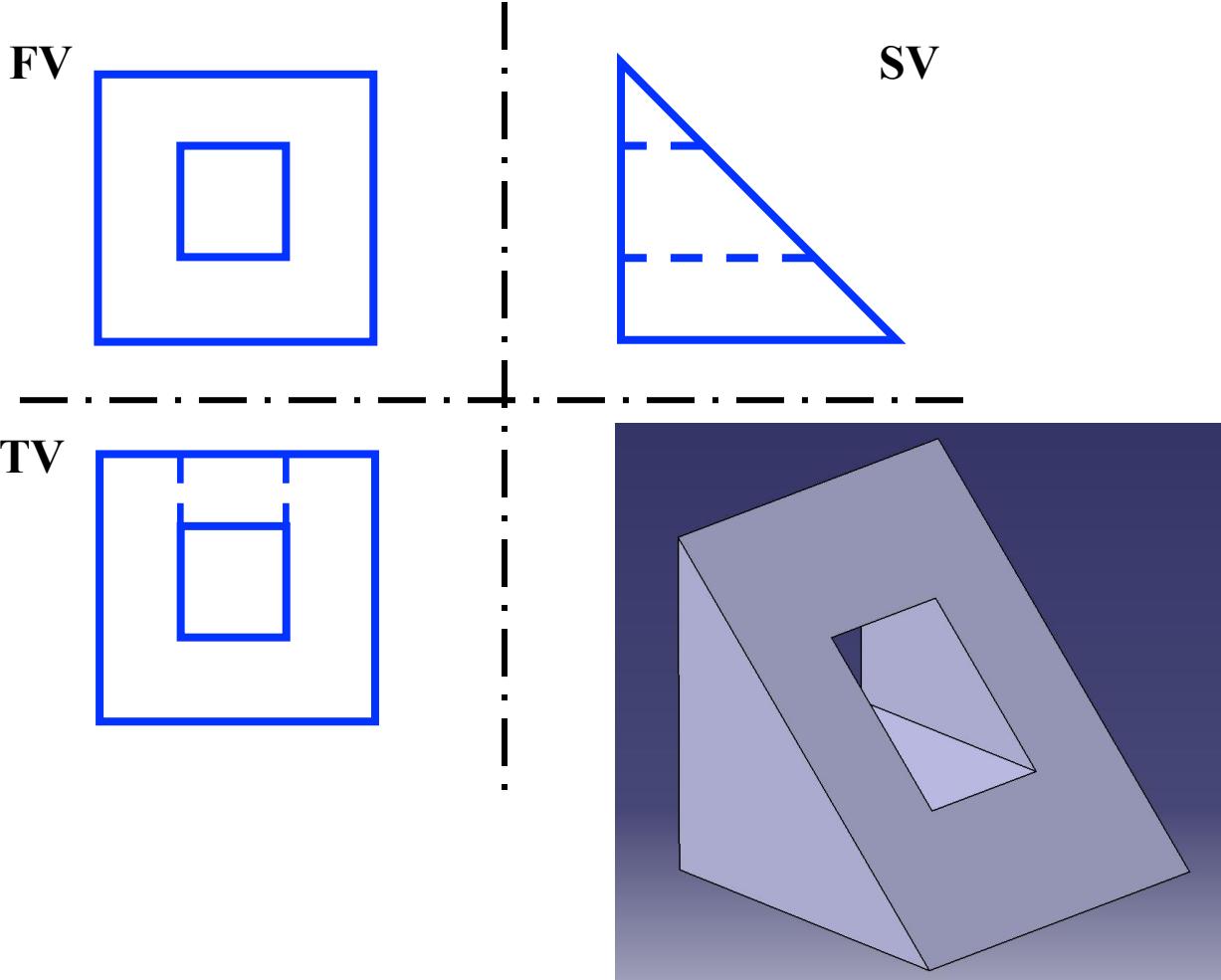


<https://www.youtube.com>

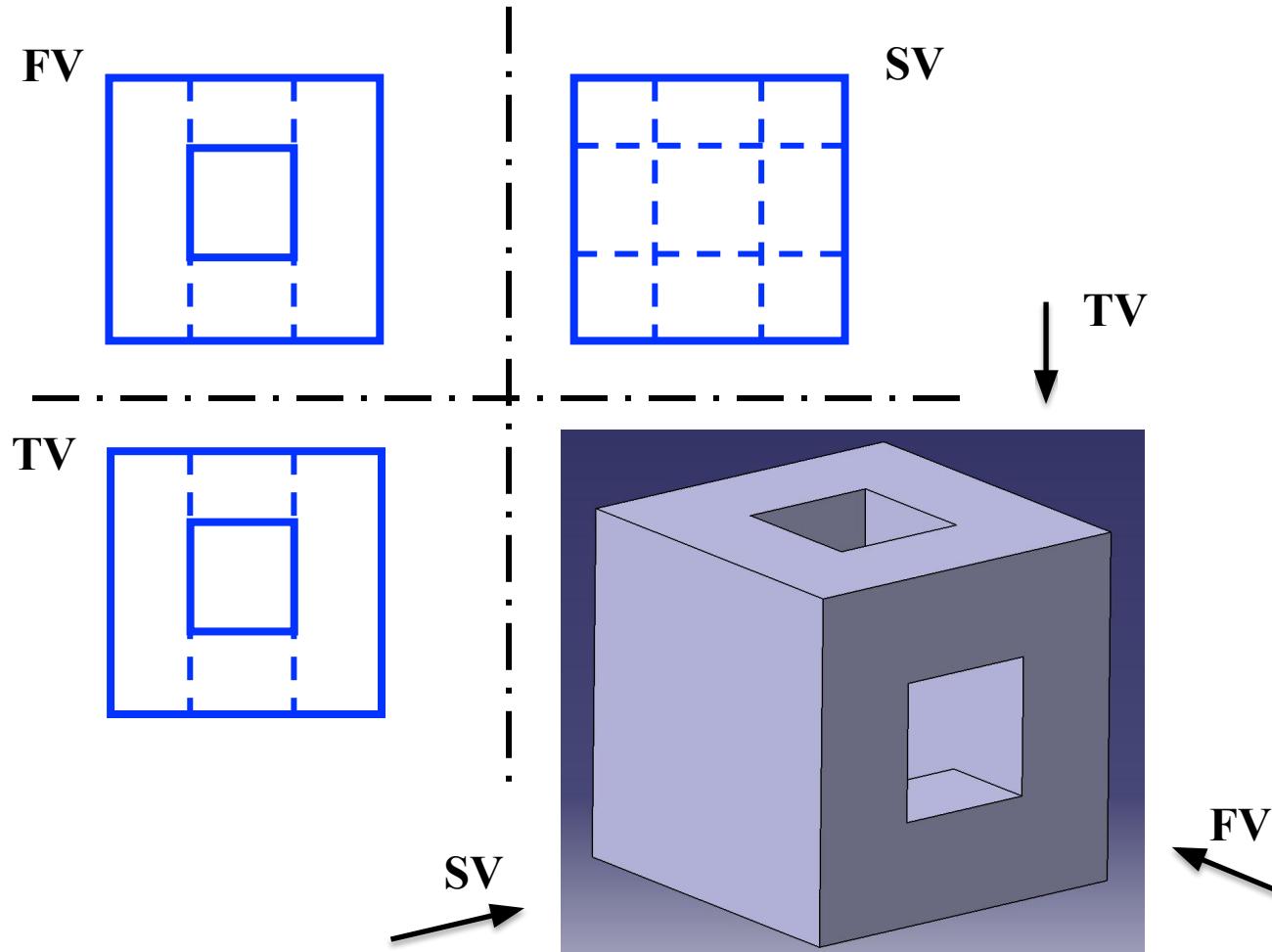
Did you try to imagine how an object looks in real world just by looking at a drawing?



