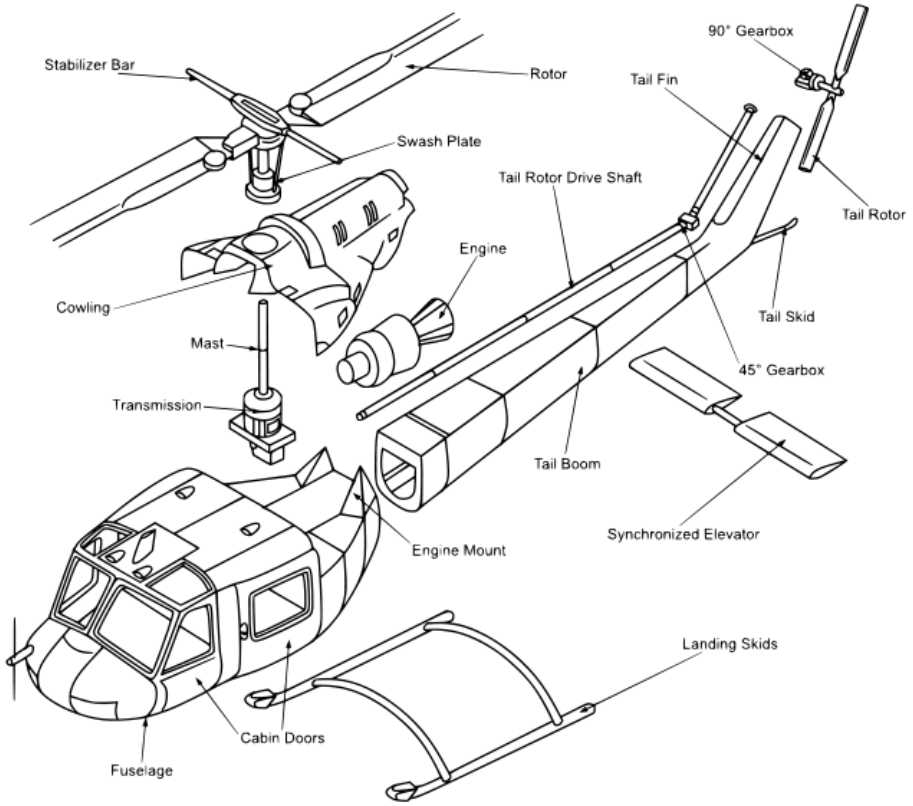
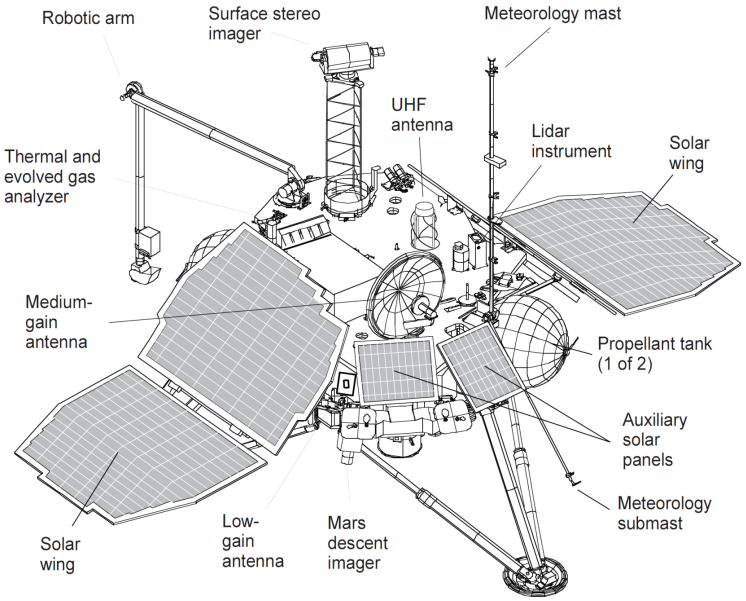
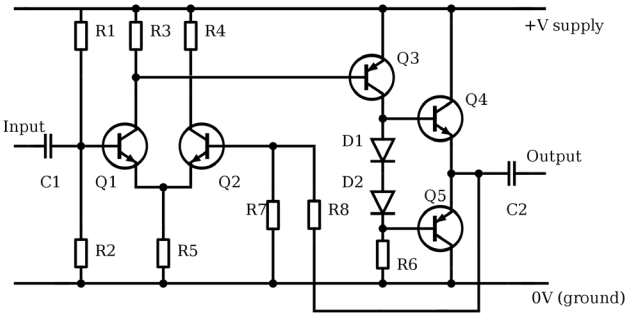




Lecture 3 – Technical drawings and laser cutting

Andrés Faíña (anfv@itu.dk)



Overview

3D modelling/printing discussion

Technical drawings

Introduction flat sheet cutting

Laser cutting

- How it works
- Cutting/engraving
- Techniques

3D modelling/printing discussion

Find a person who is not in your group

Open your motor holders in Fusion 360

Show your 3D models

- Operations that you used
- Problems that you found
- Did you remember to create a component?
- How many bodies do your parts have?
- All your sketches are in the right component?

Show your 3D printed parts and discuss

- How it works (How it clamps the motor)
- Measure some dimensions and compare them to their value in the 3D model (Tolerances)

Common pitfalls using Fusion 360

No create a new component for a new part
In multipart documents, make changes in one part without activating that component
Have several bodies for a component
    Usually, 1 component -> 1 body
    For advanced users:

    https://designandmotion.net/new-post/when-to-use-fusion-360-bodies-and-components/

Use the box/cylinder/hole command
Make copies of bodies and move them around

Good practices in Fusion 360

Think before start 3D modelling
Draw a sketch on paper
Keep your model clean
    Create a new component for a new part
    1 component -> 1 body
        Rename all sketches (or at least the critical ones)
Minimize the number of operations to avoid long design histories
When extruding, use “to object” instead of “to distance”, if appropriate
Use symmetry and linear/circular patterns

