Aalto University

Prototypes, Models, and Mockups

21st of March 2024

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Based on slides by Teppo Vienamo

Aaltonaut

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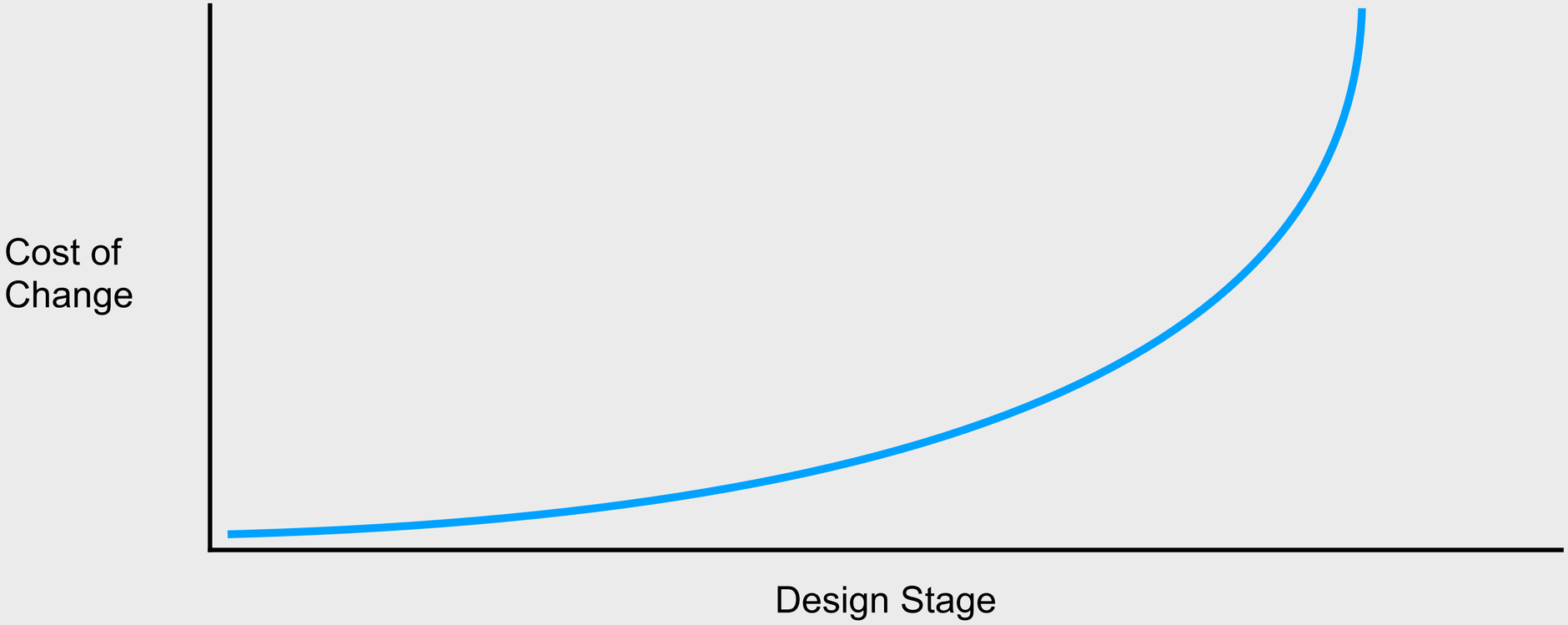
Why prototype?

Why prototype?



Introduction

Introduction

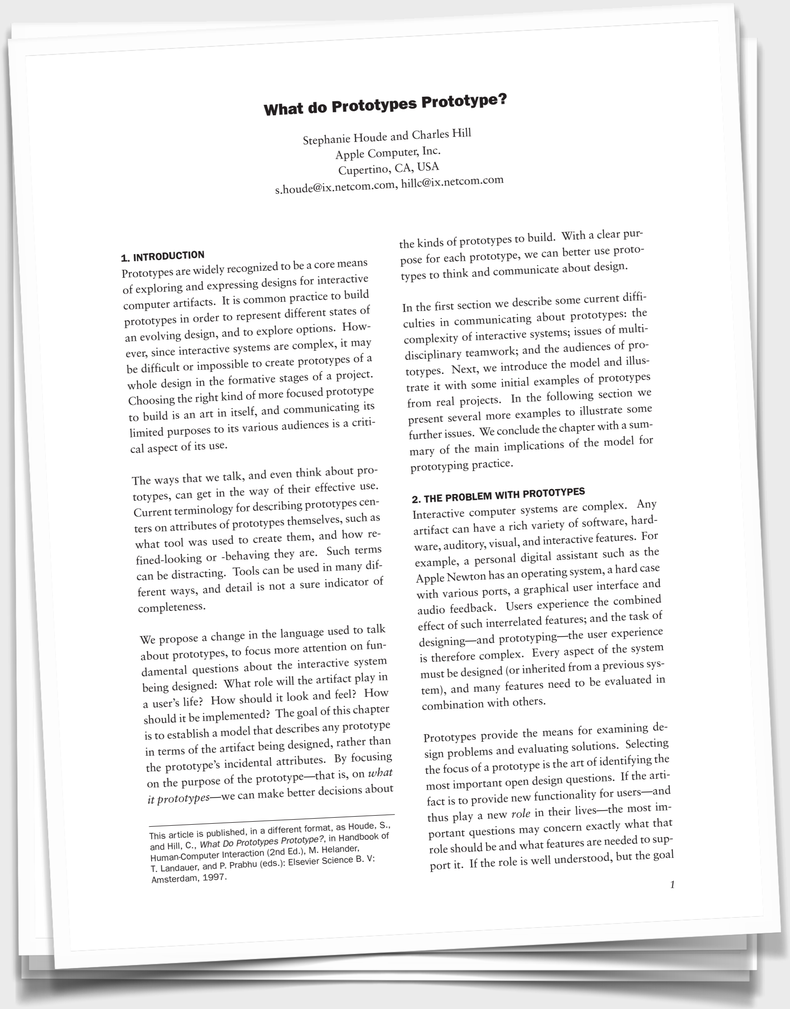
Prototyping in industry

Common materials and methods

Additional models

In-class work

Houde and Hill, 1997



What do Prototypes Prototype?

Stephanie Houde and Charles Hill
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1. INTRODUCTION

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2. THE PROBLEM WITH PROTOTYPES

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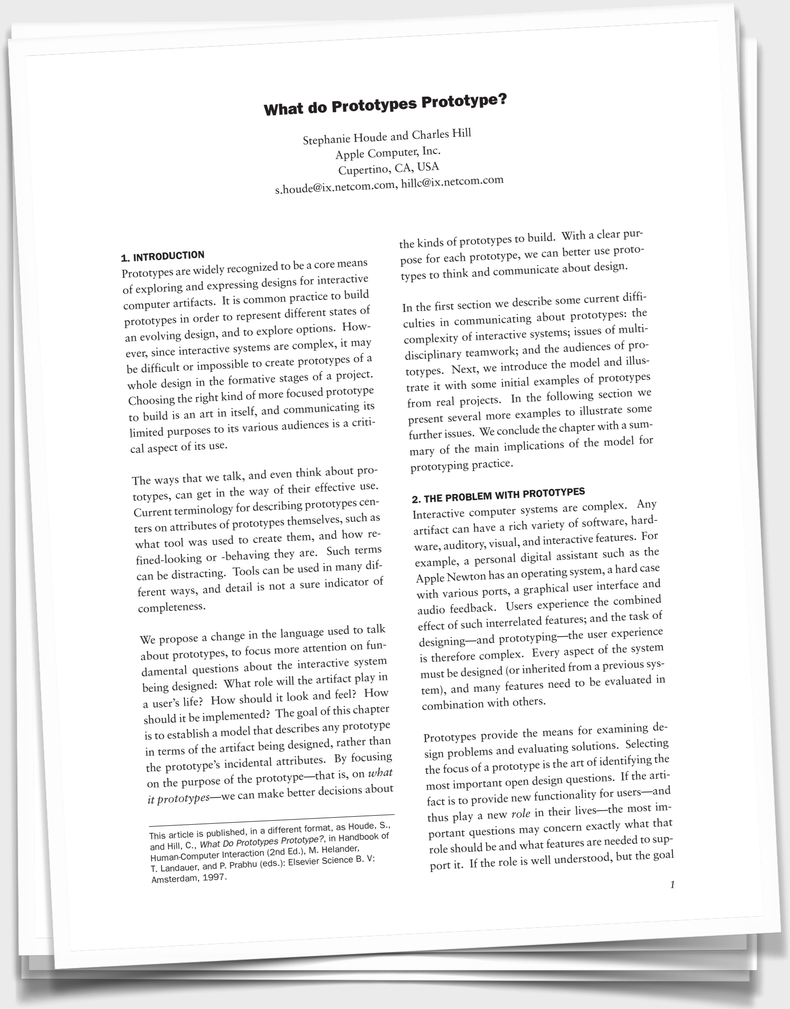

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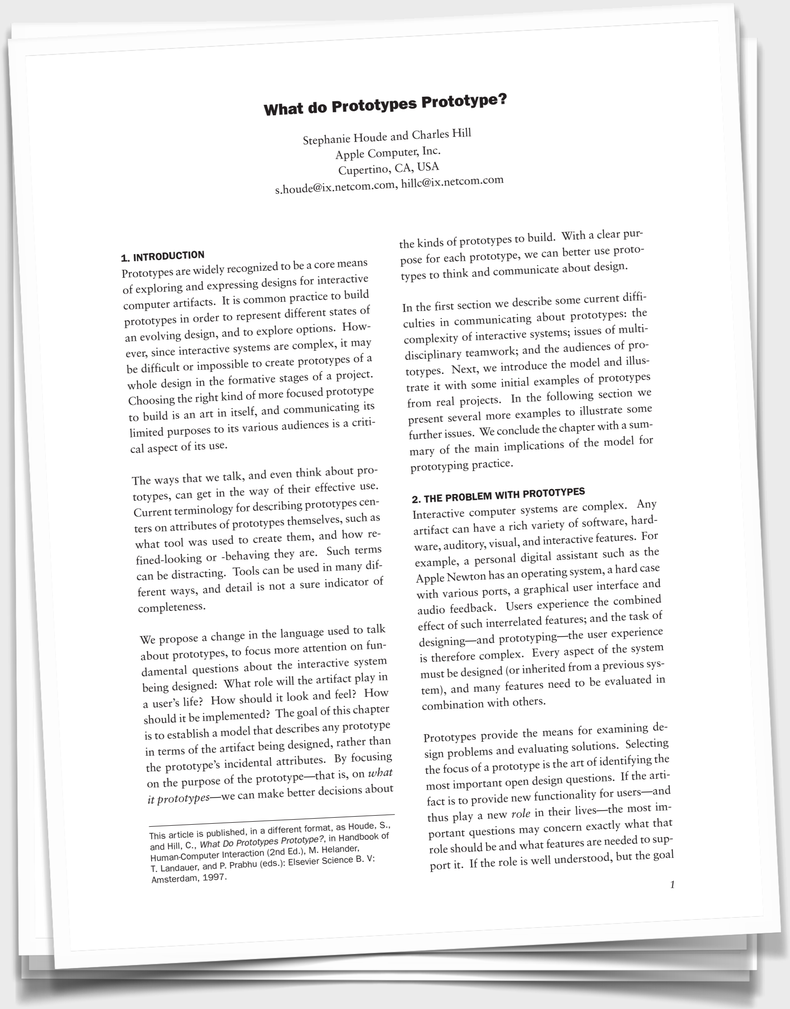
Houde and Hill, 1997