Did you try to imagine how an object looks in real world just by looking at a drawing?



Did you try to imagine how an object looks in real world just by looking at a drawing?





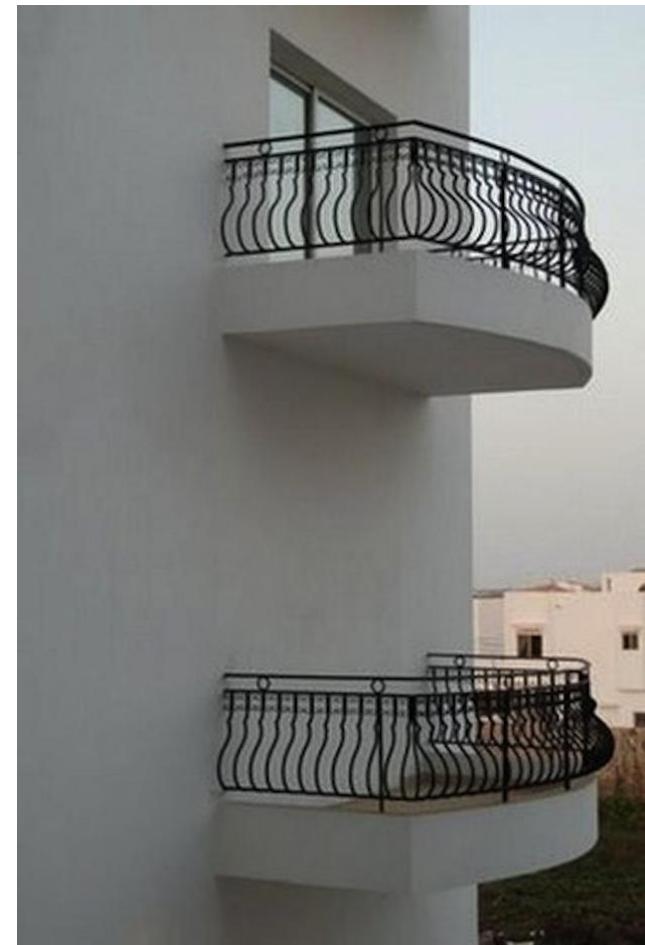
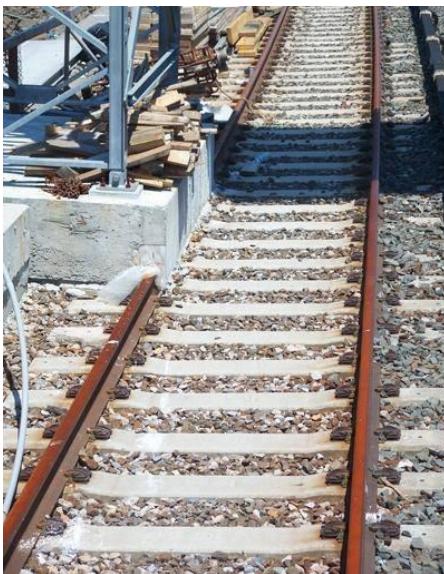
What if the person seeing a drawing uses different rules?



<https://blog.archisnapper.com/20-hilarious-staircase-building-fails/>

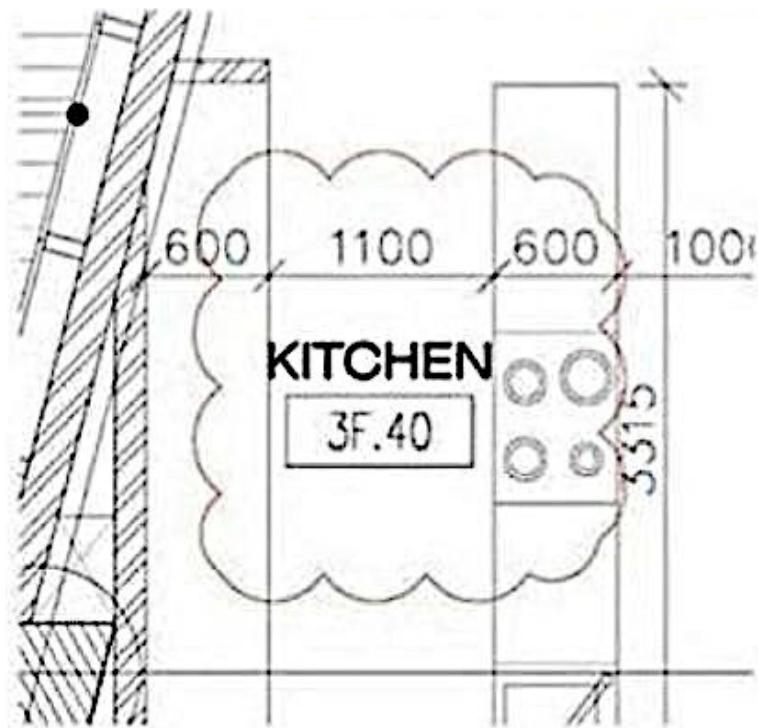


<https://wonderfulengineering.com/31-engineering-mistakes-that-make-you-wonder-who-gave-them-engineering-degrees/>



<https://wonderfulengineering.com/31-engineering-mistakes-that-make-you-wonder-who-gave-them-engineering-degrees/>
<https://www.snopes.com/fact-check/misaligned-bridge-photo/>

What if the person seeing a drawing uses different rules?

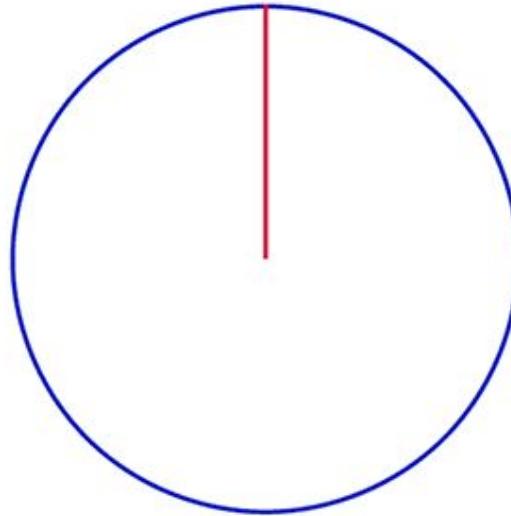
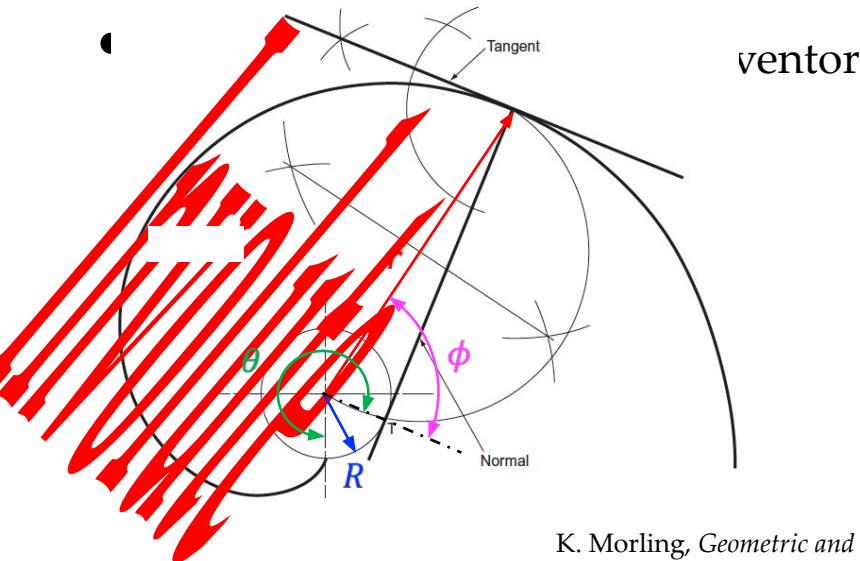