Technical drawings

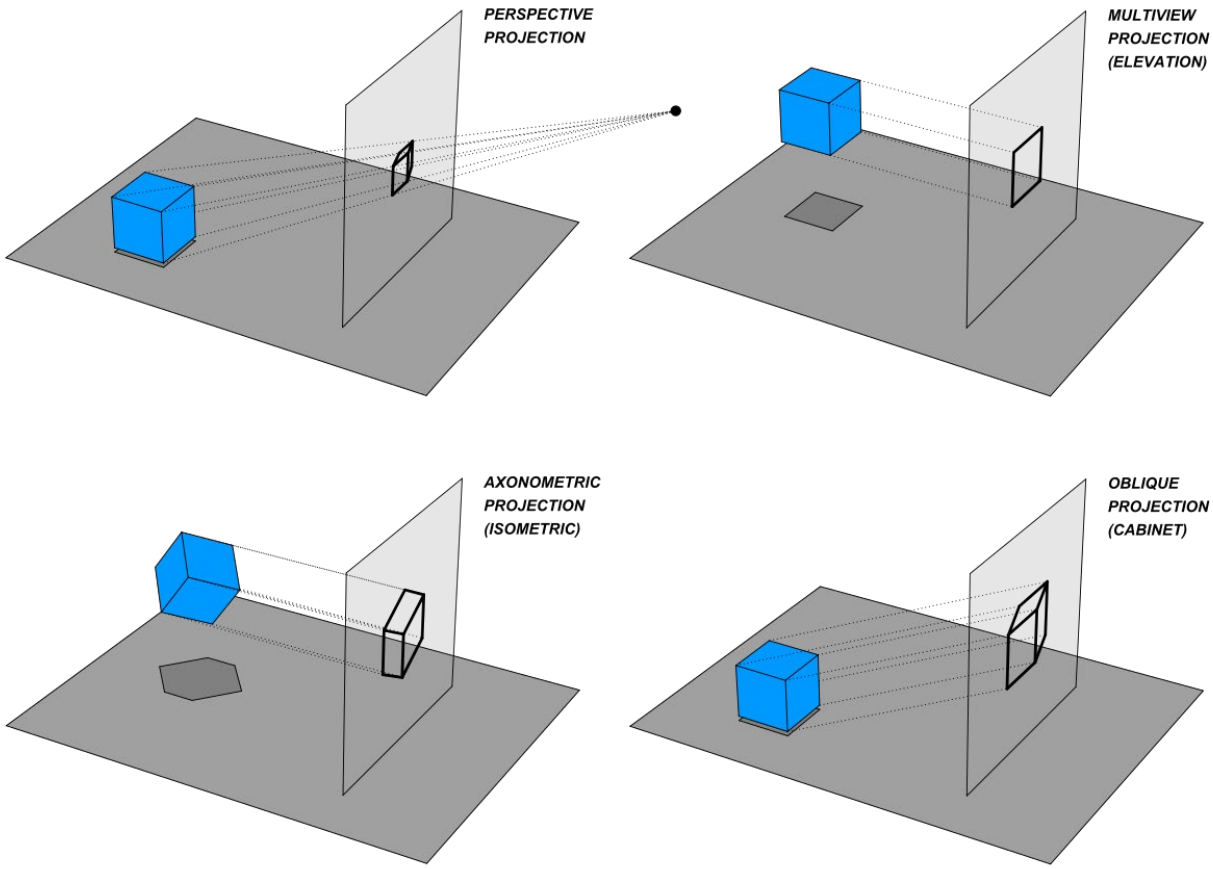
A 2D representation of a 3D part.

Purposes:

- Illustrative
- Documentation
- Manufacture parts in workshops

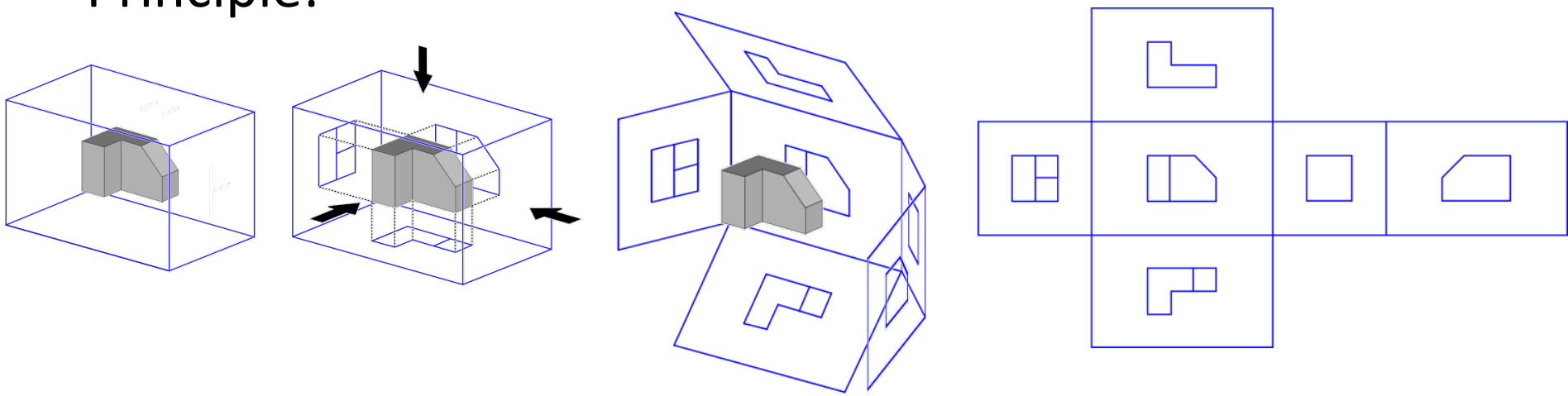
Drawings – methods

One part, several representations

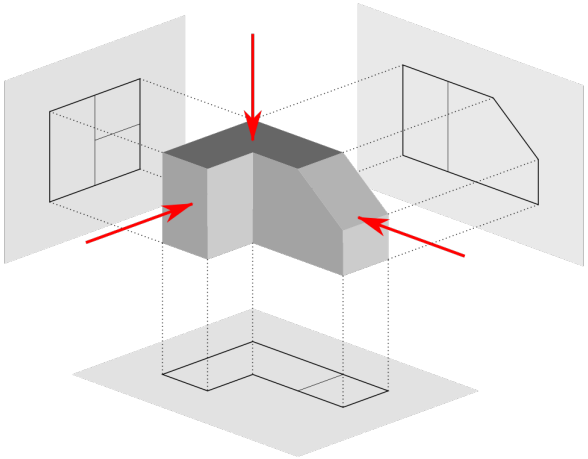


Multiview projection

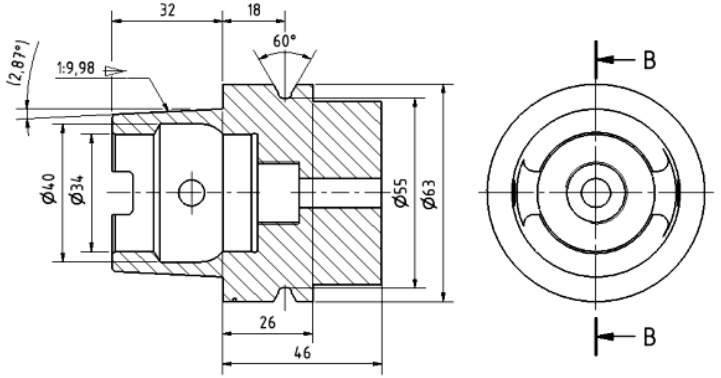
Principle:



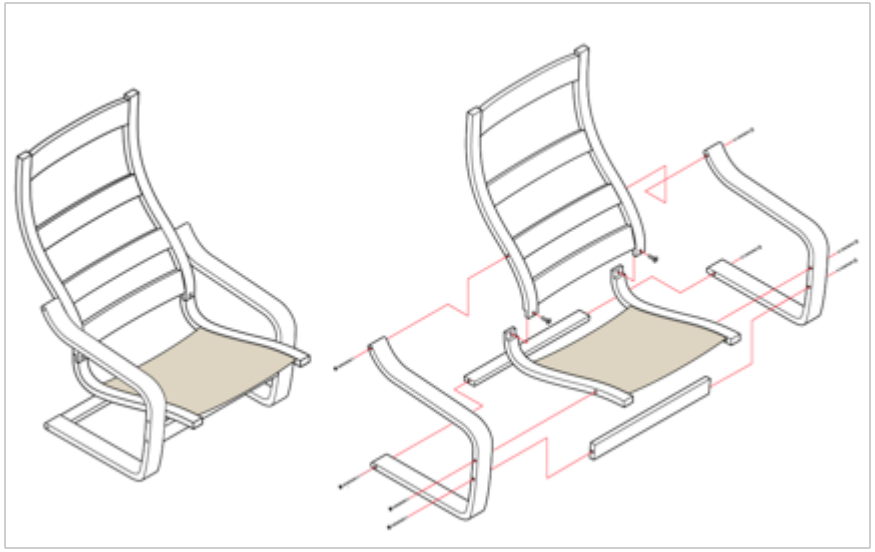
3 views

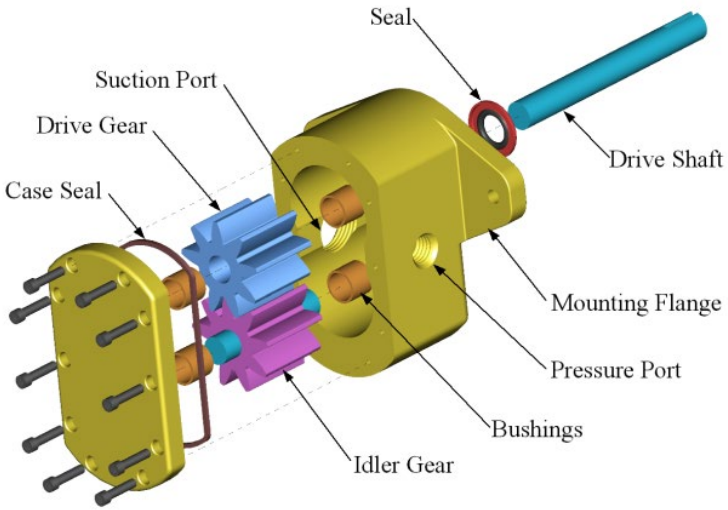


Sections



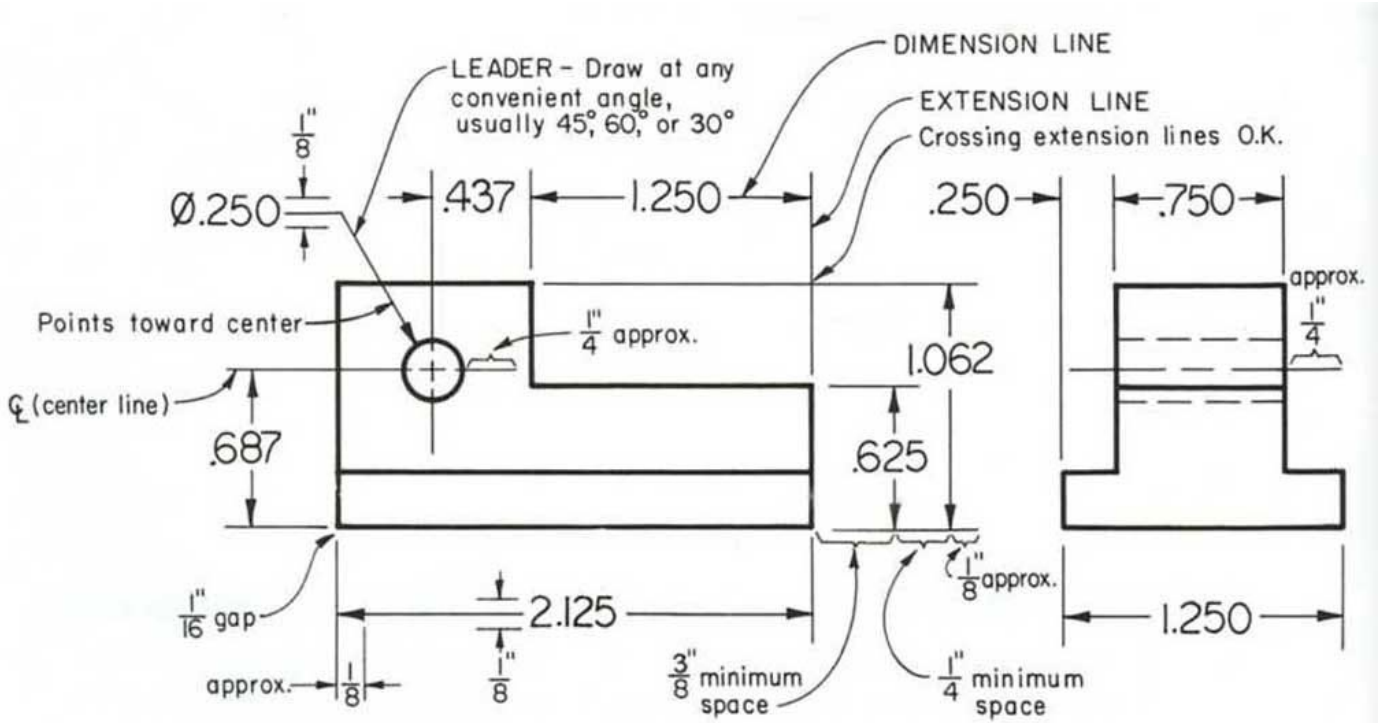
Exploded-view drawing





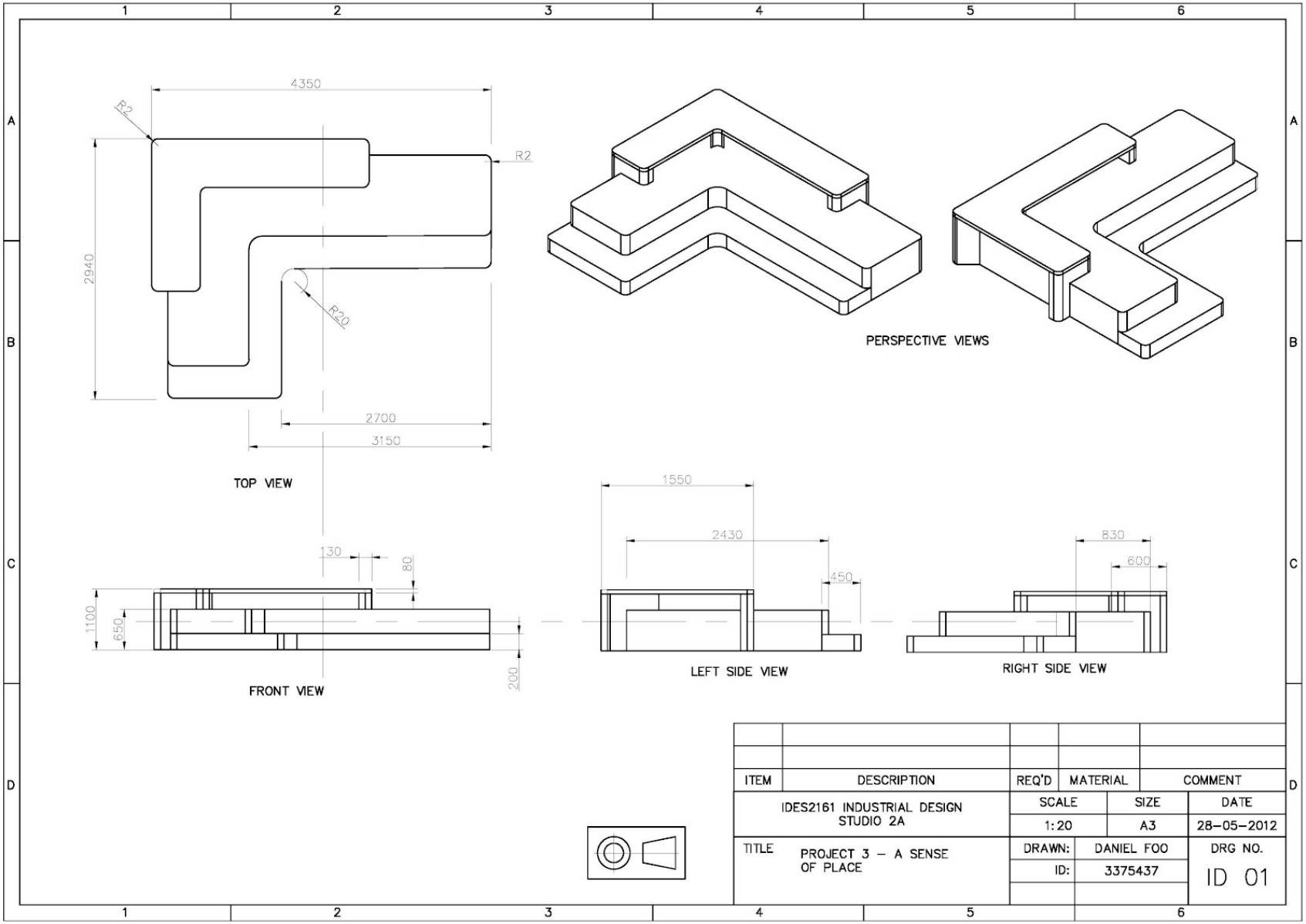
Dimensioning Rules

Give all the dimensions of the part
Do not duplicate dimensions on a drawing
Place dimensions on the most descriptive view
Dimension lines should not cross any other line



Dimensioning conventions

Title block


4350
R2
R2
2940
R20
2700
3150
TOP VIEW
PERSPECTIVE VIEWS
130
80
1100
650
200
FRONT VIEW
1550
2430
450
LEFT SIDE VIEW
830
600
RIGHT SIDE VIEW
ITEM
DESCRIPTION
REQ'D
MATERIAL