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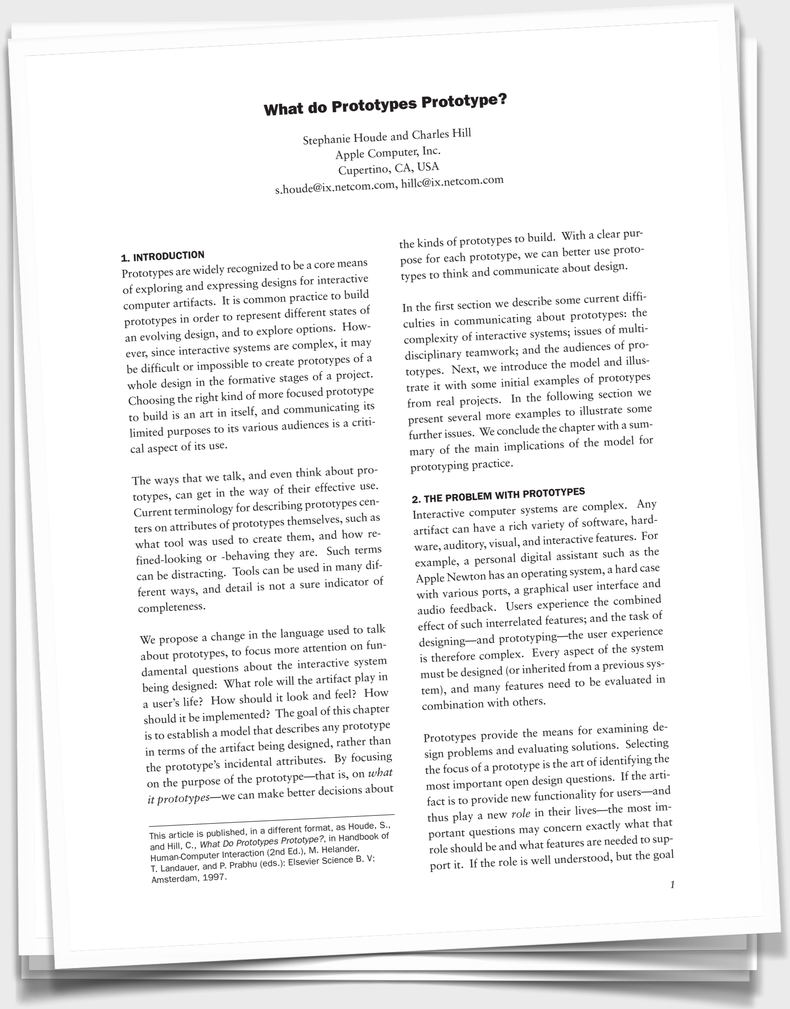

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Be clear what you are testing.

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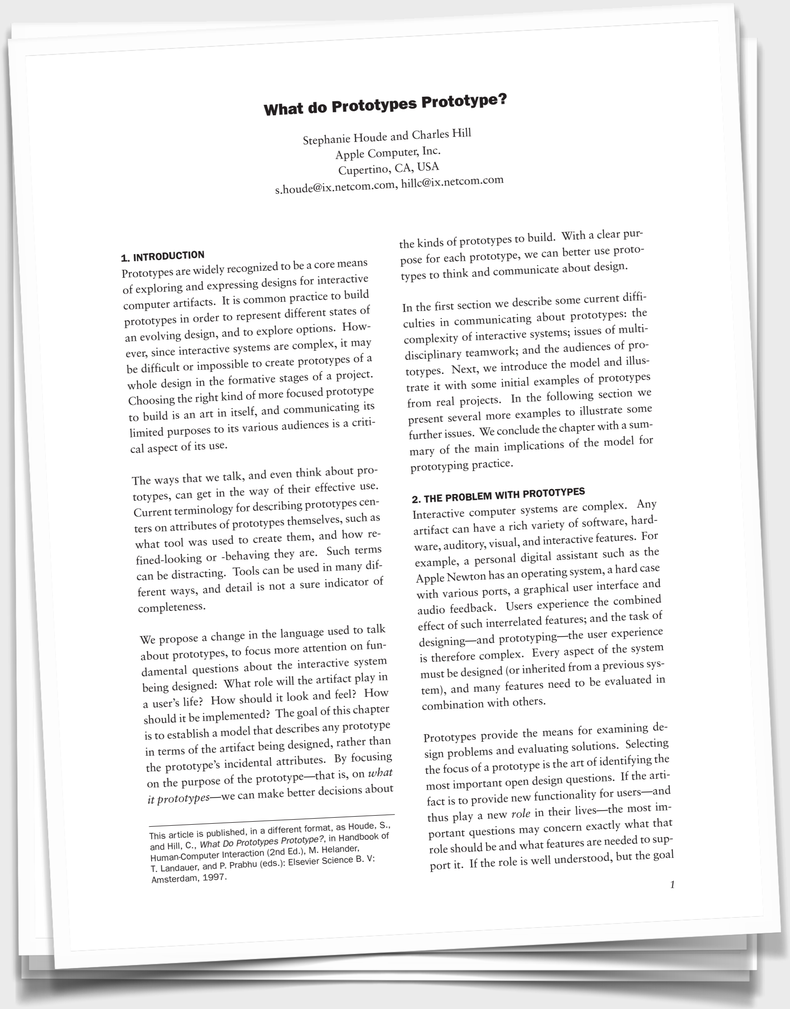

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There are different types of protos.
Make multiple prototypes.
Be clear what you are testing.
Know your audience. Prepare them.

Terminology

Prototype

Works-like-model

Looks-like-model

Appearance model

Mockup

Sketch-model

Throwaway prototype

Functional model

Wireframe

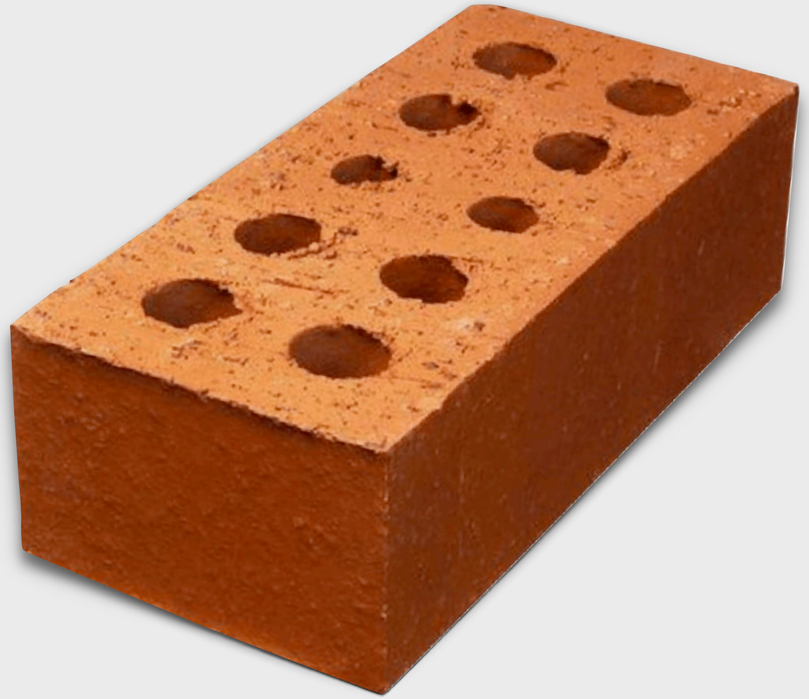
High-resolution prototype

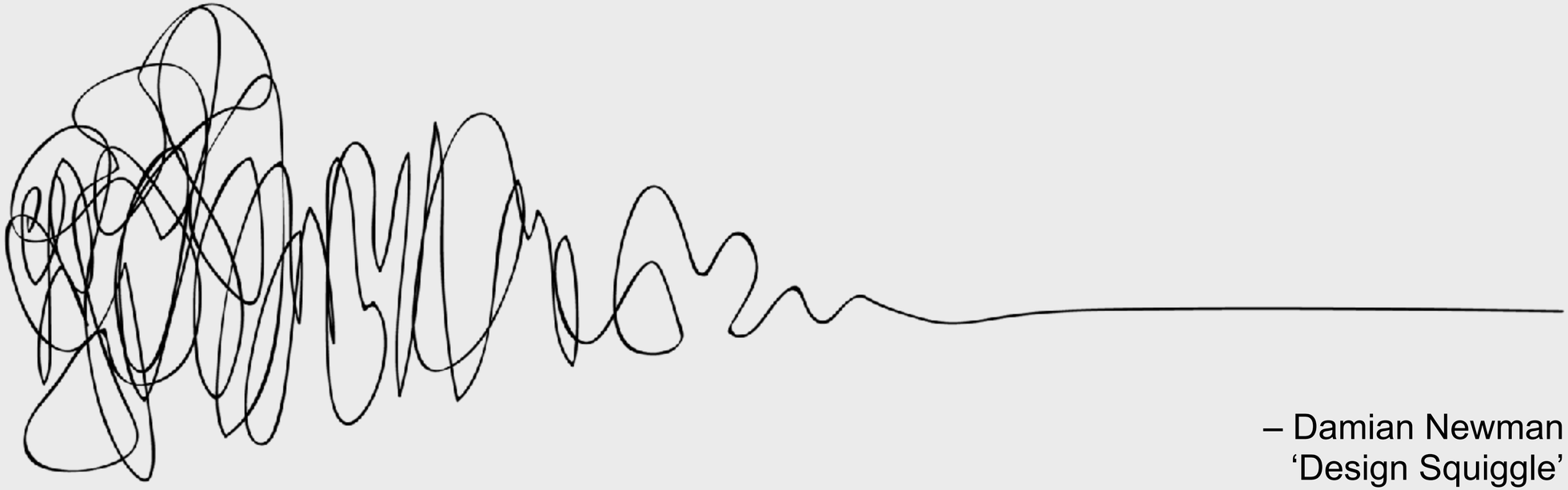
Low-resolution prototype

High-fidelity prototype

Low-fidelity prototype

Is a brick a prototype?





– Damian Newman
‘Design Squiggle’

IDEO prototype of medical device

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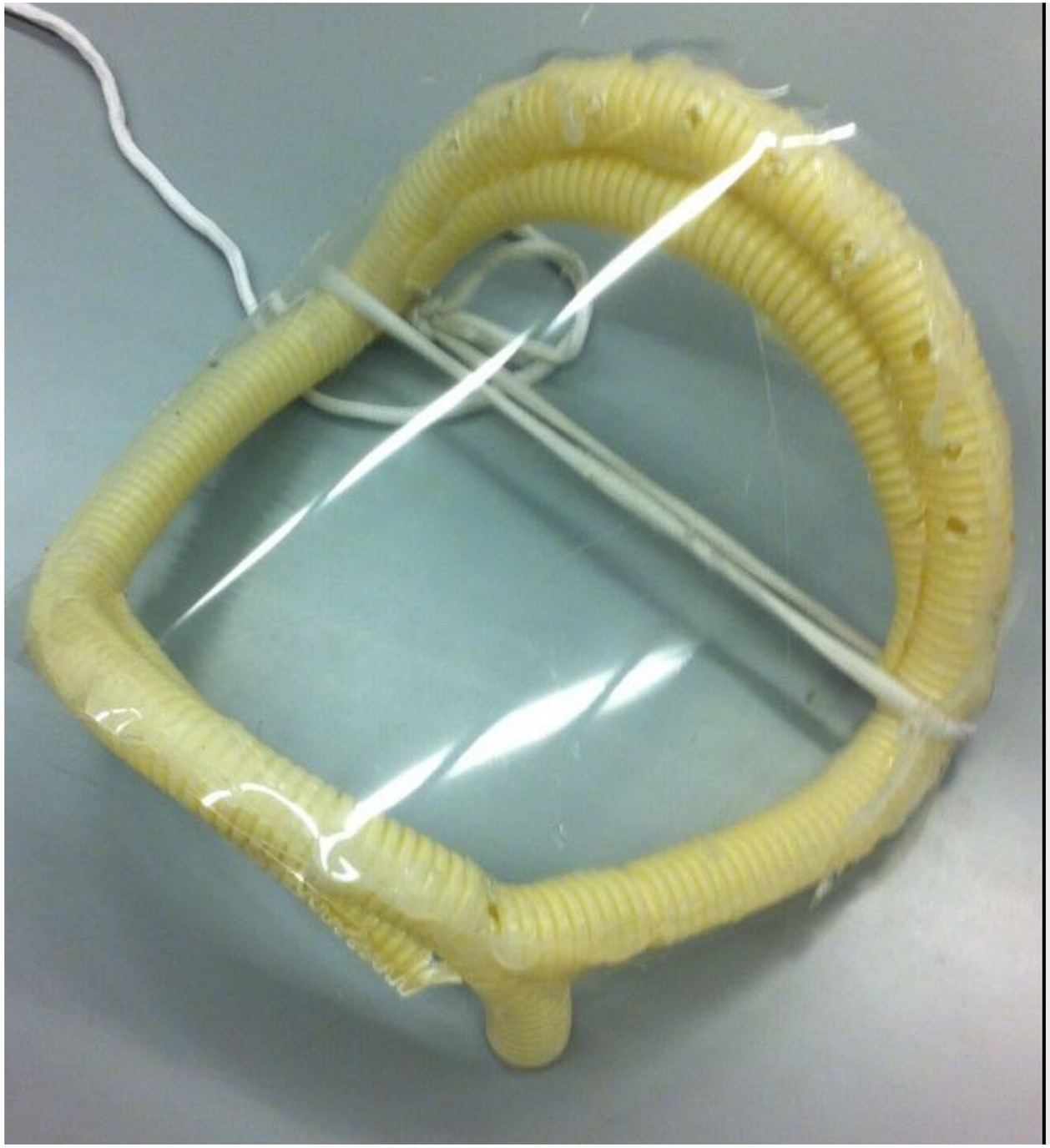
aivan