*Please be careful when you put revision clouds on your drawings,
some of the contractors do not understand.*

<https://blog.miragestudio7.com/construction-mistakes/1443/>

Curriculum

- Basics of engineering drawing, notations, nomenclature
- Geometric constructions
- Orthographic projection and auxiliary views
- Isometric projections
- Perspective Projections



K. Morling, *Geometric and Engineering Drawing*, Elsevier, 3rd Ed., 2010

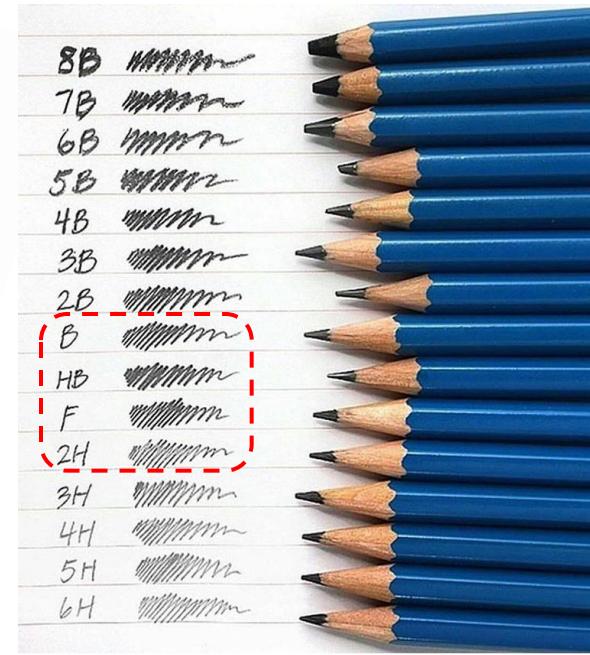
<https://grabcad.com/library/spear-gear-1>

http://www-mdp.eng.cam.ac.uk/web/library/enginfo/textbooks_dvd_only/DAN/gears/meshing/meshing.html

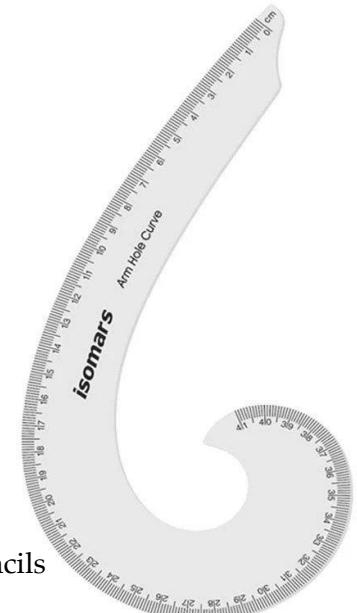
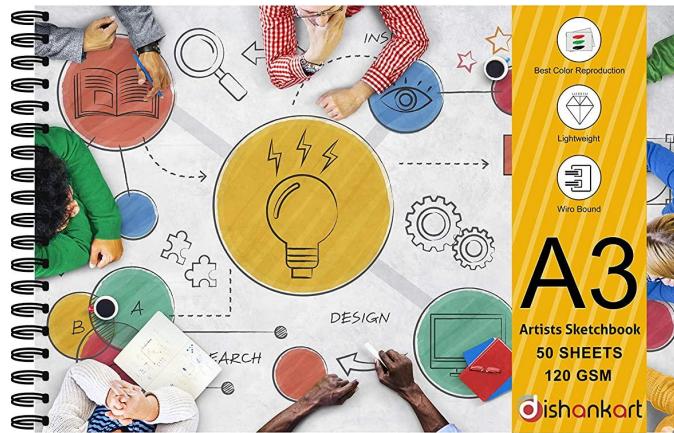
<https://graphicdesign.stackexchange.com/questions/37775/best-2d-animation-software>

Stationery

- One art book of standard size (A3 or A4)
- Rulers - one foot long and six inches long (can buy the one foot ruler with rollers for the ease of making parallel lines)
- Compass - good quality
- Protractor
- A pair of set squares: 45° - 45° , 30° - 60°
- Pencils (wood or mechanical) – H/2H, HB/B
- Sharpener for wooden pencil
- Eraser - good quality
- A clean soft cloth/tissue
- French curves