COMMENT
IDES2161 INDUSTRIAL DESIGN STUDIO 2A
SCALE
1:20
SIZE
A3
DATE
28-05-2012
TITLE
PROJECT 3 – A SENSE OF PLACE
DRAWN:
DANIEL FOO
ID:
3375437
DRG NO.
ID 01

Generating a drawing

Change to Fusion 360!

Introduction flat sheet cutting

How it works

There is a flat material (sheet)

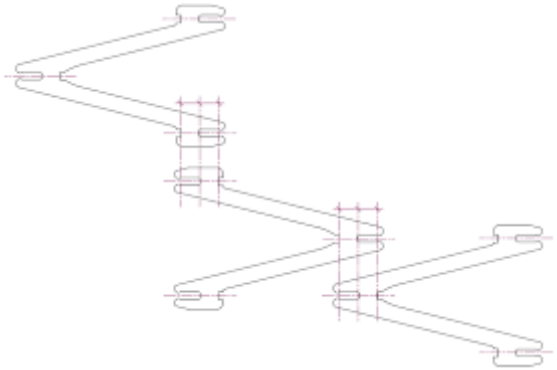
A machine cuts/engraves the sheet

Methods to cut the material:

Method	Cuts	Speed	Quality	Max .thickness	Other
Plasma cutting	Only metals	Fast	Low	< 20mm	Fumes
Water jet	Everything	Slow	Good	< 250mm	No heat
Laser cutting	some materials (depends on the laser)	Medium	Good	< 12mm	Fumes