Throwaway

Quick experiment
Learn
Next version

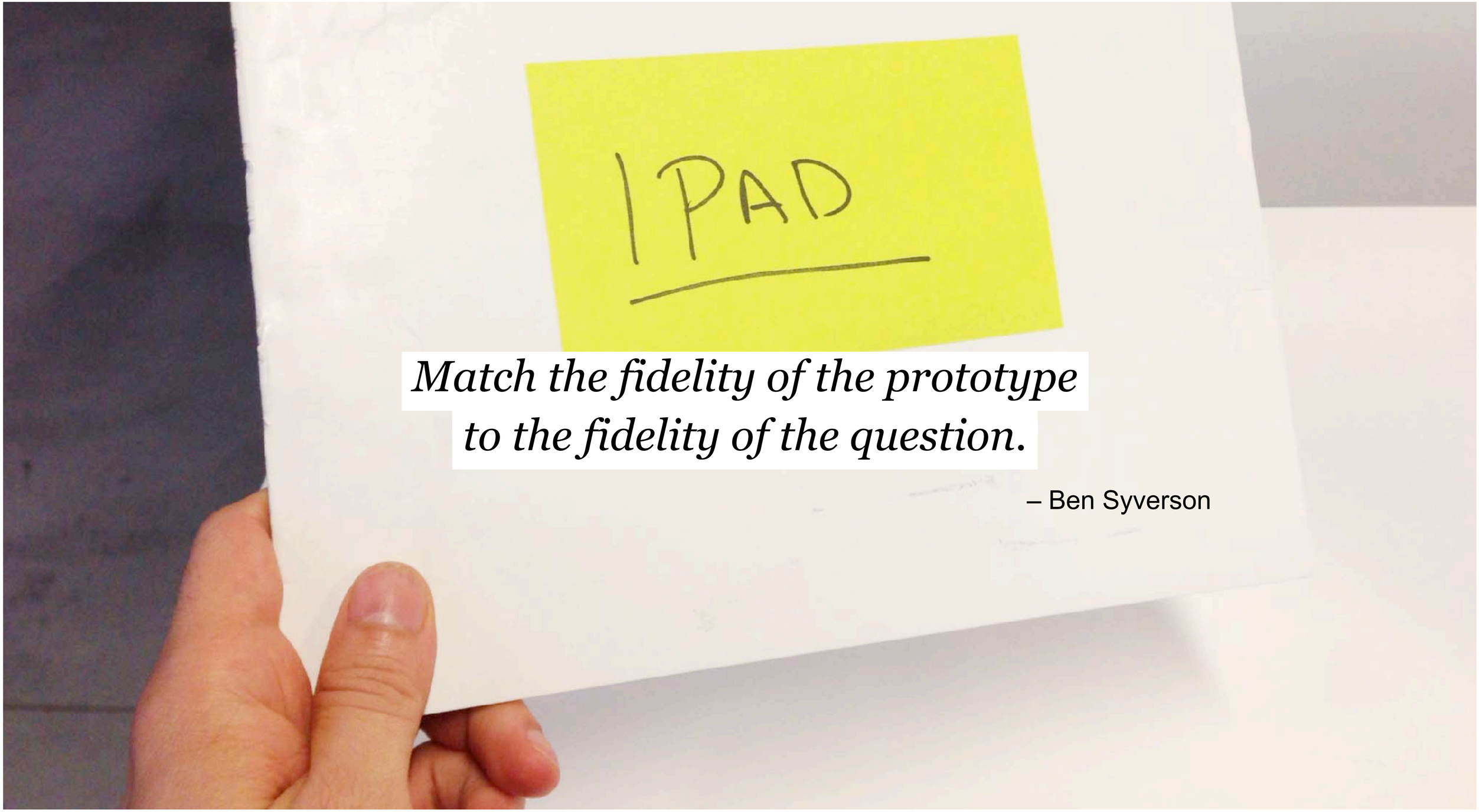
Teppo Vienamo


Aalto University
m3design


Aalto University
Cone Health


WOW
North Shore News


Aalto University
ZGF



Match the fidelity of the prototype to the fidelity of the question.

– Ben Syverson

Mockup

Preliminary design
Critical issues more obvious
Fast & cheap (Throwaway)
Possible inaccurate & brittle
Foamcore, styrofoam, wood…

Mockup

HELSINGIN SANOMAT Uutiset Lehdet Tilaa

Etusivu HS Ytimessä HS Visio News in Russian Uusimmat Politiikka Kau

Kaupunki | Junaliikenne

VR rakensi uusien lähijunien testivaunun Helsingin rautatie-asemalle

Oikeaa junavaunua muistuttavan testivaunun avulla VR kerää palautetta eri junan käyttäjäryhmiltä.

Kesäkuussa VR järjesti testipäivät, jolloin senioriryhmä kävi vierailemassa vanerista rakennetussa testivaunussa. KUVA: ELINA VUOKSENMAA / VR

Rosa Lehtokari HS

9.8. 18:57

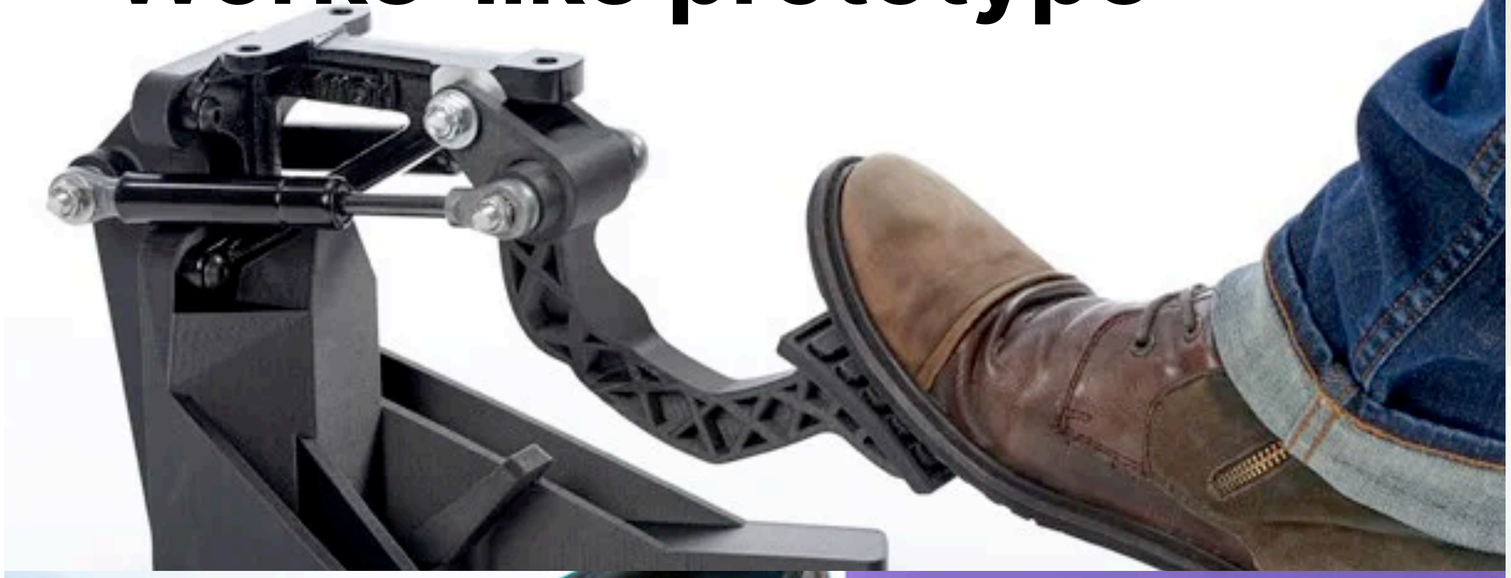
VR rakensi uusia lähiiunia muistuttavan testivaunun Helsingin

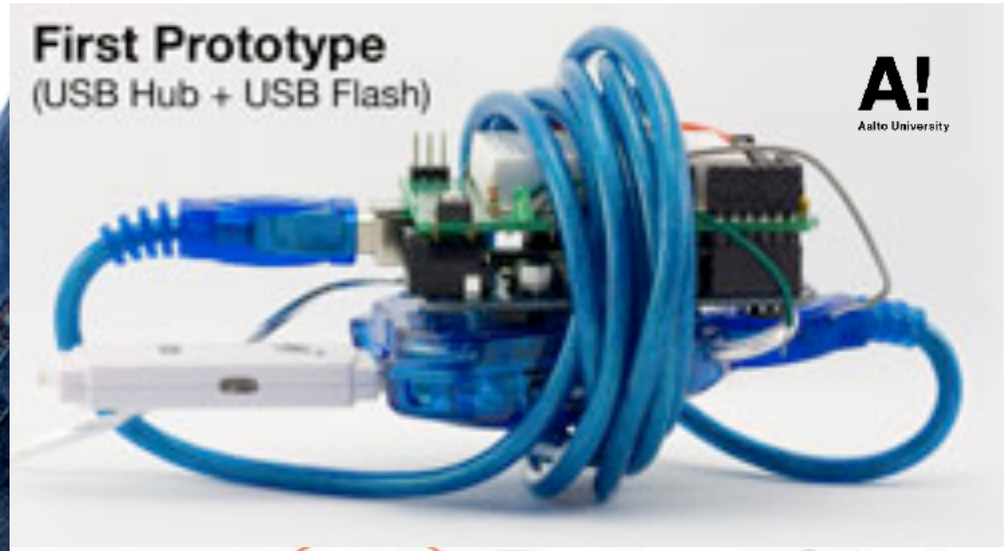
Functional

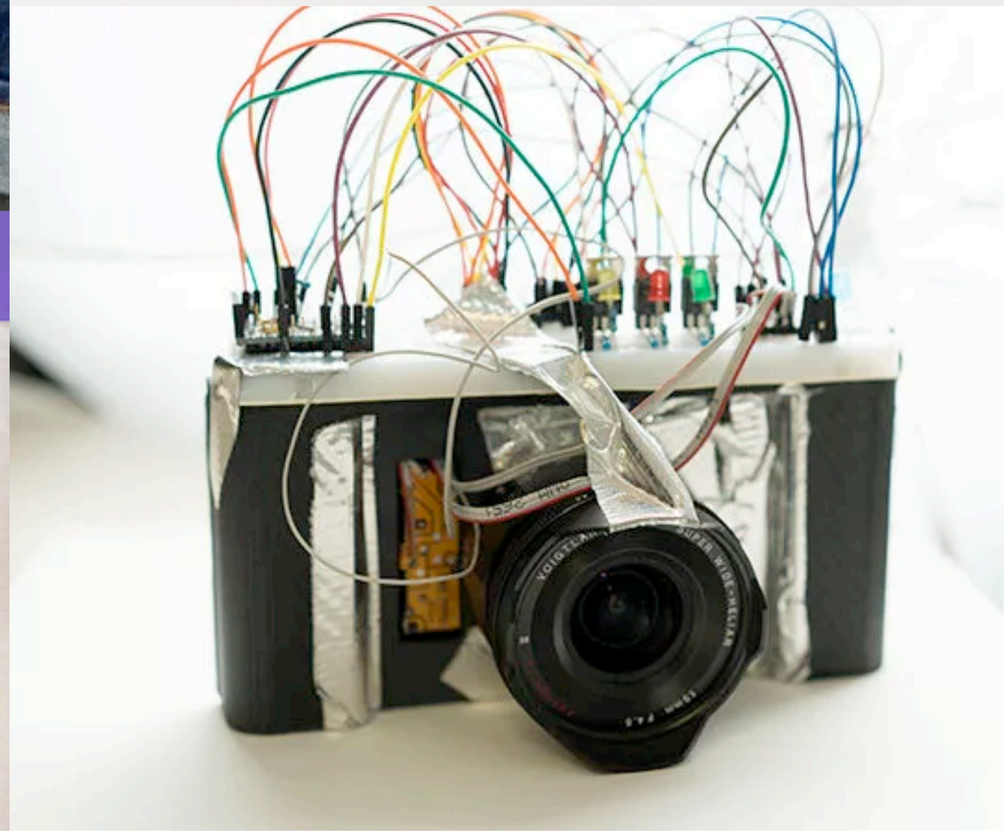
User testing
Feature testing (eg. strength)
Real materials, with proto tools