Pictures are representative and it's not necessary to go with the same brands

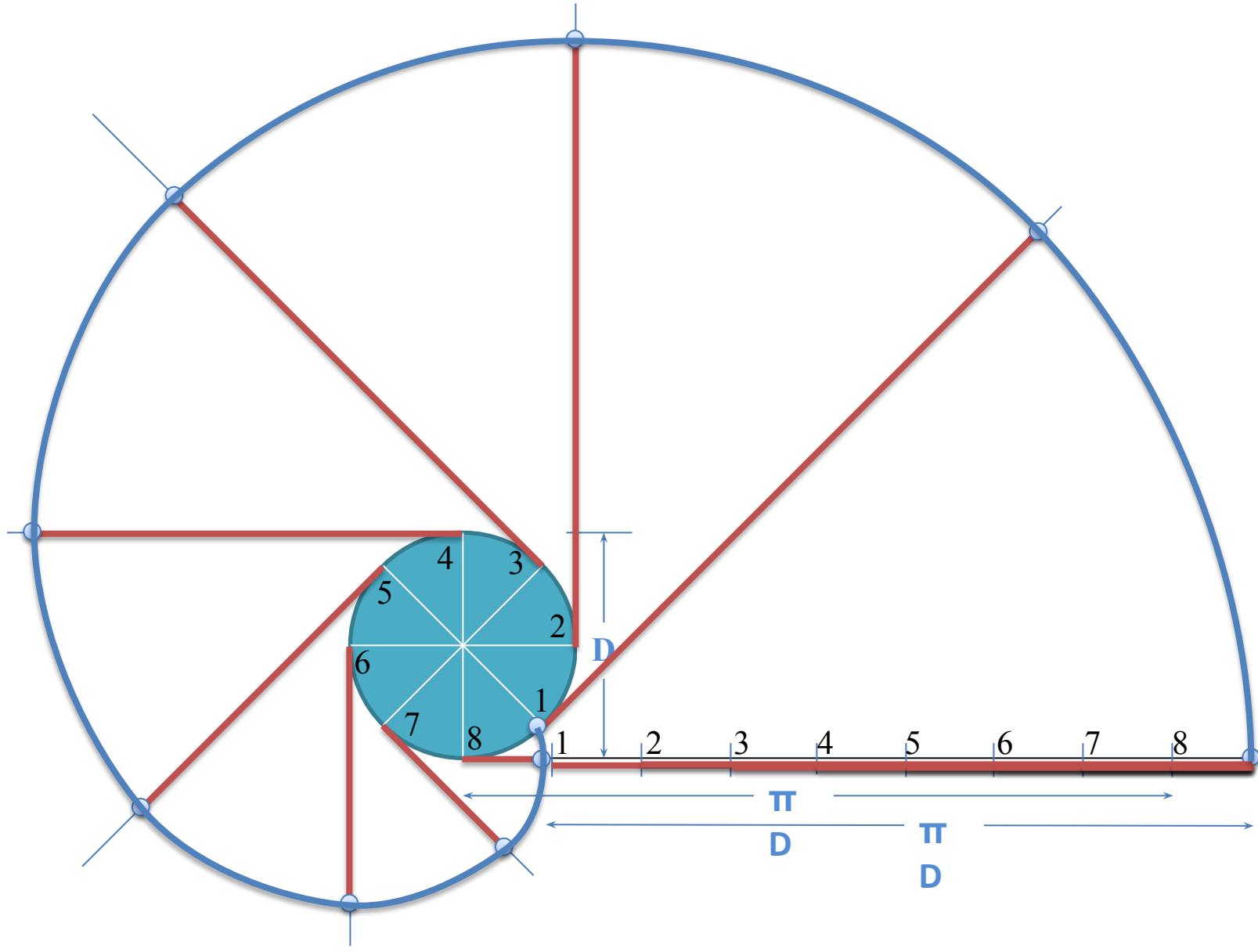


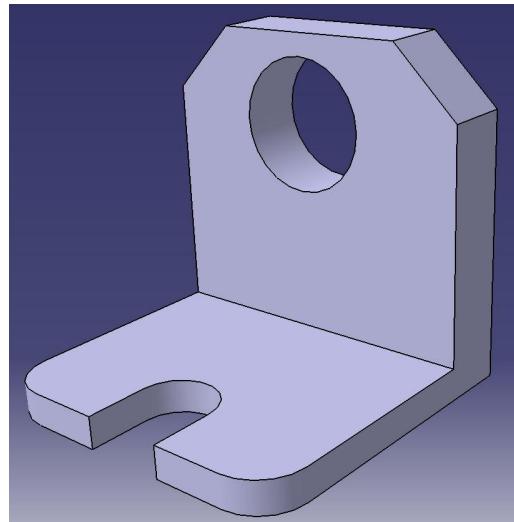
<https://www.quora.com/What-do-H-HB-F-B-and-E-stand-for-on-art-and-architectural-pencils>

<https://isomarsshop.in/products/isomars-armhole-french-curve-set-of-2-with-marking>

<https://www.amazon.in/>

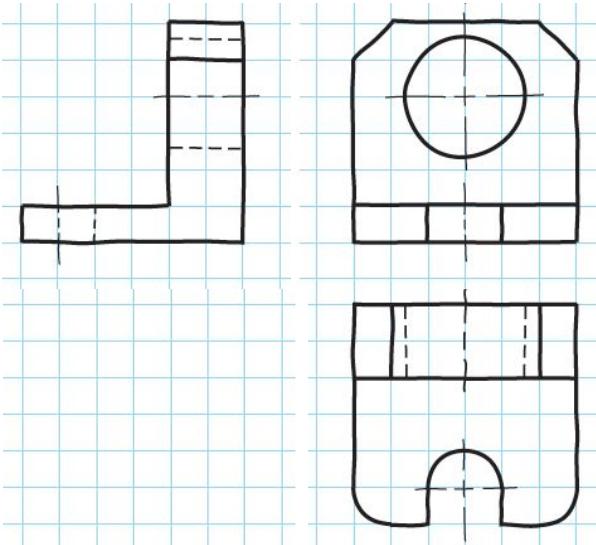
Topics in the course: Basic Geometric Constructions