Ugh, a 2D technique…

From flat to 3D
by Philip Beesley



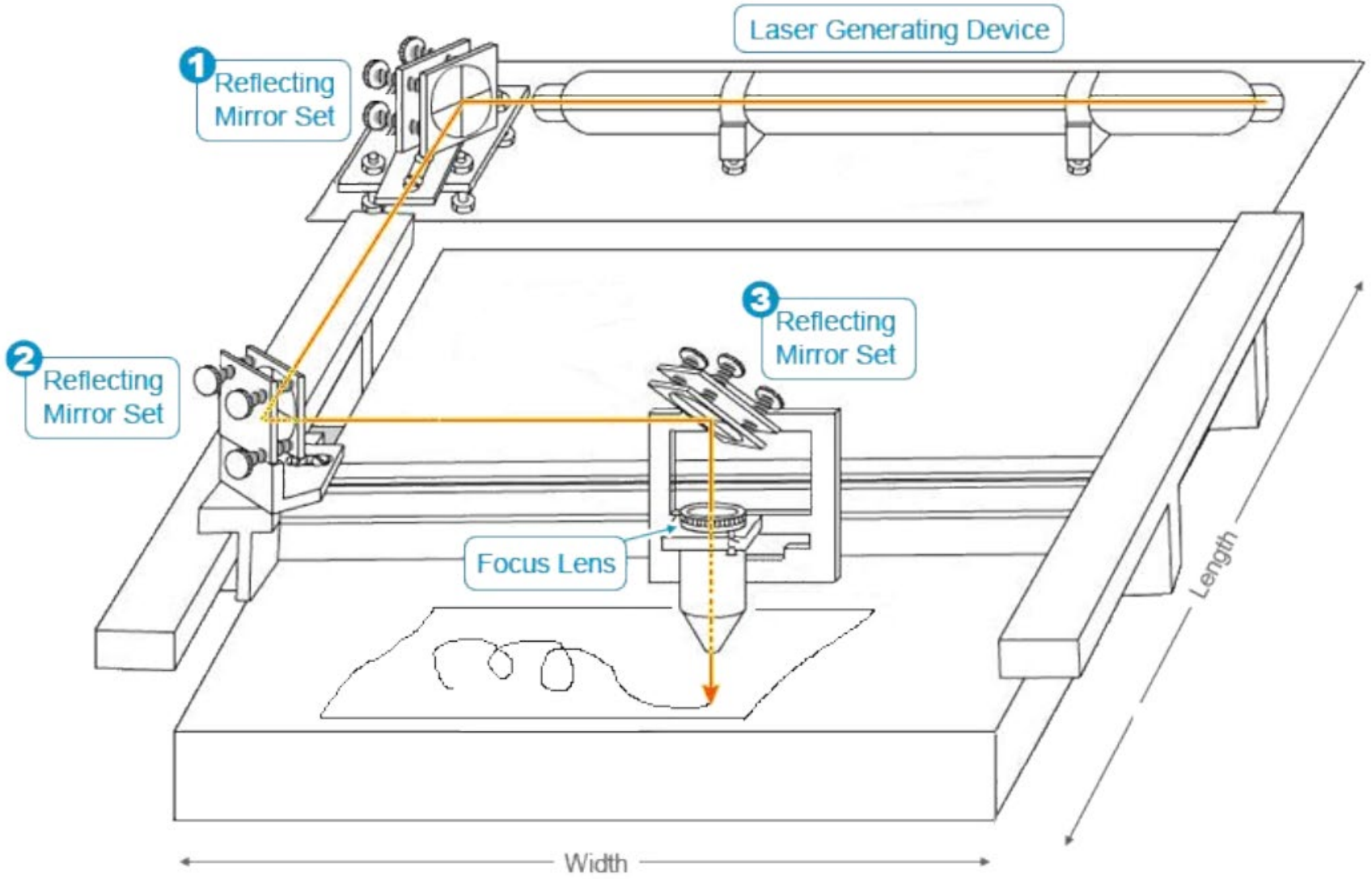
Ugh, a 2D technique…

Dermoid - CITA, KADK 2011 - Lasercut plywood slotted together - no glue or bolts

Ugh, a 2D technique…

https://www.youtube.com/watch?v=UA__bXPRdhw&t=21s

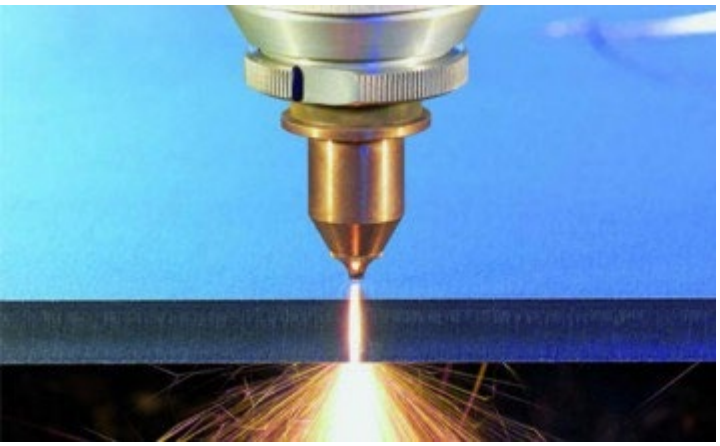
Laser cutting - How it works

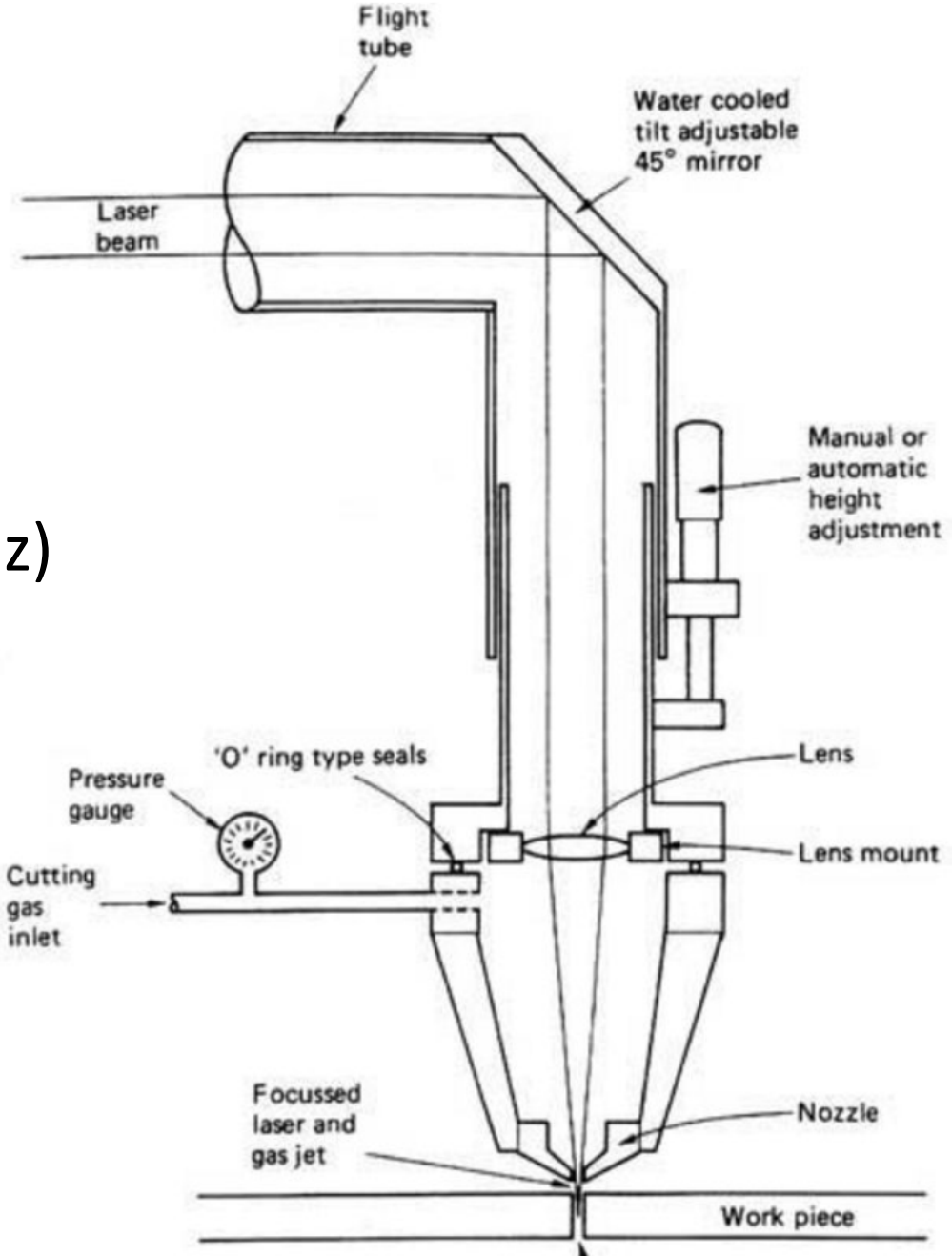


Laser cutting - How it works

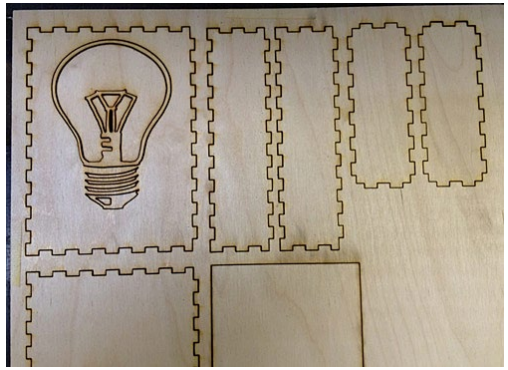
Basic parameters

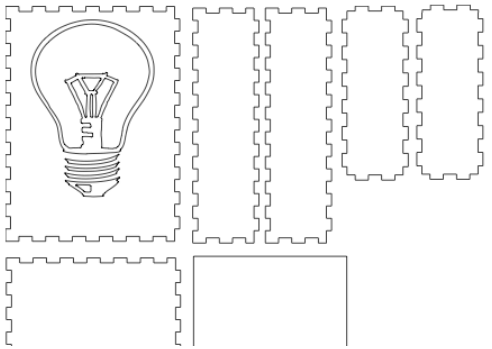
- Power (0-100%)
- Speed (0-100%)
- Frequency (0-5000Hz)





Laser cutting – Cutting/Engraving





Vector cutting:

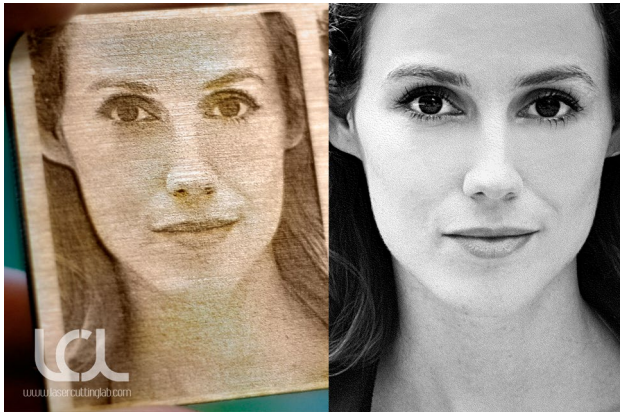
cut through the material

following a line pattern

Engrave:

Etch the surface of the material

using an image



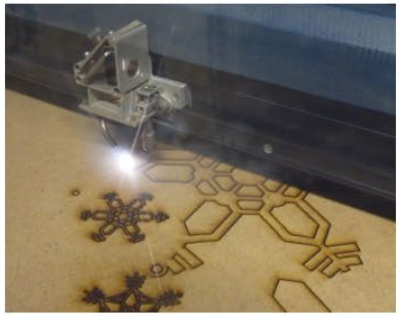
Laser cutting - Cutting/Engraving parameters

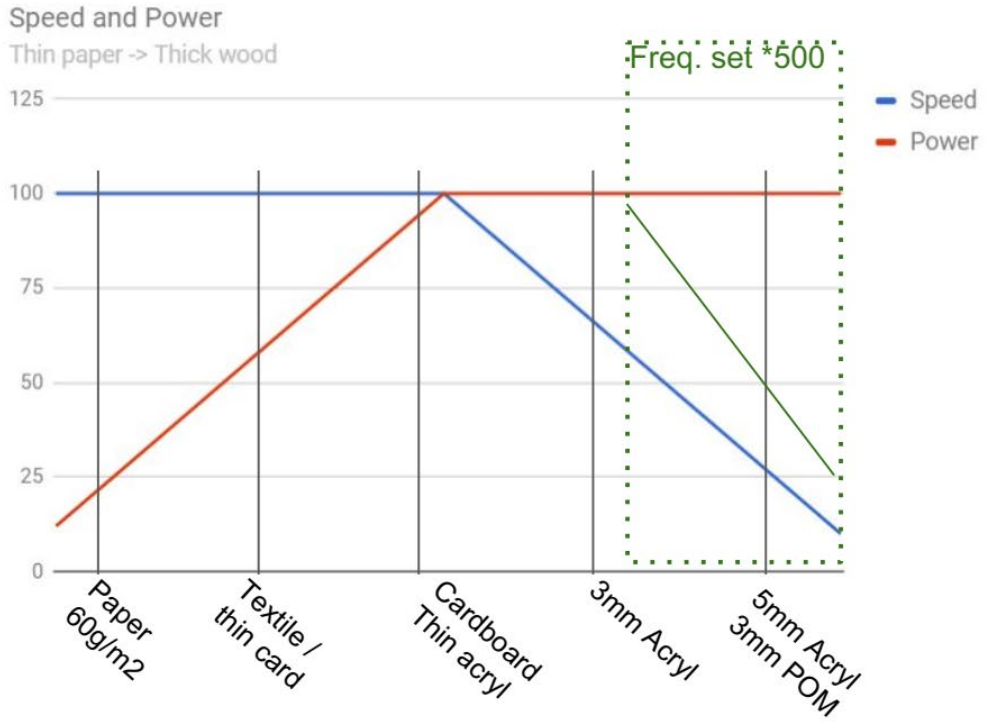
Depend on the material

Power :
-Linearly dependent on speed

Speed : -linearly dependent on power

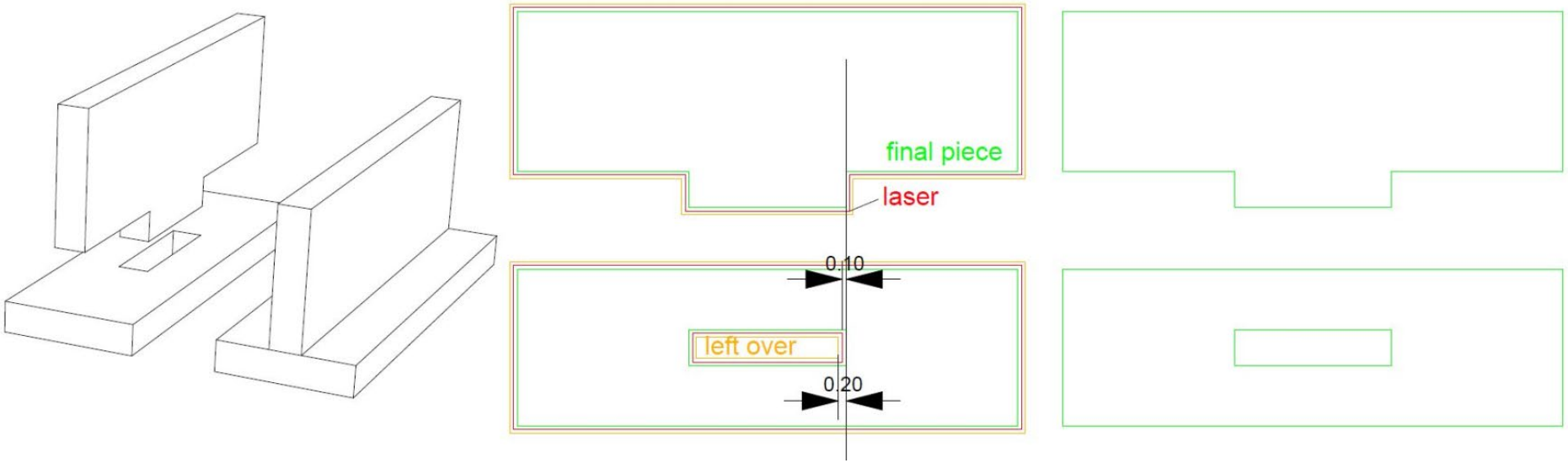
Frequency : mostly relevant at slow speed





Laser cutting – Kerf or cut away

Depend on the material, but
Cut Away for a lasercutter is typically 0.2mm



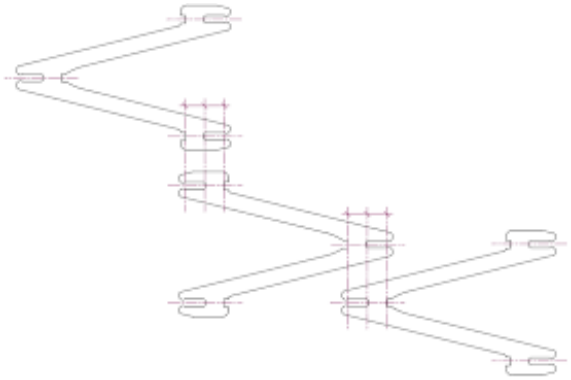
Laser cutting – Bending

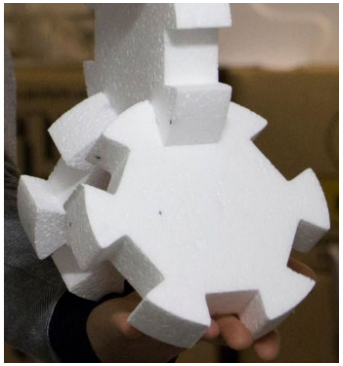
- Metals
  - Bending deformation
- Plastics
  - Heat bending
  - Acrylic good
  - POM difficult
- Paper/Cardboard
  - Folding
  - Engrave the folds
- No suitable for wood