Teppo Vienamo

Works-like prototype







Finalised appearance model

Customer appeal
Commercial fairs
Brochures and photoshoots
Non-functional
Mfg:
- 3D-print finalised by hand
- machined
- silicon mould casting

Teppo Vienamo


1 Scheveningen Noord
R-NET
HTM | kom verder!
STADLER
HTM
METROPOOLREGIO
ROTTERDAM DEN HAAG


6A
Reizen met de zekerheid van R-NET
door HTM


← Vredespaleis
5A

Common materials and methods

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Additional models

In-class work

Overview of common materials

Foams

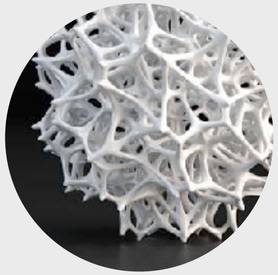
Foamcore & cardboard

Polyurethane blocks

Metals

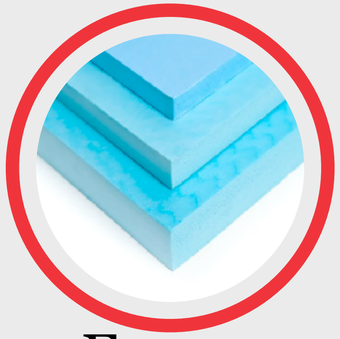
Plastics

Wood



Additive mfg.

Overview of common materials



Foams

Foamcore & cardboard

Polyurethane blocks

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Plastics

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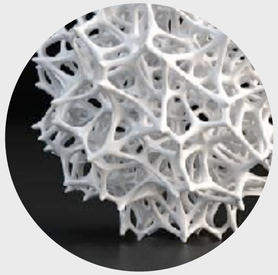


Additive mfg.

Polyurethane blocks

Special material made for model making

Wide selection
Soft grades for hand tools
Denser & tougher grades for machining
Heat resistant
Hard grades for tooling

Can be shaped by hand or machined
Do not use hot wire cutter!
Gives off toxic fumes.