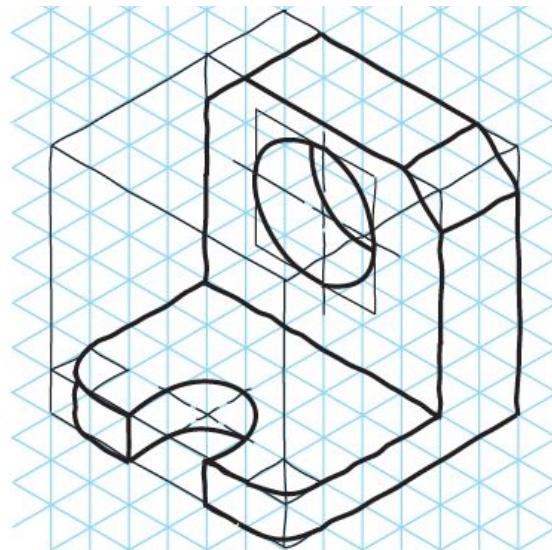


3D solid model

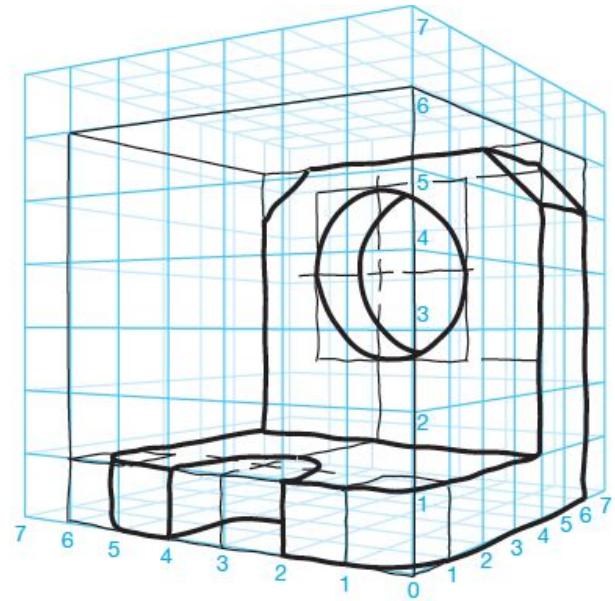
Orthographic projection

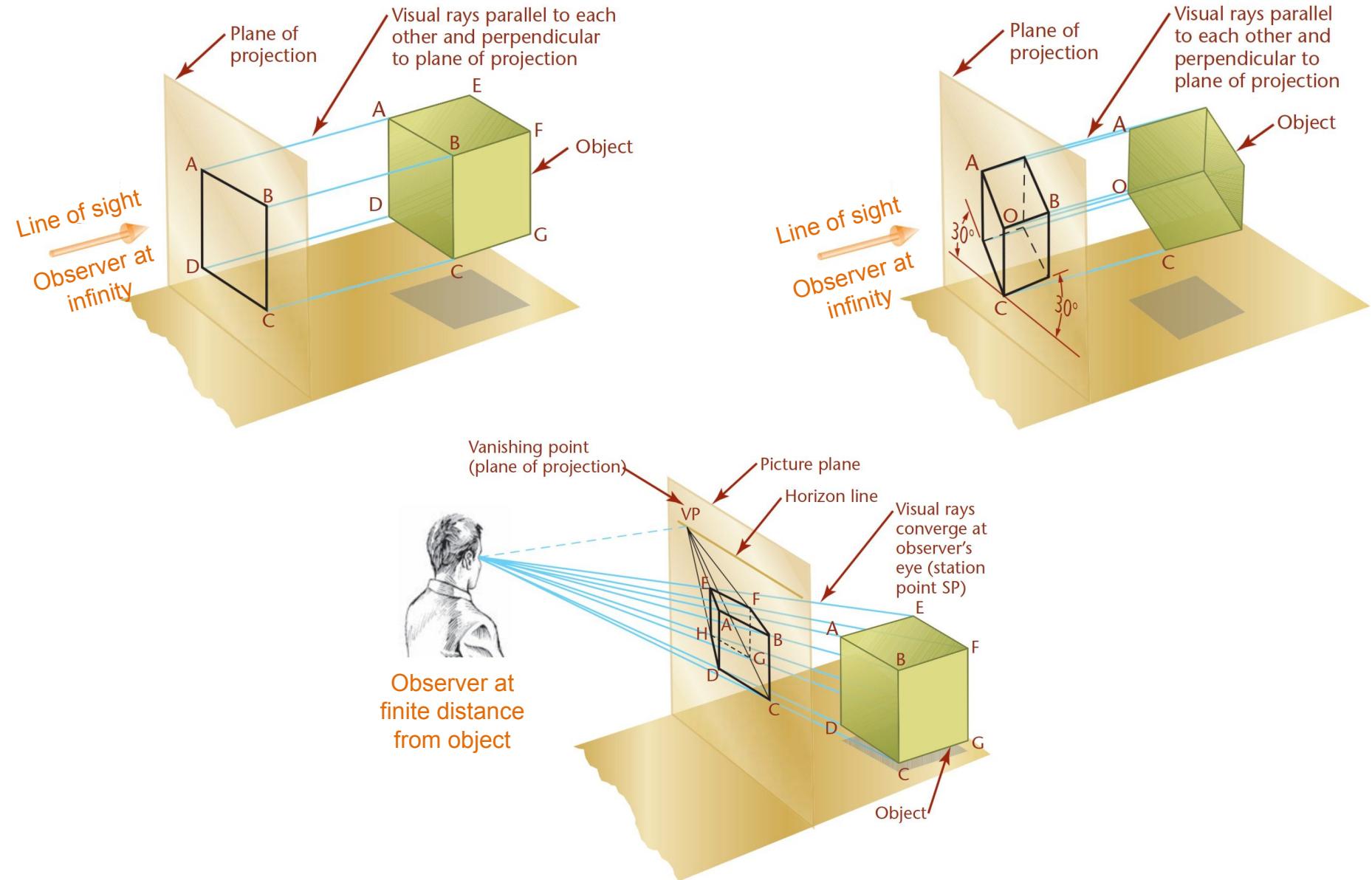


Isometric projection

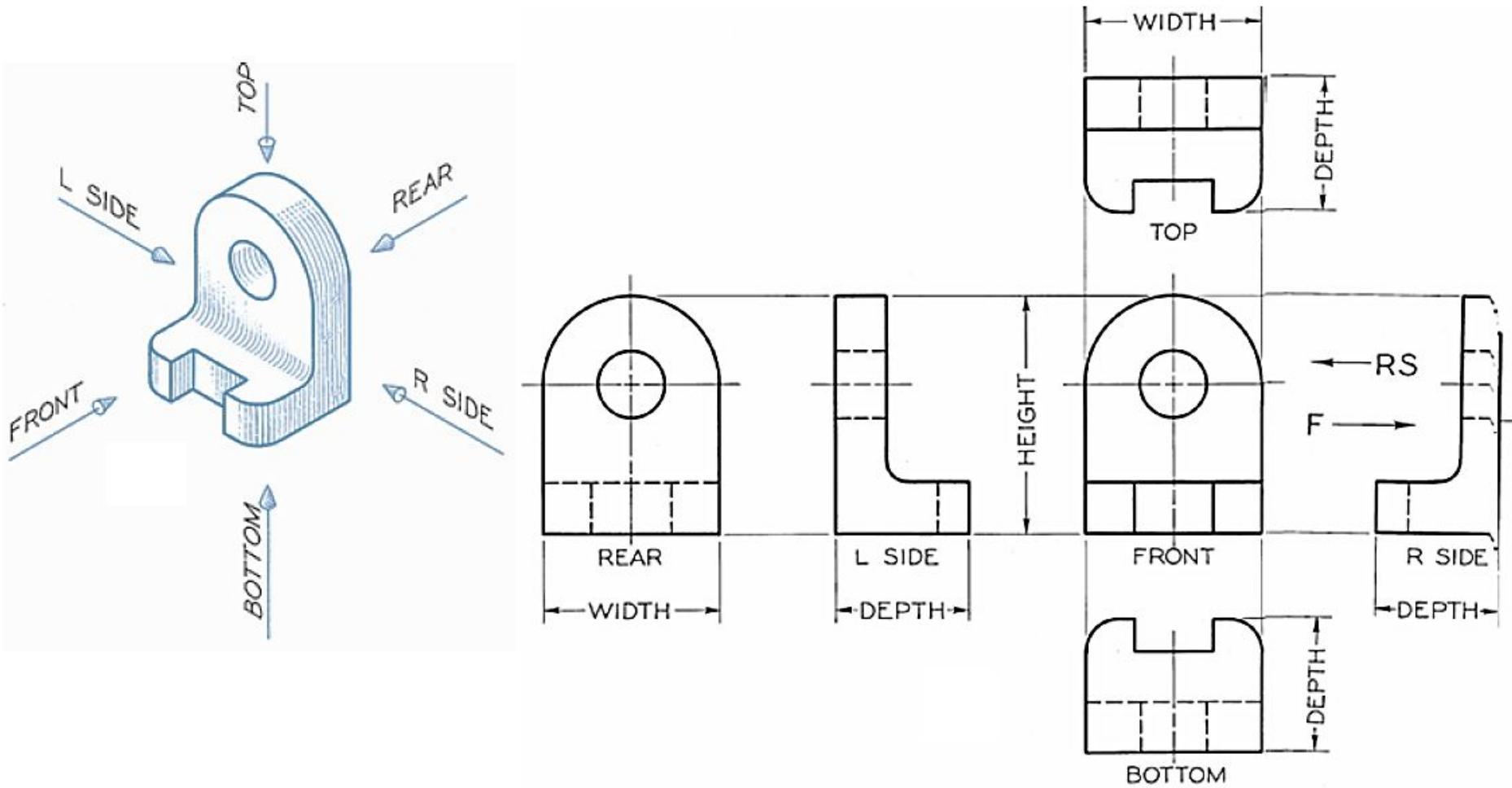