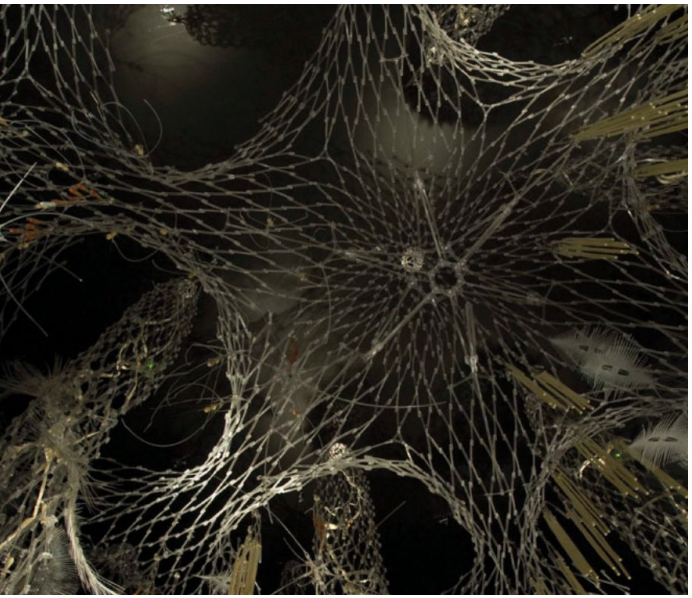
Laser cutting – Bending

https://www.youtube.com/watch?v=nEjFMYNGY4g

Laser cutting – Slotting and snap fit





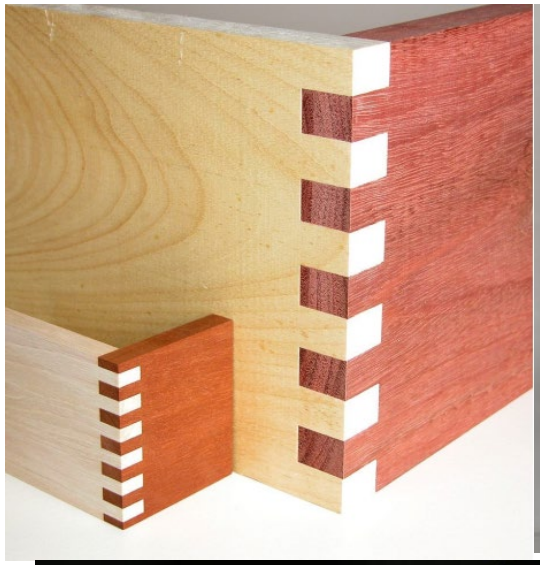


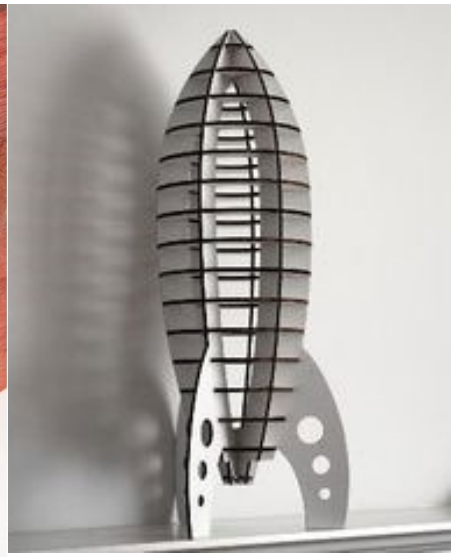
Laser cutting – Finger joints

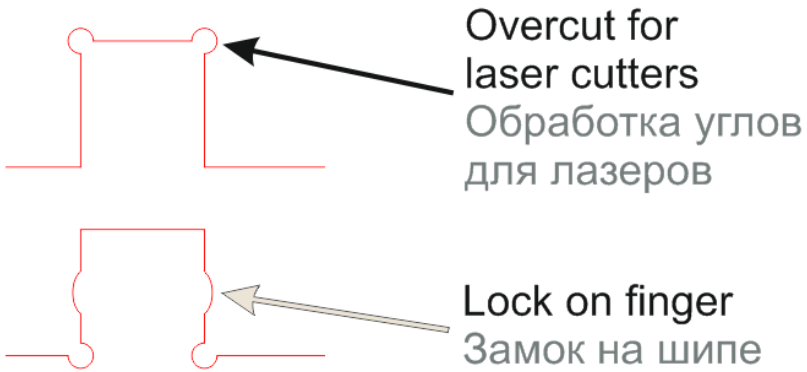
Easy to build

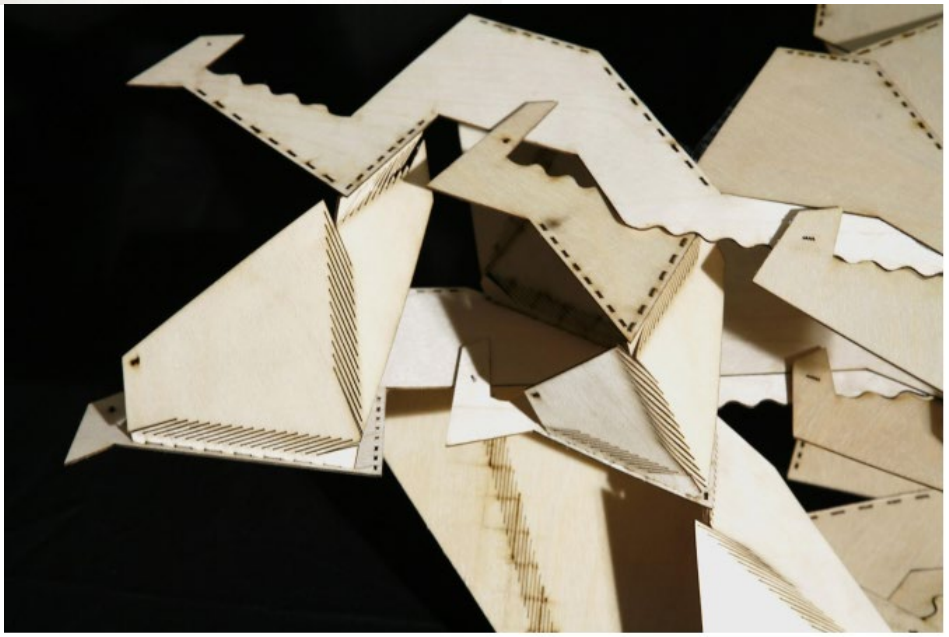
Remember that the laser removes material

Compensate that if you want a tight fit









Laser cutting – Finger joints

Making boxes:

https://makeabox.io/

http://www.makercase.com/

http://boxdesigner.connectionlab.org/

http://www.instructables.com/id/The-Ultimate-Guide-to-Laser-cut-Box-Generators/

https://www.thingiverse.com/thing:255013

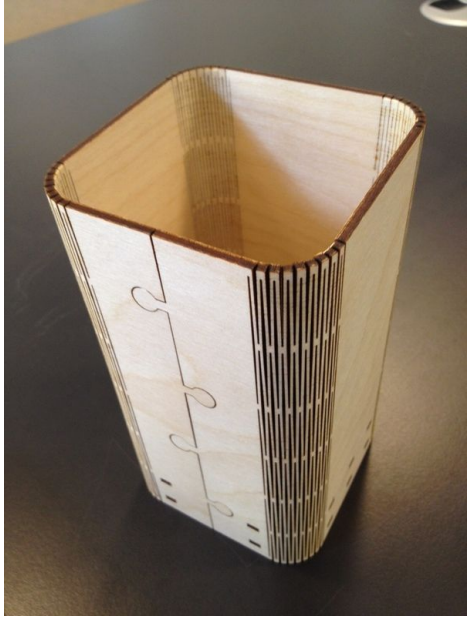
http://www.festi.info/boxes.py/

Laser cutting – Finger joints

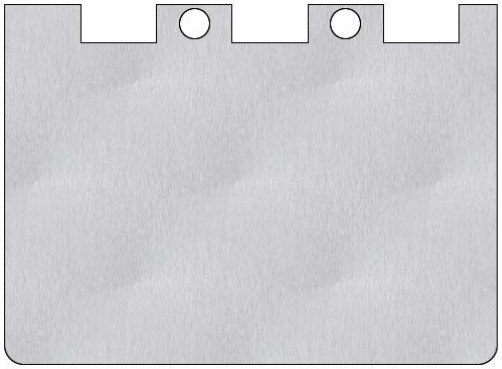
https://www.youtube.com/watch?v=4fFH_TcI-9U