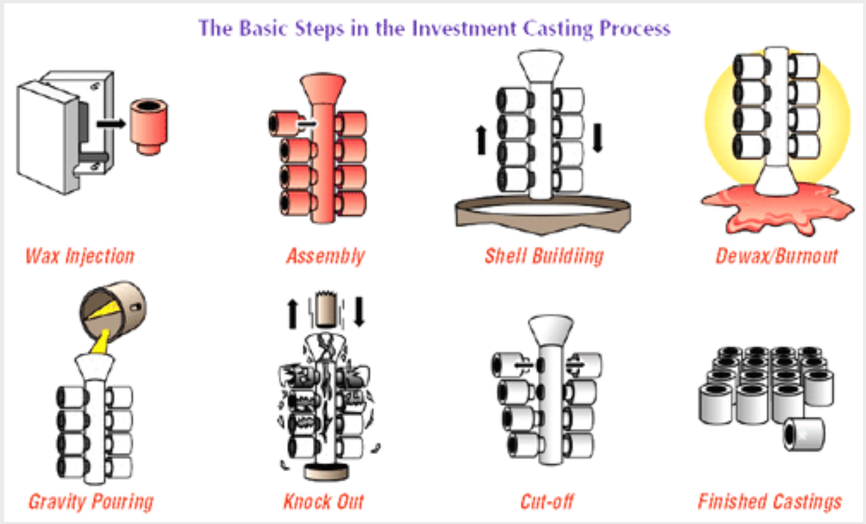
Metals

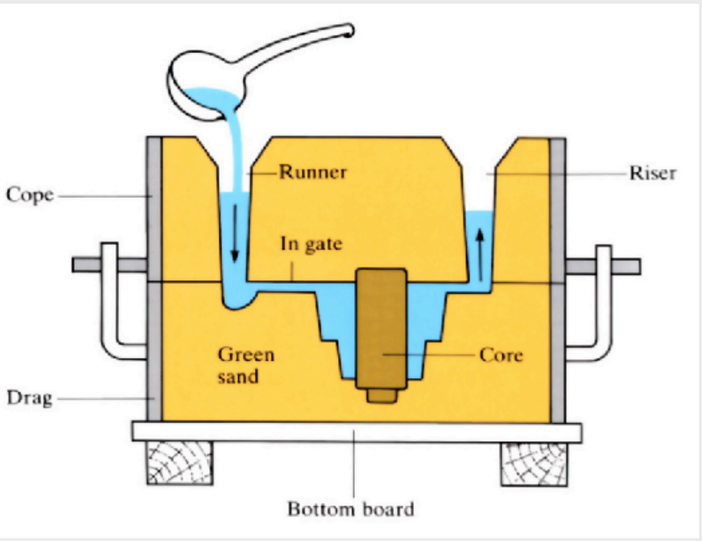
Machining
lathe, mill

Sheet metal
metal cutters, laser, water-jet

Welding
MIG, TIG, LBW

Casting
investment casting,
sand casting





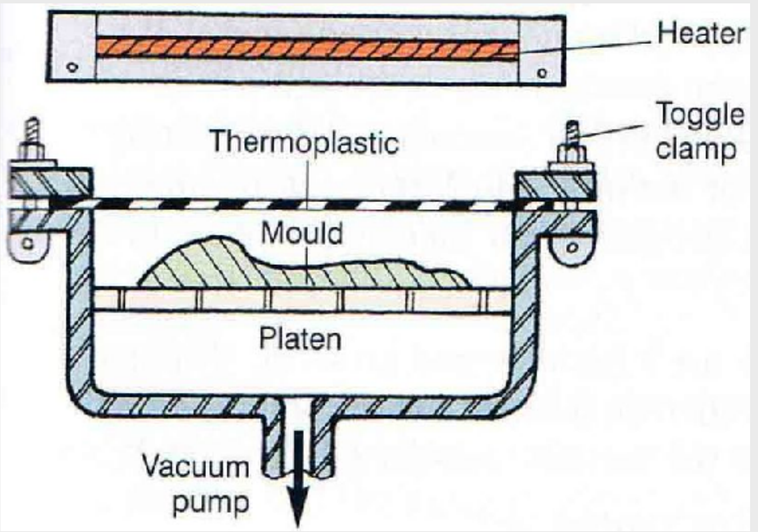
Plastics

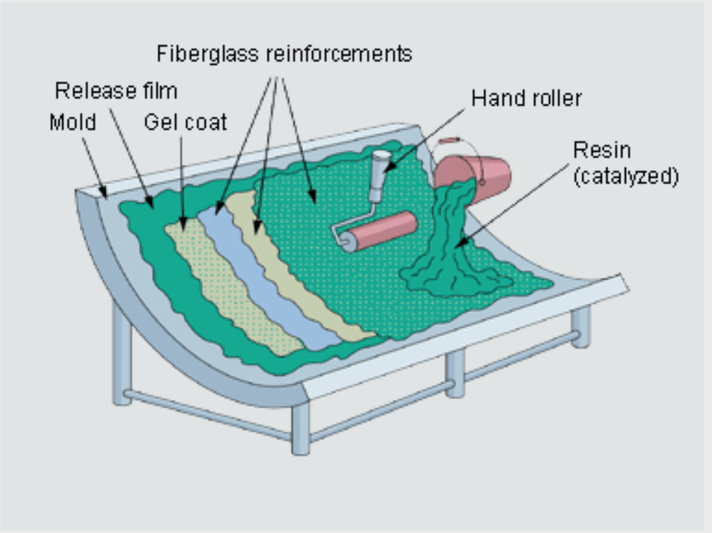
Cutting
laser, water-jet,
hand tools

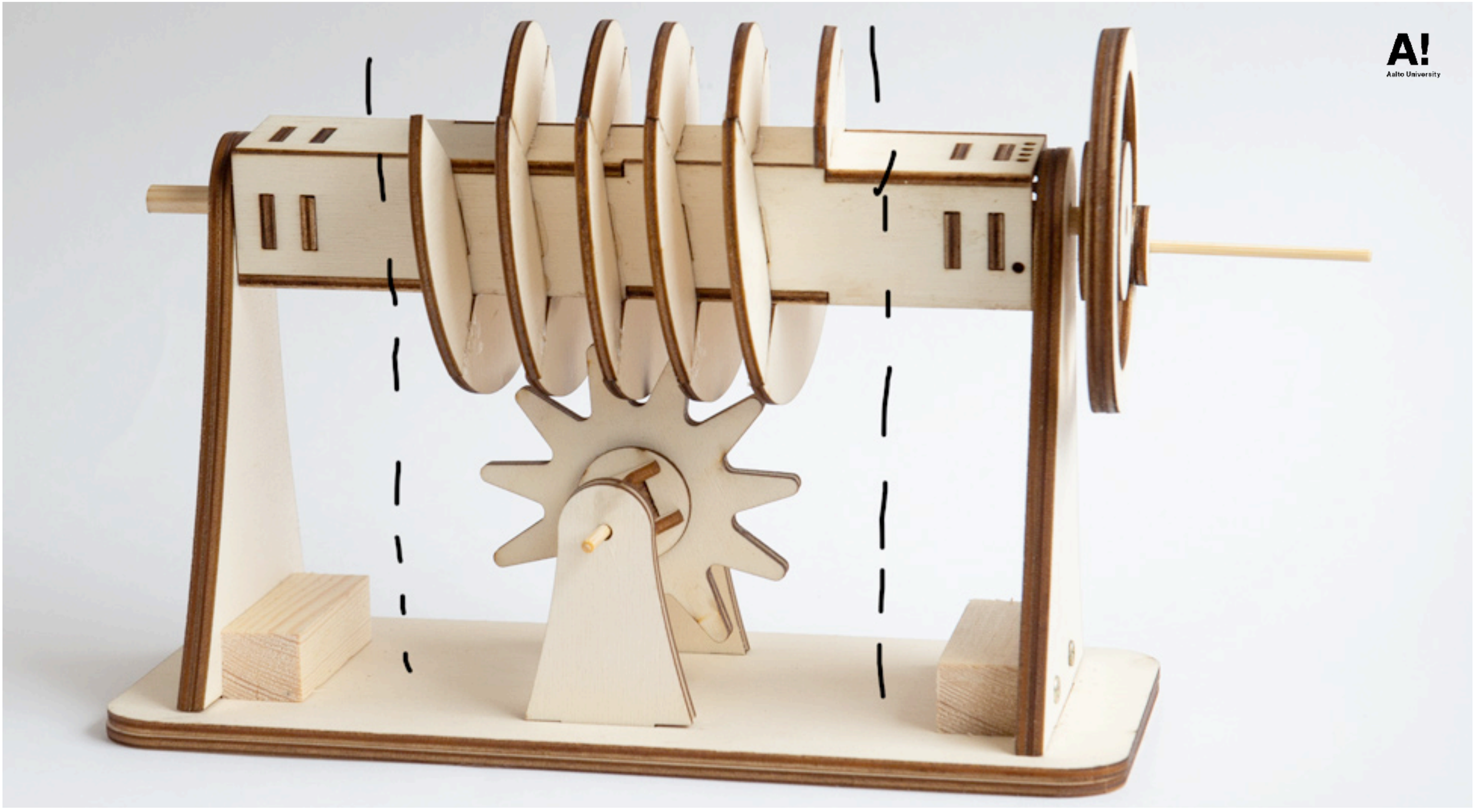
Forming
thermoforming,
vacuum forming

Casting

Laminating



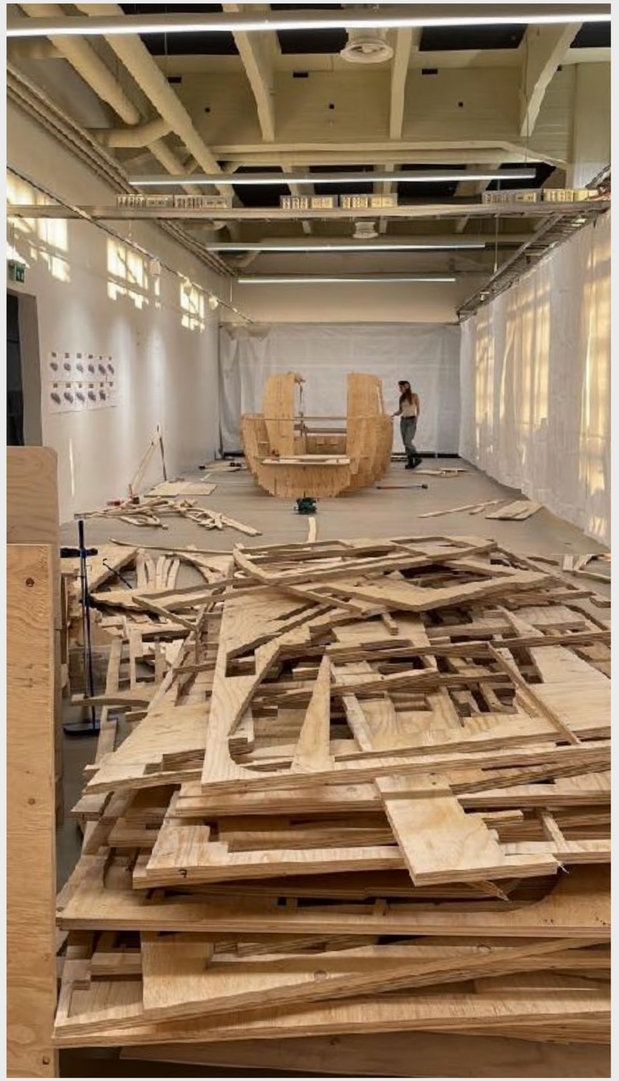




Wood

Cutting
band saw, table saw, hand saw,
CNC router, water-jet, laser cutter

Forming
sanding, chiseling, drilling,

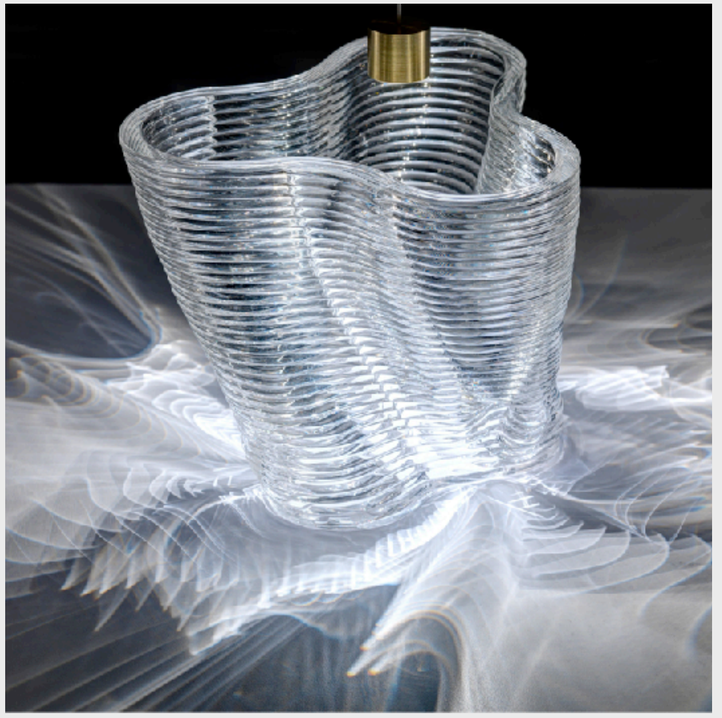


Additive manufacturing

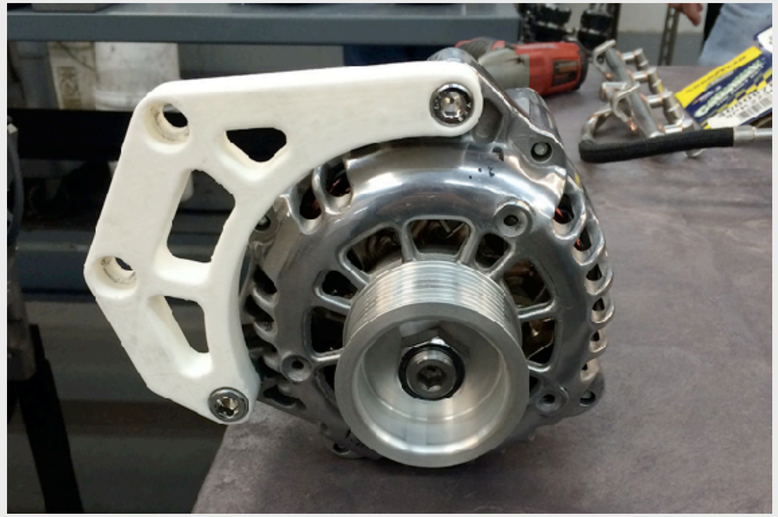
Making the model
CAD software,
slice the model,
build by layers

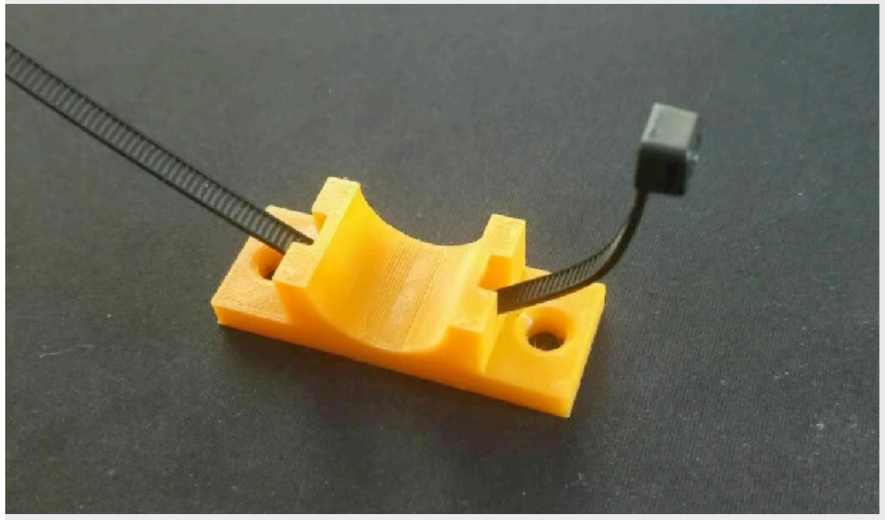
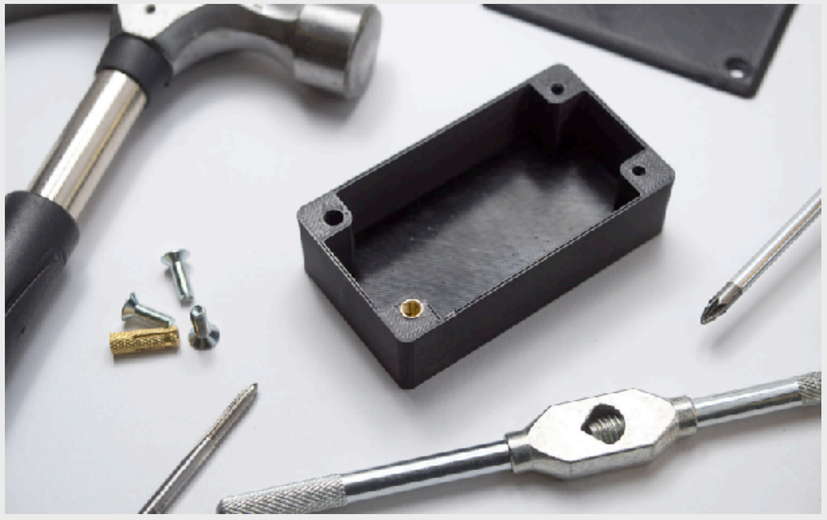
Different technologies
FDM, melted plastic extrusion
SLA, hardening by light
SLS, sintering powder by laser
material jetting, binder jetting

Different materials
many different plastics,
metals



3D-printed parts


Working with foam

Material

Cutting

Sanding

Joining

Painting

Foamed polystyrene

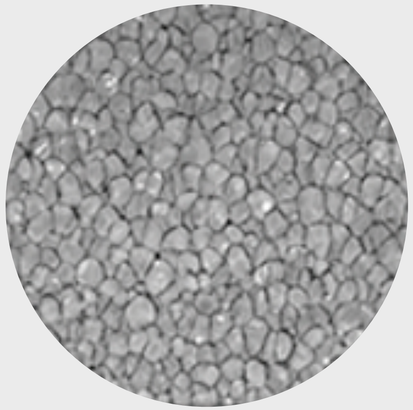
Extruded ‘foam’
(2500 mm x 600 mm x 140 mm)

Expanded ‘styrox’
(2400 mm x 1200 mm x 800 mm)

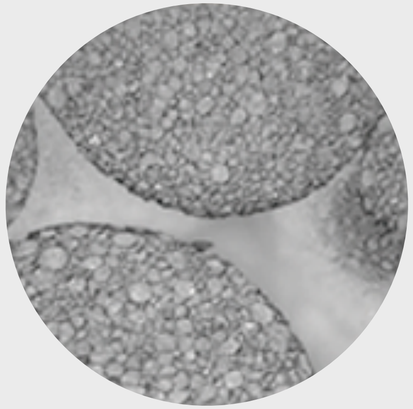
Glueing with polyurethane wood glue,
or double-sided tape