Perspective projection

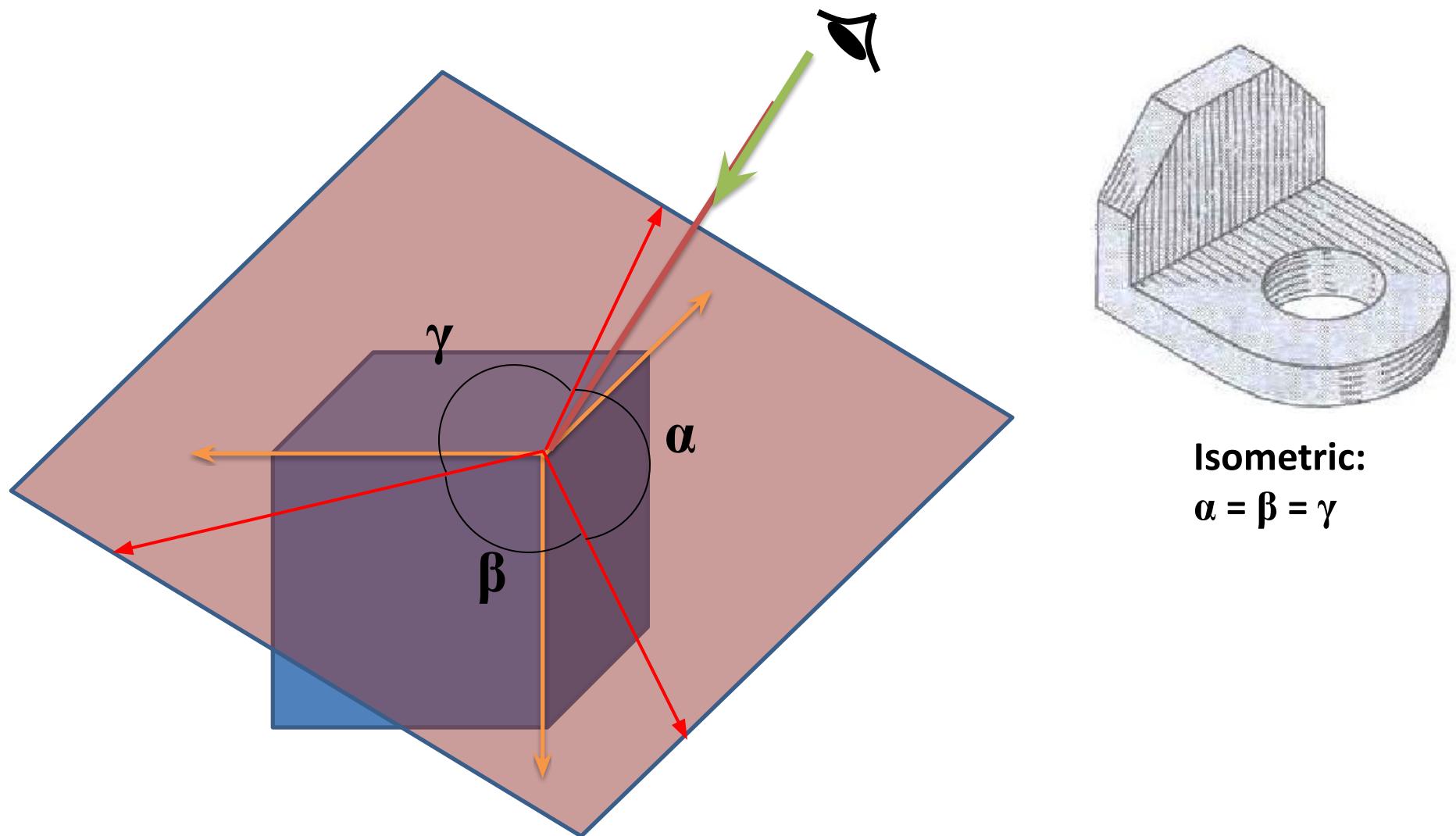




Topics in the course: Orthographic projections



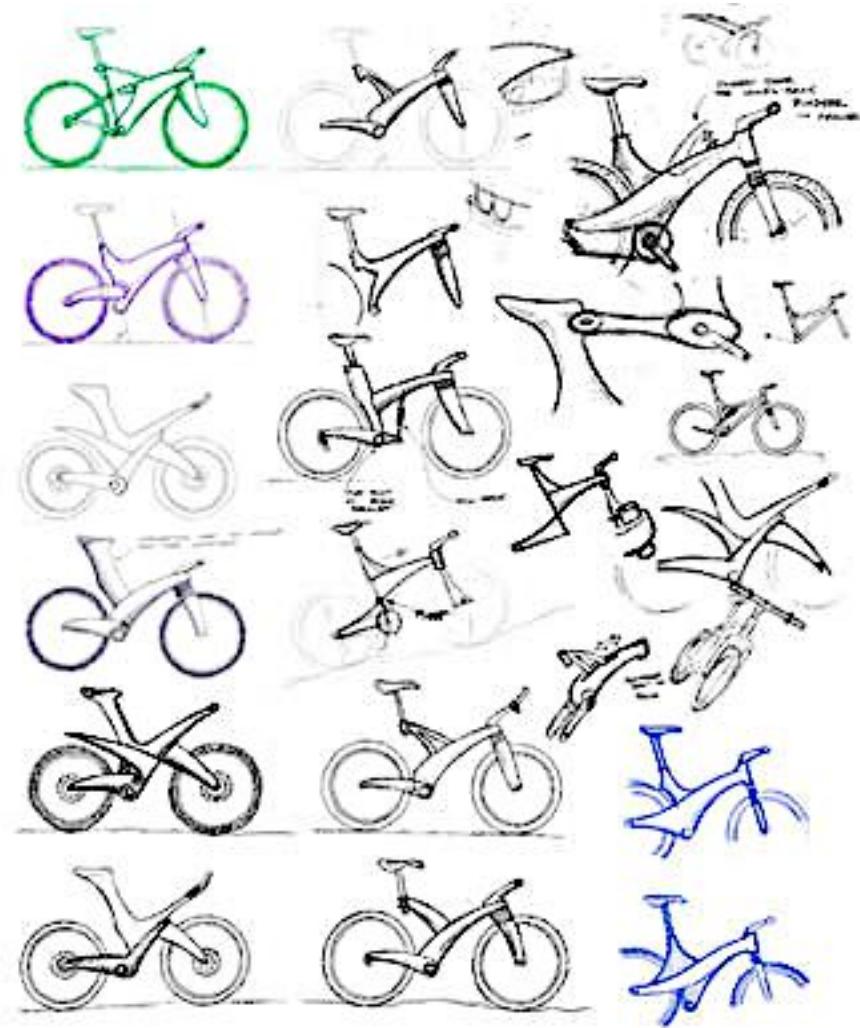
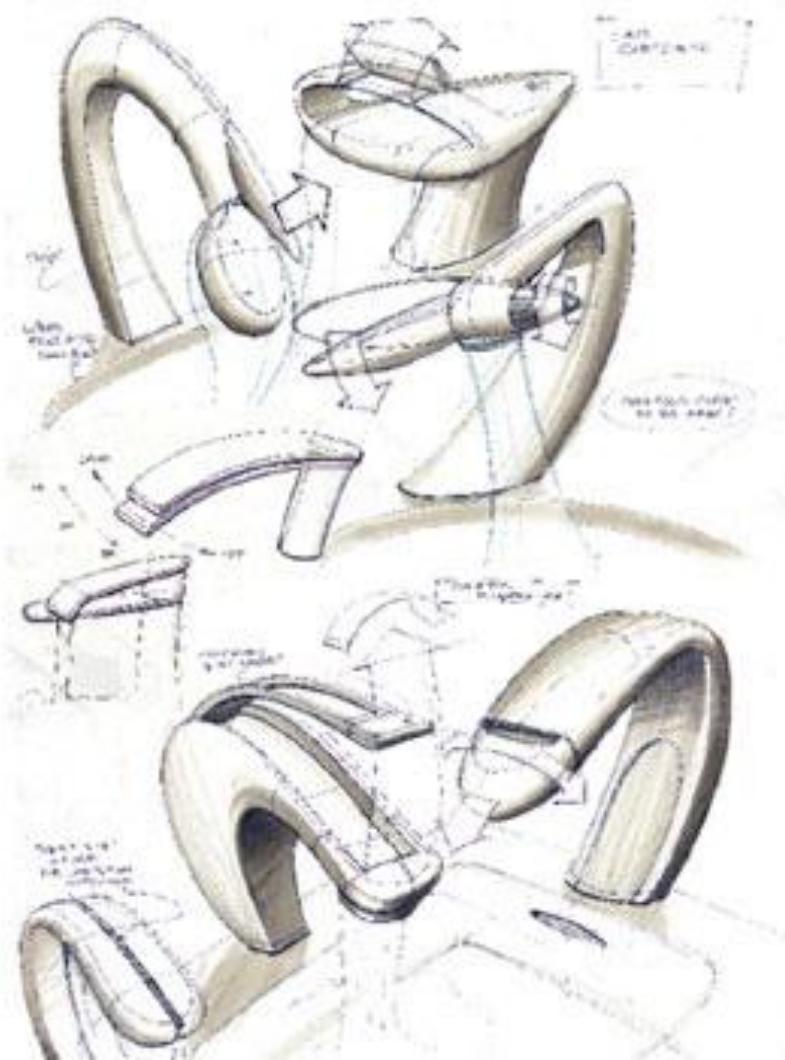
Topics in the course: Isometric projections