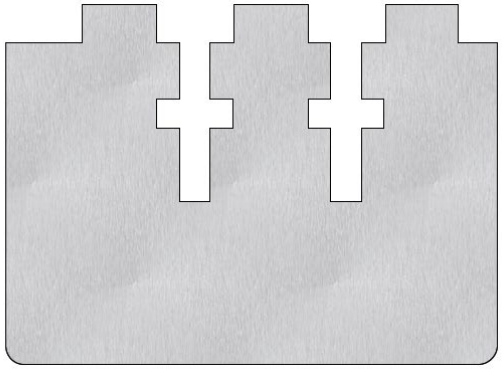
Laser cutting – Other techniques

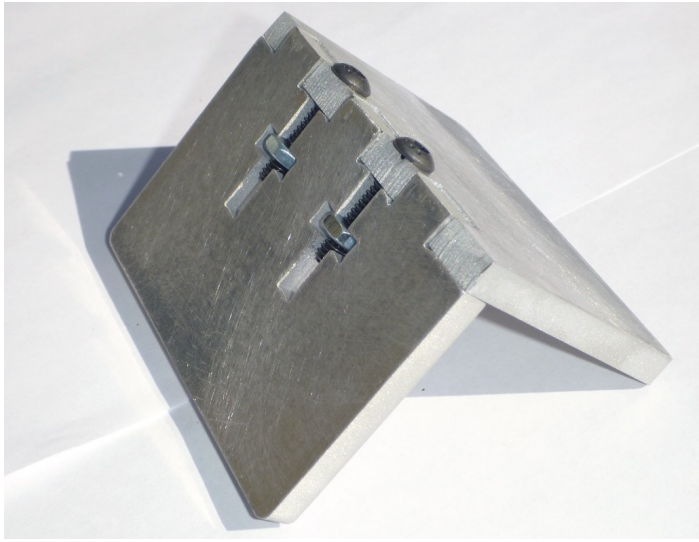
Engraved acrylic + light



Living hinges







Finger joints + Tnut

Laser cutting– Safety

Never laser cut PVC!

- Very toxic fumes
- Damage the machine
- Never laser cut a material that you don't know what is

Never open the lid of the laser cutter while it is working

- Reflections of the laser can damage your eyes easily

Always use the fume extractor and the air pump

- Automatically you switch on the laser, but double check

Do not try to use it with materials not suitable to laser cut

Ask for supervision the first time!

Today´s plan

Design a key-ring (20 min max.)
- Use constraints in the sketch
- Design it in Fusion 360 using constraints
  - Export sketch to DXF (or drawing to pdf)
  - Open in in Illustrator or Inkscape
    - Remove construction and auxiliary lines
    - Change line thickness to 0.0125mm
    - Add an image to engrave

Cut and engrave the key-ring (Dirty lab)
- Learn to use a drill press (Dirty lab)

Learn to bend acrylic (REAL lab)

Learn to use a drill press (REAL lab)

While you wait:
- Work on the MA
- Ask your doubts about modelling !

Mandatory activity

Design a base for the robot to support (**mandatory**: **laser cut**):

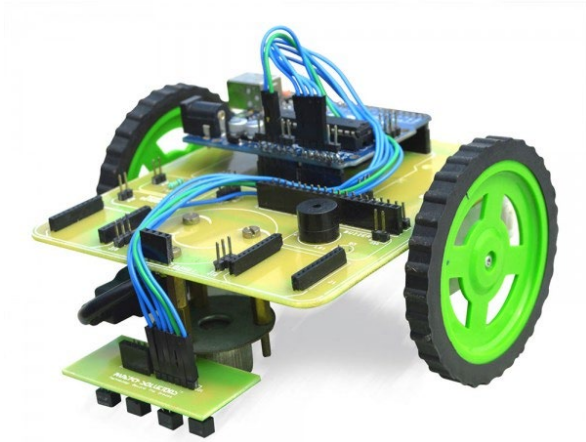
- Chassis (motor and motor holder)
- Arduino
- Breadboard
- Sensors (leave some free space)

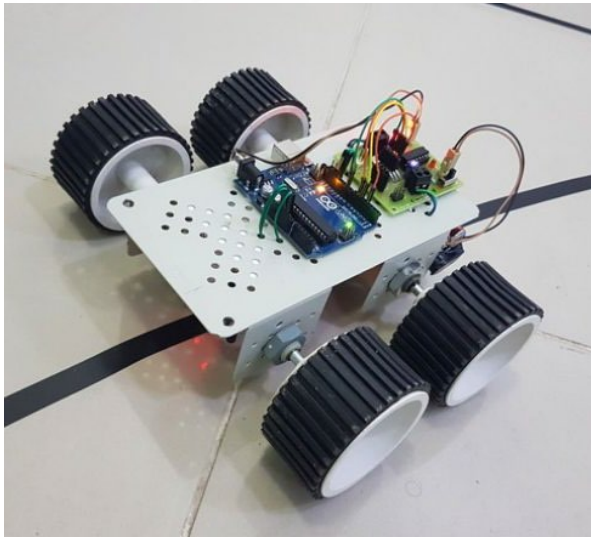
Design the wheels for the robot

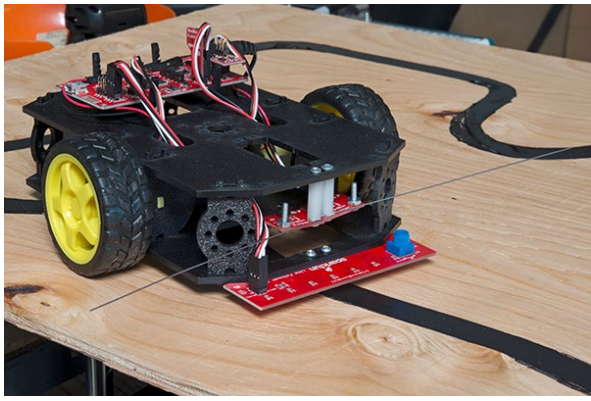
- 3D printed or laser cut

Make a technical drawing with the basic dimensions of the robot

Laser cut/3D print them and come to next lecture with them







Mandatory activity tips

Do not spend too much time designing the wheels
- Easiest - > laser cut them + rubber band

Your 3D models can be rough
- Not model irrelevant features, e. g. resistors on Arduino
- Model only important features, e. g.
  - mounting holes
  - overall dimensions
  - connectors that should go through cases

Make an assembly to get the right dimensions of the base

Be creative, try to avoid rectangular bases

Think in the functionality of the part

Dirty lab (IxD)

Room:

5A54

Resources:

Laser cutter (Supervision 1st and 2nd time)

Ask for materials in REAL lab

Drill press (1st and 2nd time under supervision)

Sander (1st and 2nd time under supervision)

Milling machine (Only under supervision)

Opening hours :

Dirty lab is usually open

If not, ask to Halfdan (IxD, 5A58)

Ready?

Let´s cut!

Andrés Faíña, 4D26
anfv@itu.dk