Paint with water based paint,
solvents melt foam

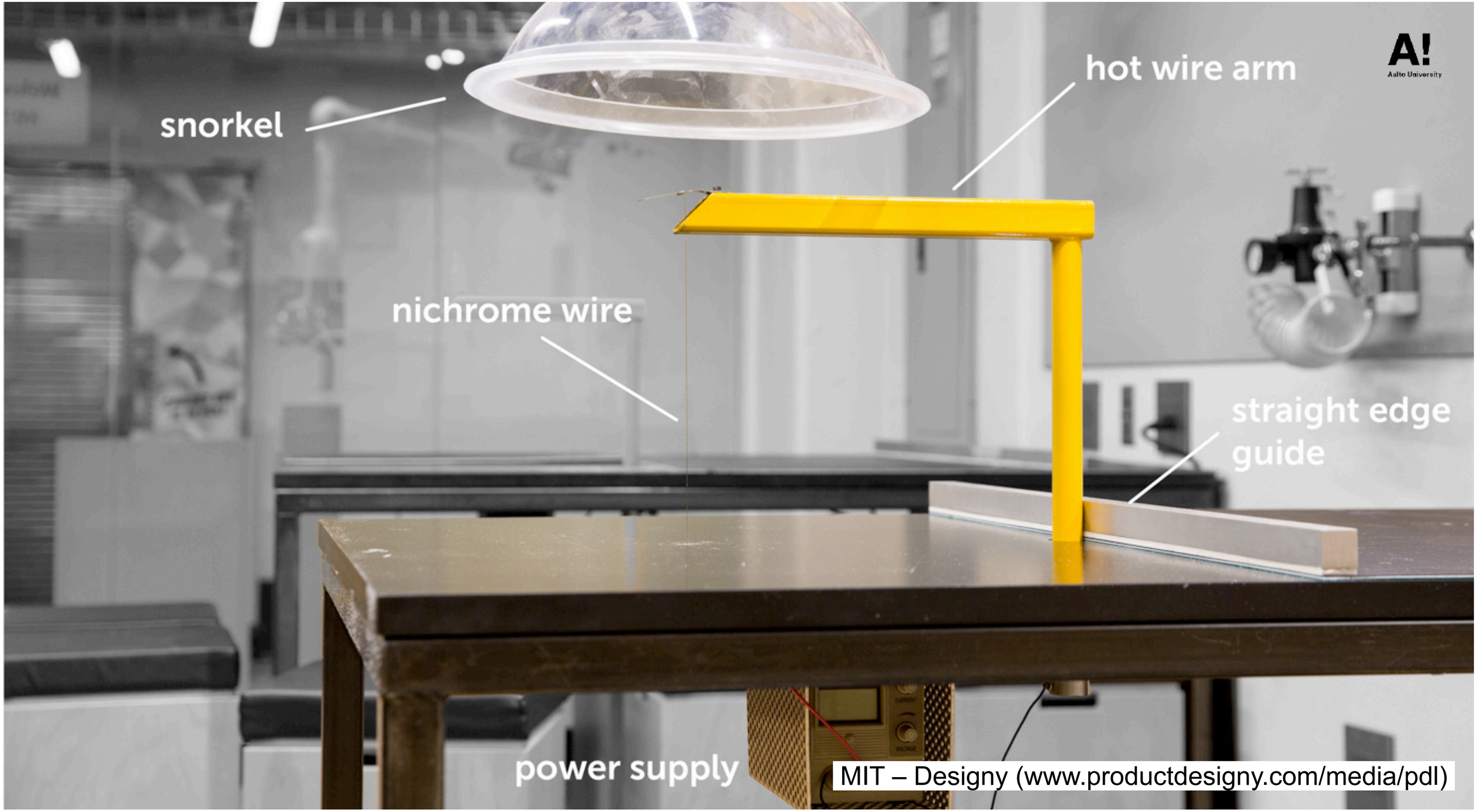
Free forms, organic shapes possible.



XPS

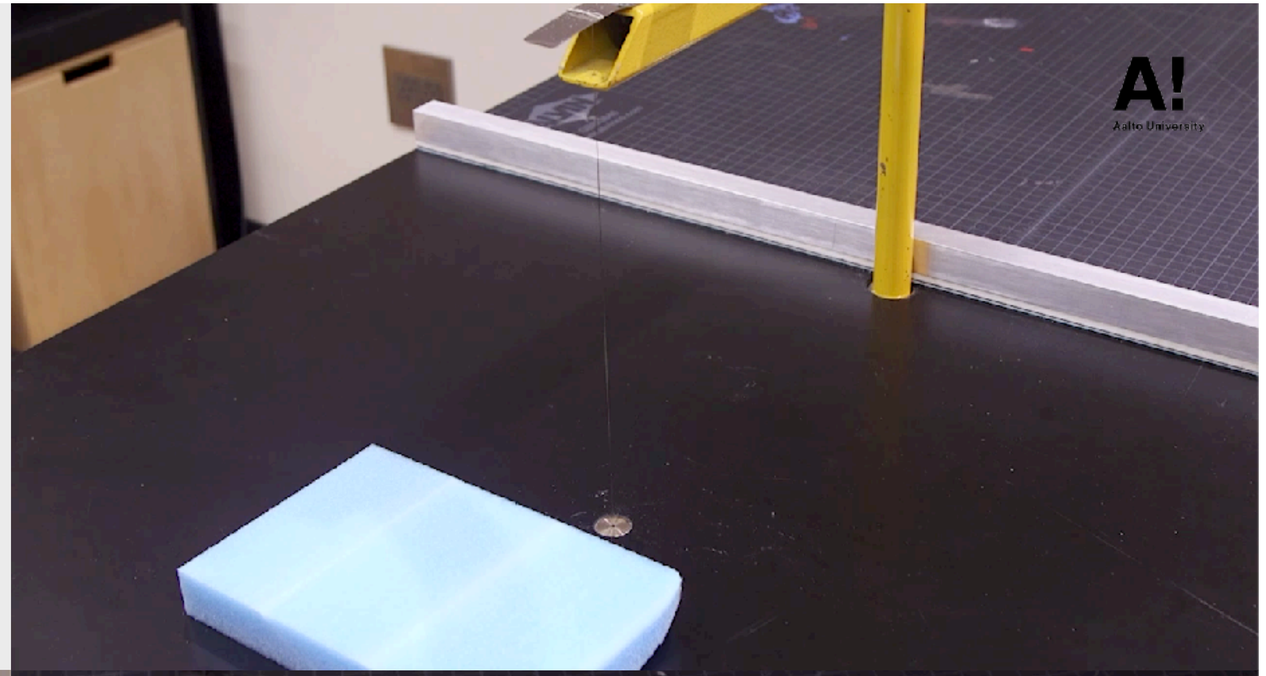


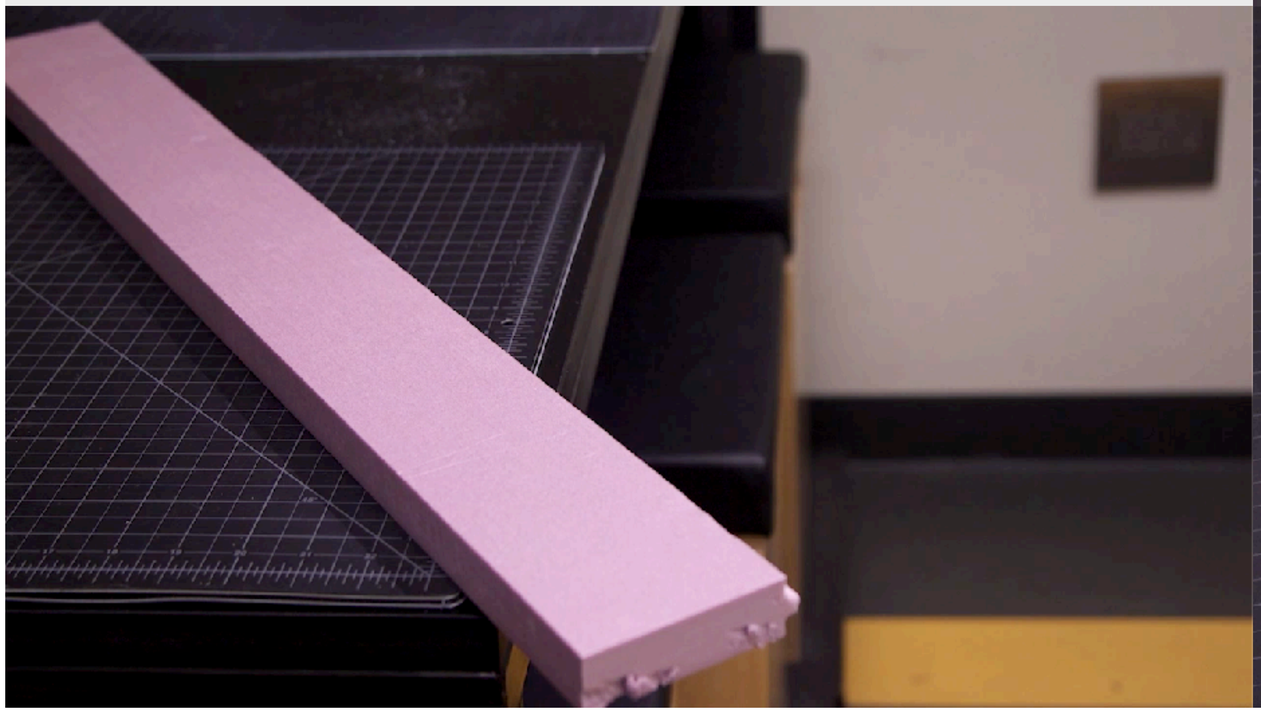
EPS


snorkel
hot wire arm
nichrome wire
straight edge guide
power supply
MIT – Designy (www.productdesigny.com/media/pdl)

Cutting

Check that wire is perpendicular
Speed too fast and wire will flex, too slow and you will melt a larger ‘hole’





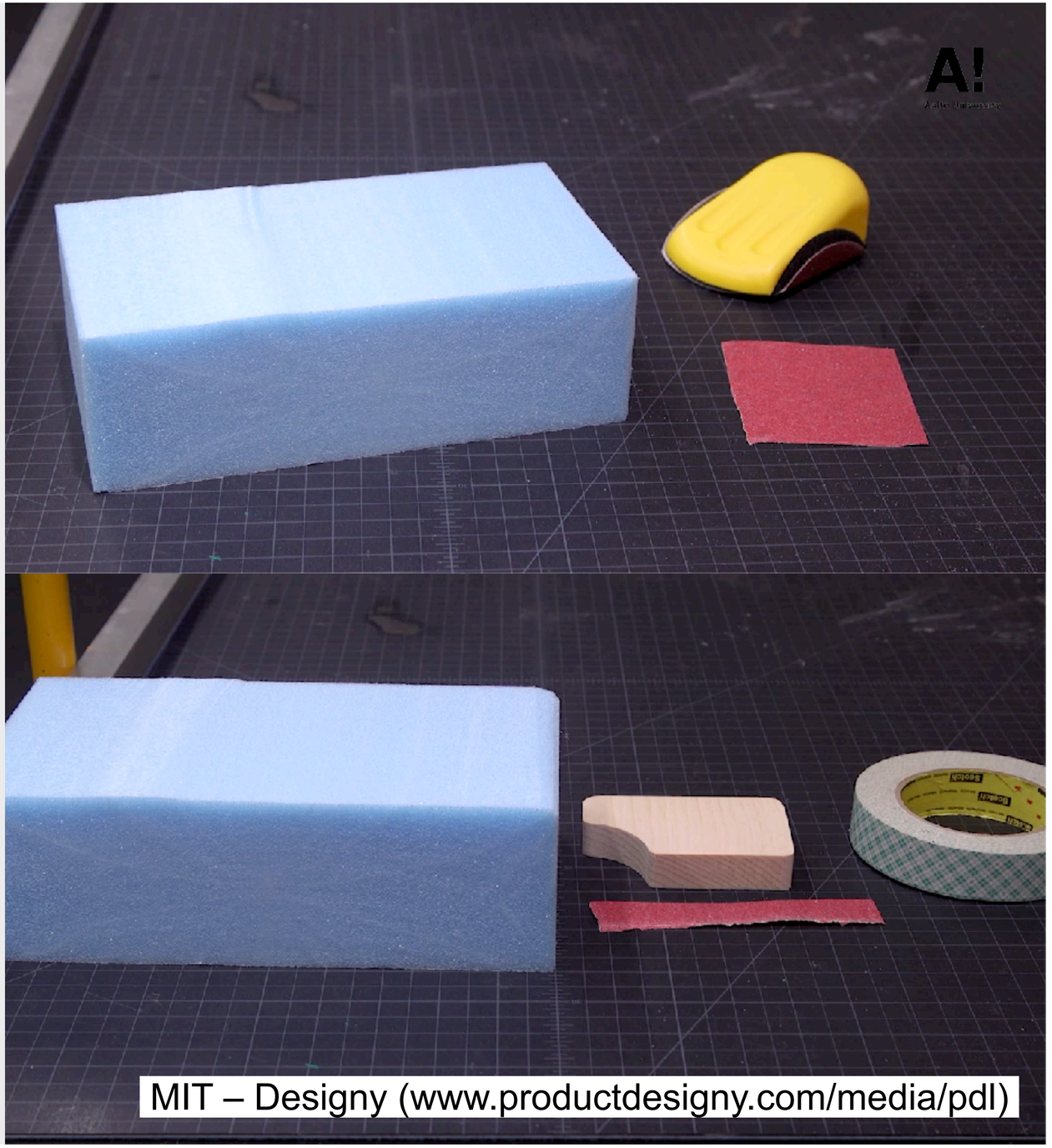
MIT – Designy (www.productdesigny.com/media/pdl)

Sanding

Use a sanding block otherwise you can easily introduce curvature from the way you are holding the sand paper.