Topics in the course: Perspective projections



Topics in the course: Basics of Sketching



<https://design.tutsplus.com/tutorials/the-role-of-sketching-in-the-design-process--psd-153>

Drawing scale

- Representative Fraction (RF) or Scaling Factor (SF):

$$RF = \frac{\text{Dimension on Drawing}}{\text{Actual Dimension}}$$

- Drawing scale is defined in the form

$$\text{Scale} = \text{Drawing} : \text{Actual}$$

- However, it is customary to represent it in the form

$$\text{Scale} = 1:(1/RF)$$

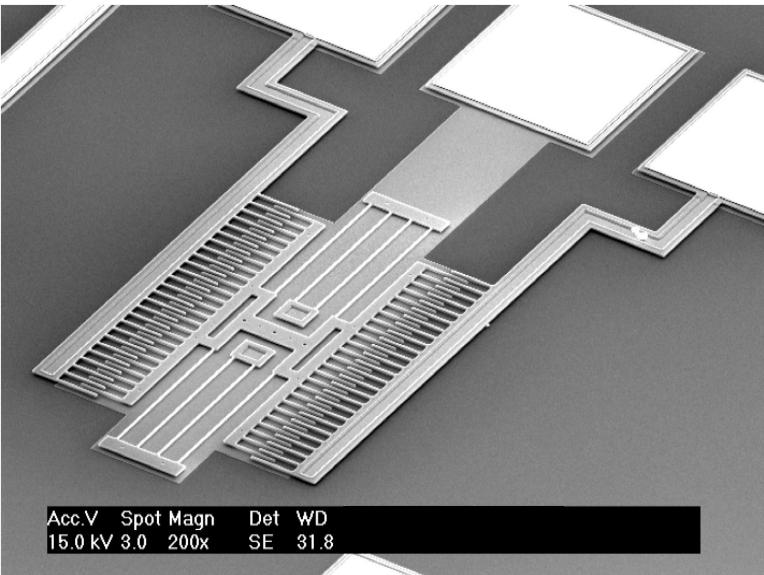
- The actual object is five times larger than the size shown on drawing ($RF < 1$, reduced scale)

$$\text{Scale} = 1:5$$

- The actual object is five times smaller than the size shown on drawing ($RF > 1$, enlarged scale)

$$\text{Scale} = 1:0.2$$

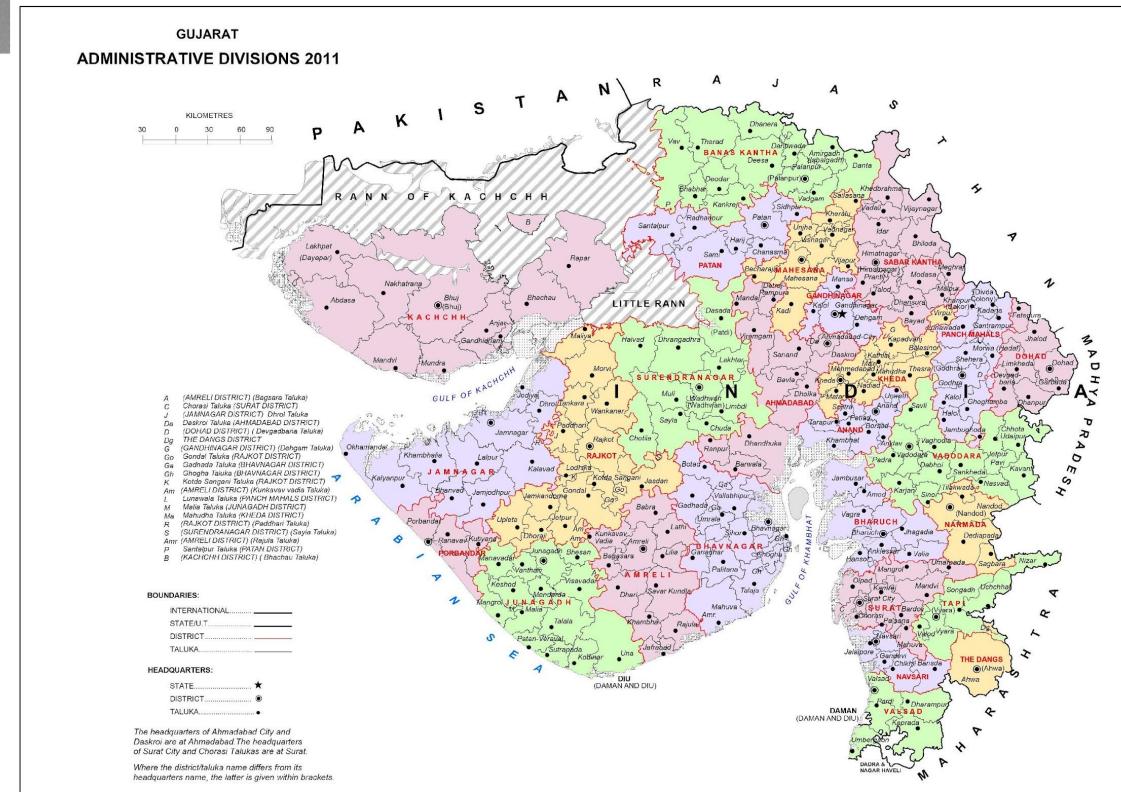
- Note that only length dimensions get scaled and not the angular dimensions