Shaped sanding blocks can give you exactly the curvature you want.

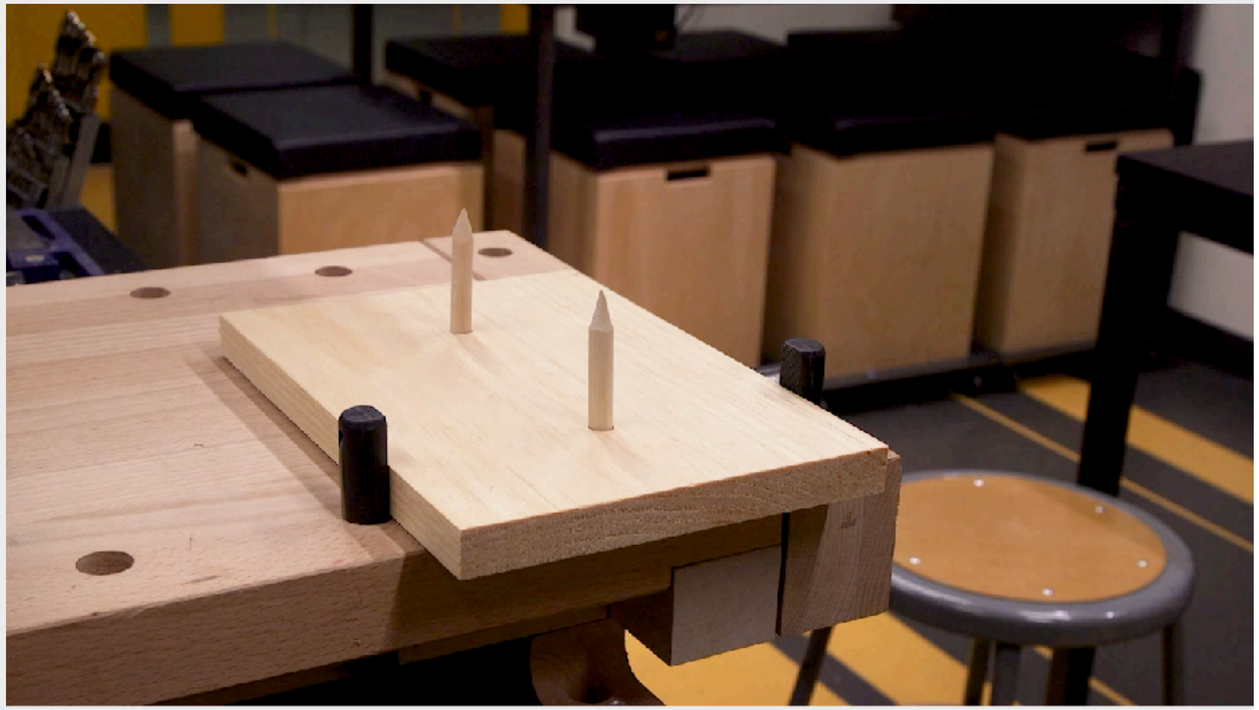
Rasps can remove a lot of material very quickly, but are not as precise.



Joining

Glue with polyurethane wood glue, double-sided tape, or spray glue such as ‘Super 77’ — if unsure, test!

Mechanical attachments are also possible, with toothpicks, or larger wooden stakes. Don’t undo/redo the attachment, the holes will get bigger every time and become loose.



MIT – Designy (www.productdesigny.com/media/pdl)

Painting

Use **water based paints** such as acrylic paint. Solvents melt polystyrene.

YouTube: OJ’s Models

Working with sheets

Material

Tools

Joining & forming

Foamcore, foamboard, kapa & (corrugated) cardboard

Paper or plastic surface

Polystyrene or polyurethane foam sandwich

Cutting
utility (‘Olfa’) knife & straight edge, laser cutter

Glueing
hot glue gun

Planar object, cylinders
‘sheet metal’ structures

Tools

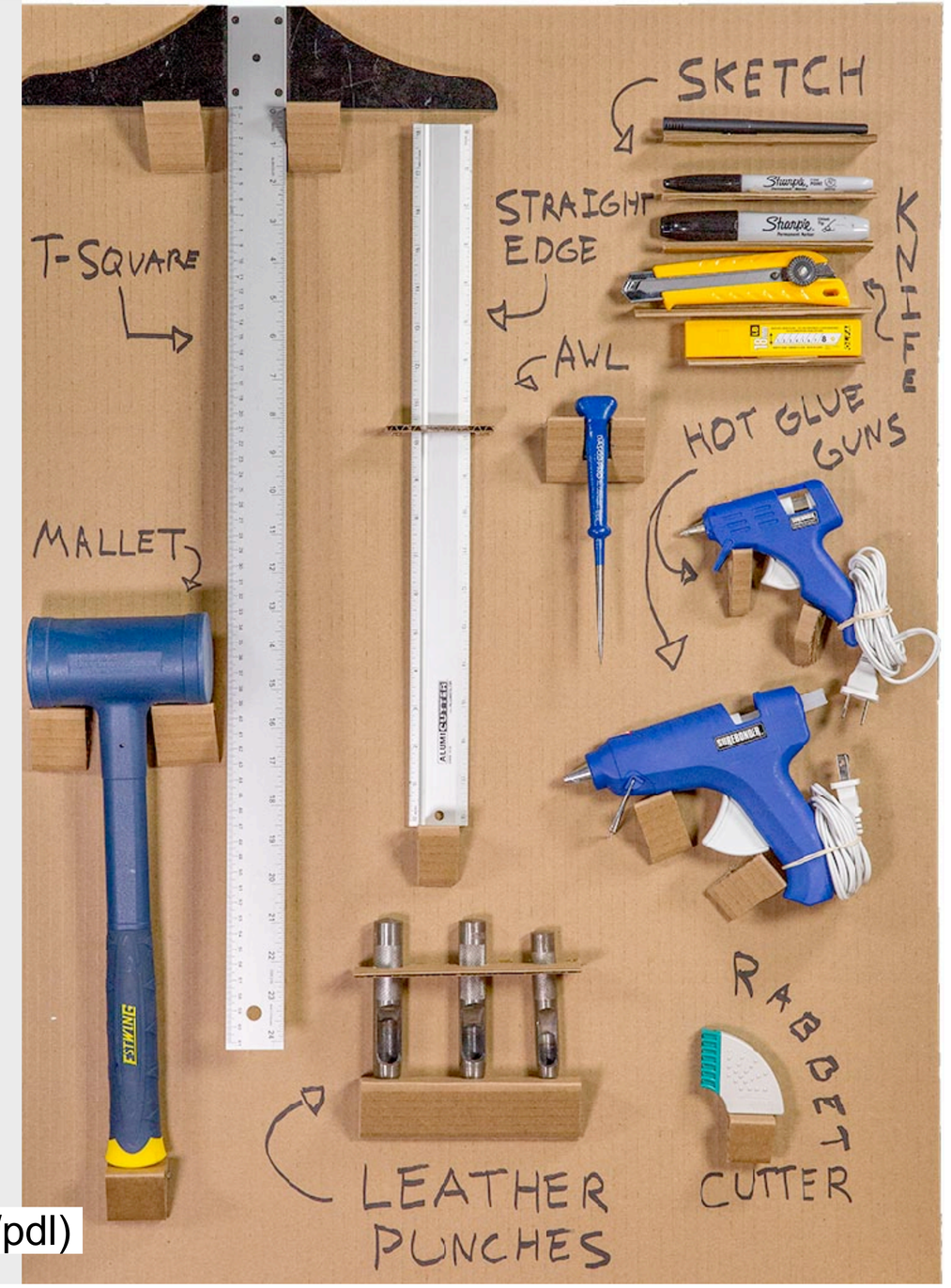
T-square & straight edge — get your angles right and cut lines straight

Awl, mallet & leather punches for making holes

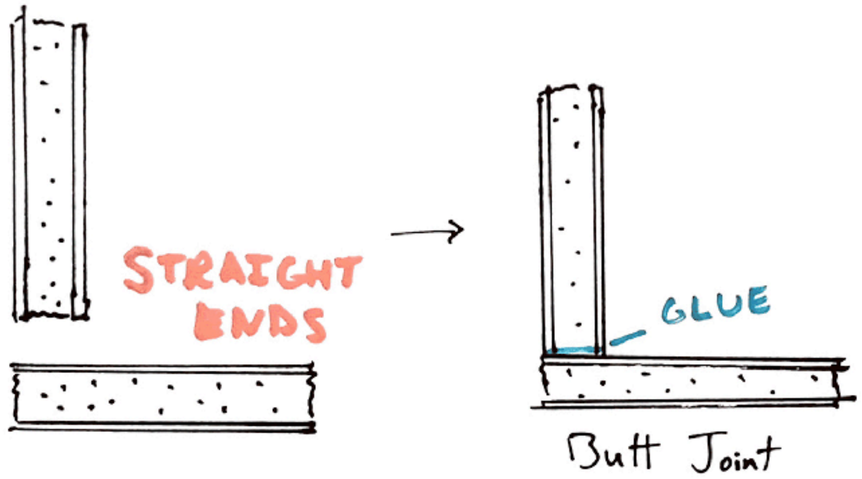
Hot glue guns set quick quickly, for more time to adjust, use traditional wood glue

Knives use a knife for a better edge — don’t use scissors, they squash the core!