Scale = $1: 10^{-3}$

High vibration sensors: Modelling, design and integration, Conference Paper, May 2009
DOI: 10.1109/ESIME.2009.4938479, Source: IEEE Xplore

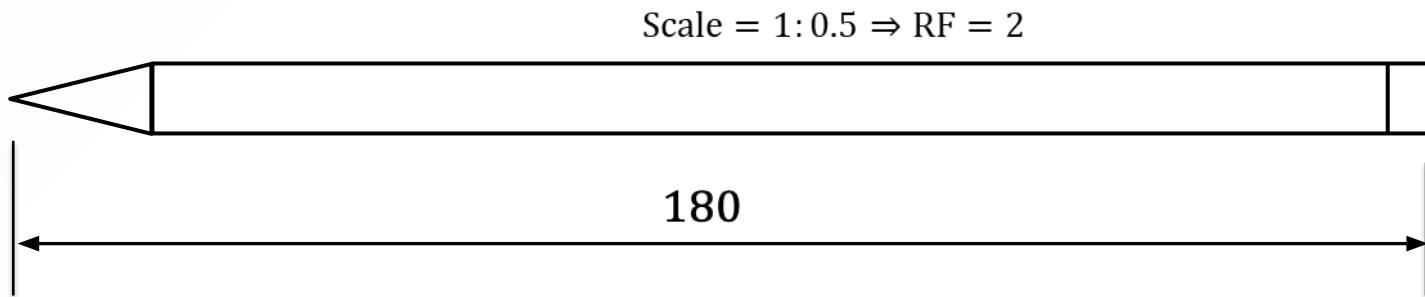
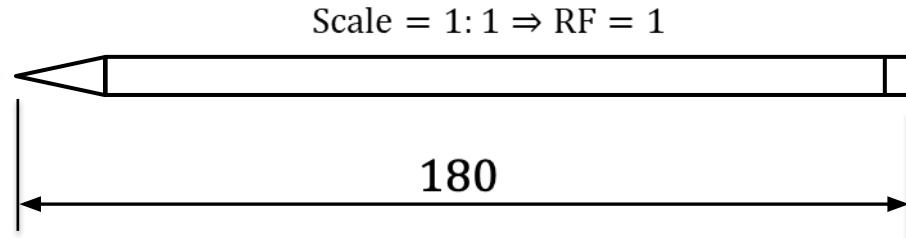
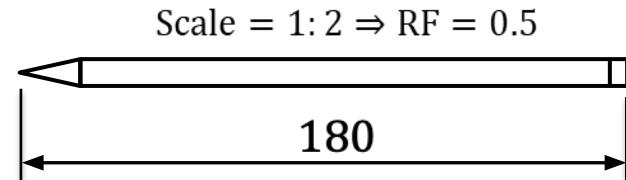
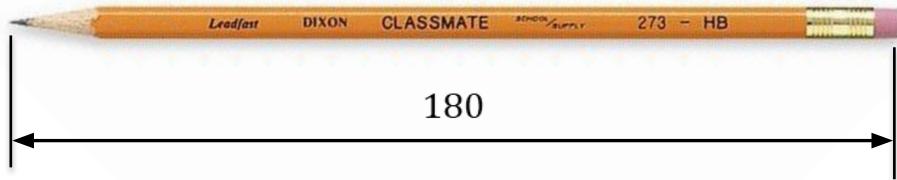
<https://www.bragitoff.com/wp-content/uploads/2016/04/gujarat.jpg>

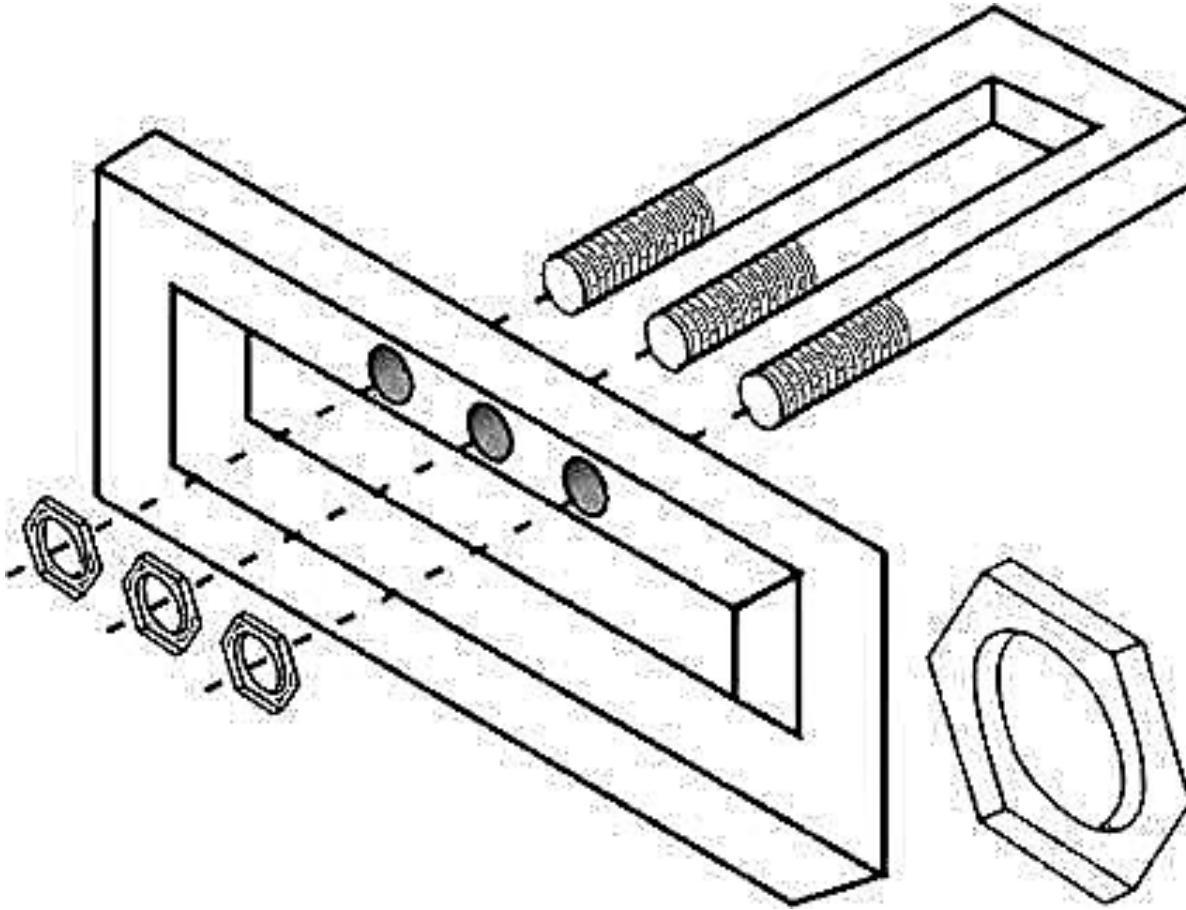


Scale = $1: 10^6$

Drawing scale

- On the drawing, always show the actual dimension and provide the scaling factor (RF)
- If $RF < 1$, the actual object is larger than the one shown in the drawing
- If $RF > 1$, the actual object is smaller than the one shown in the drawing
- ...





Thank you