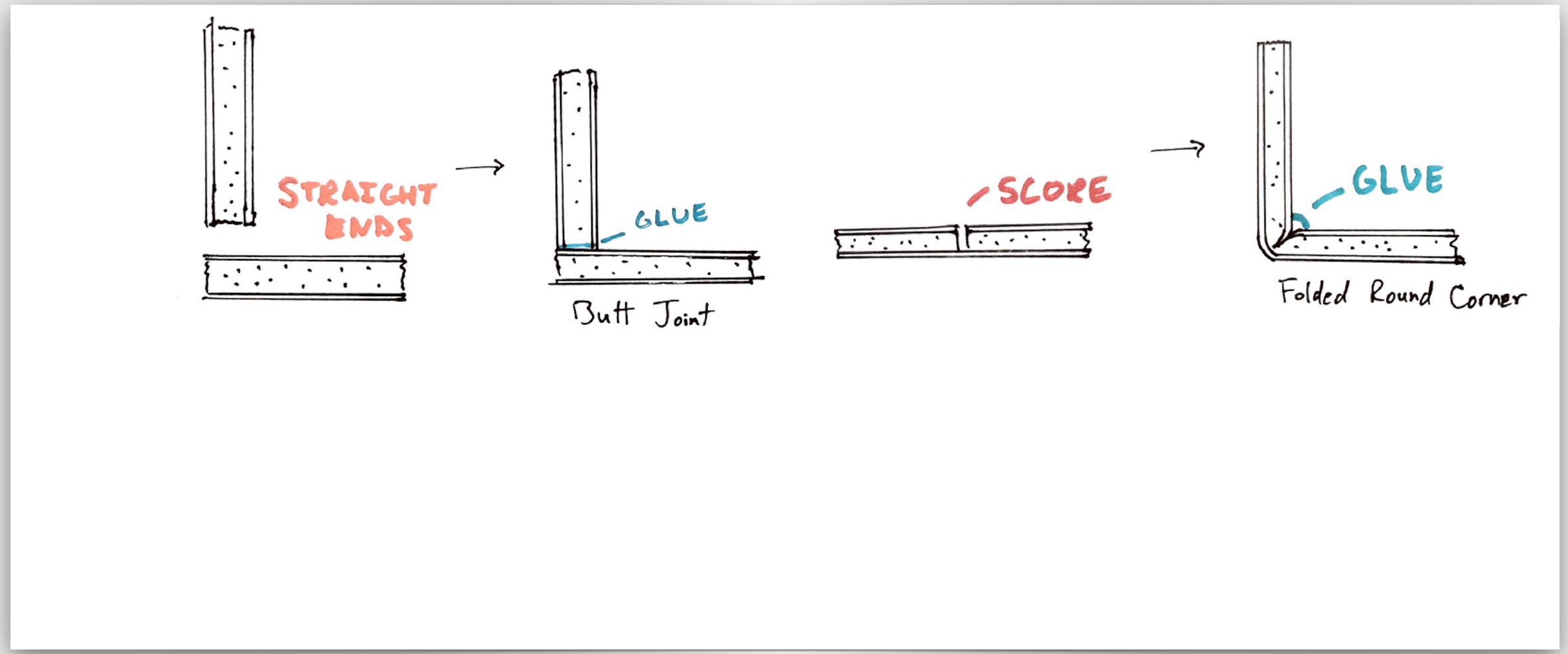
Rabbet — special tool for fancy joints



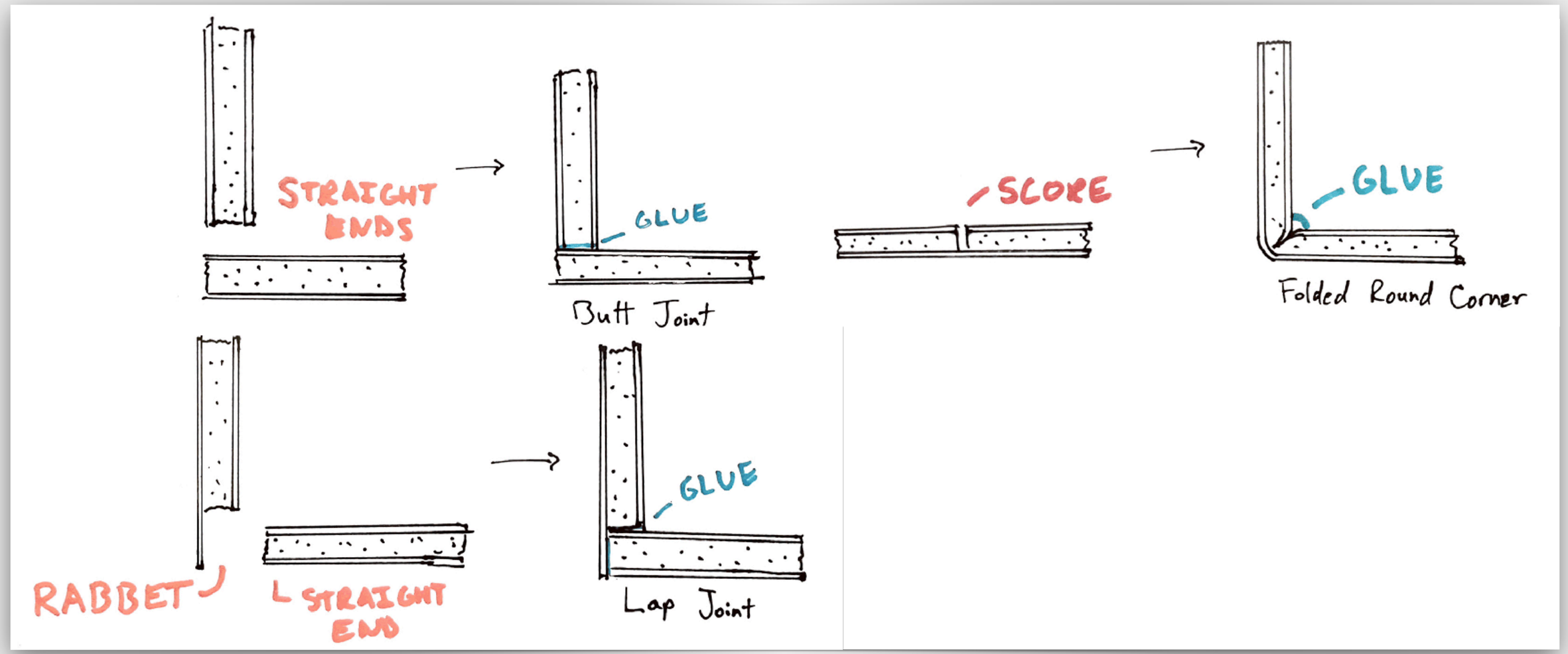
Joining & forming



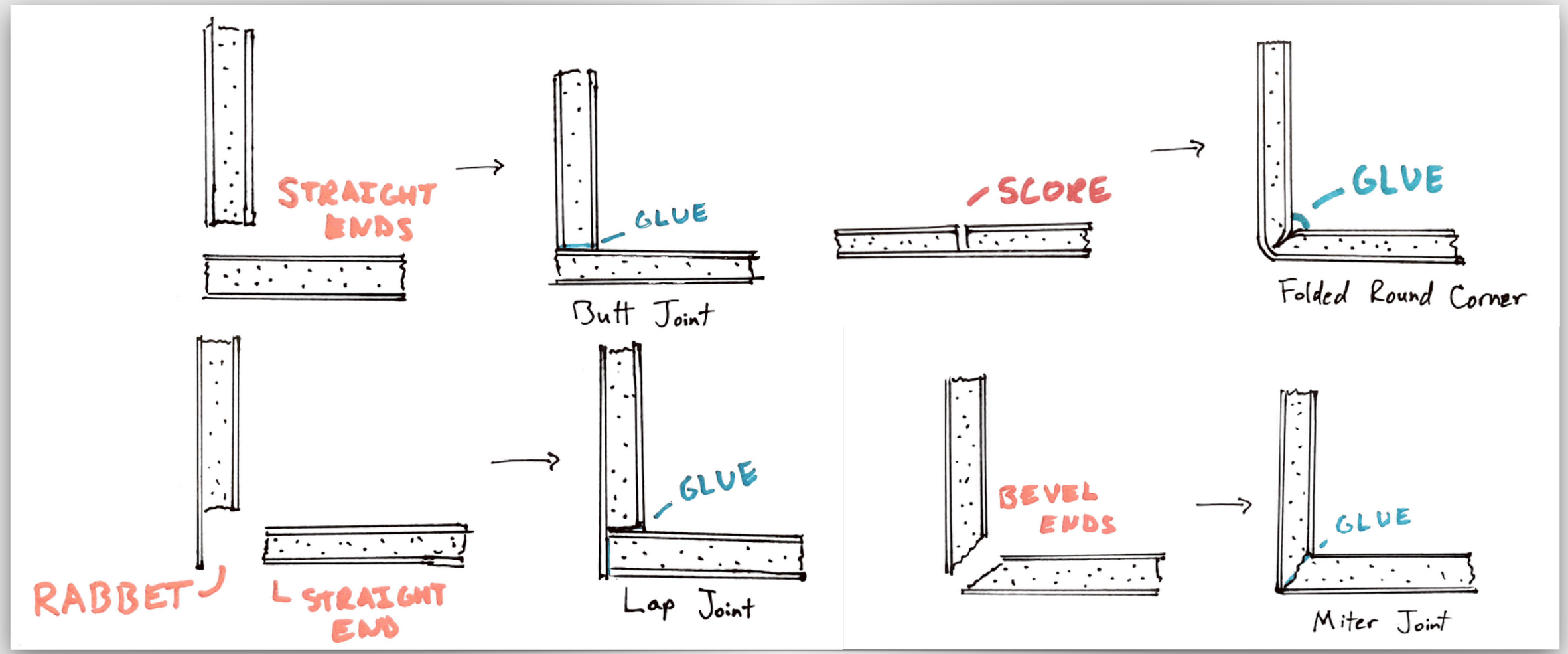
Joining & forming



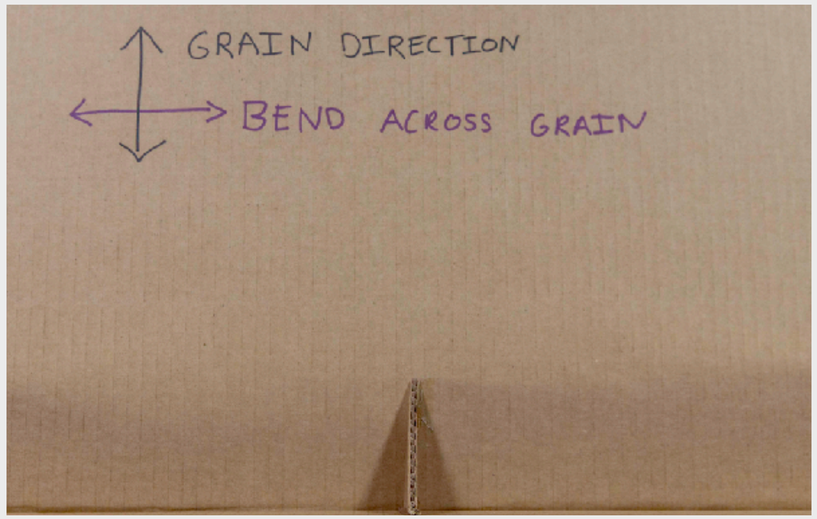
Joining & forming



Joining & forming



Joining & forming



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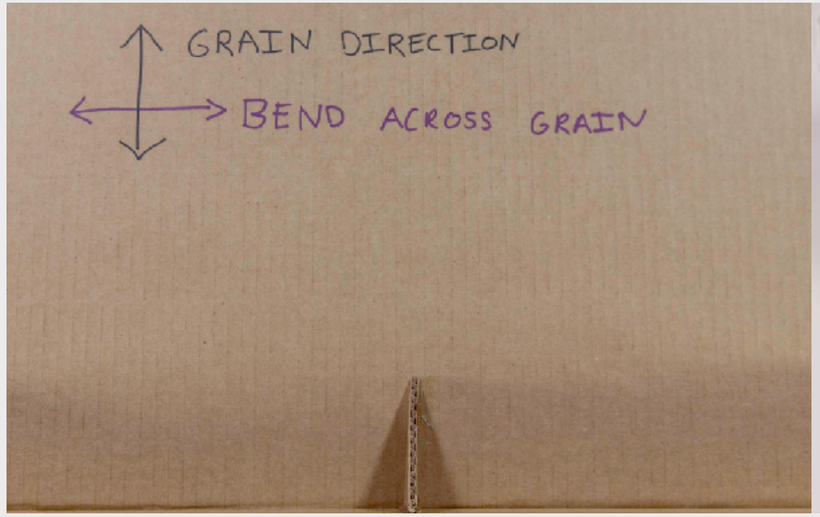
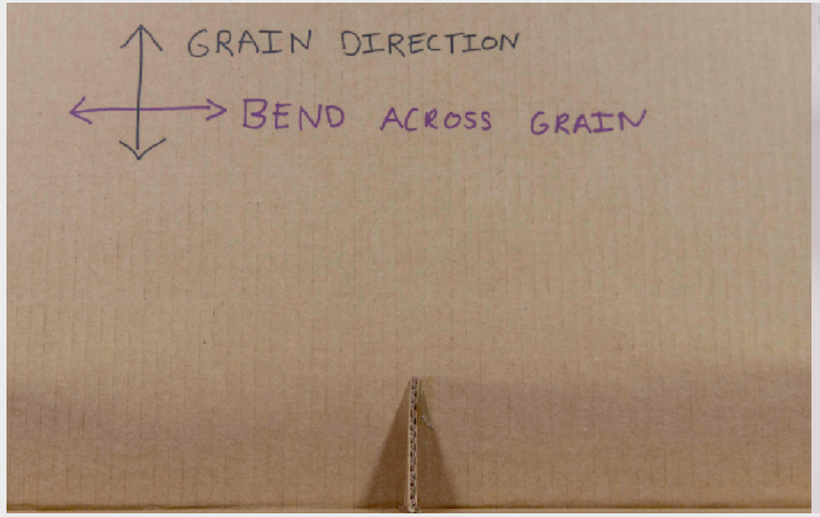
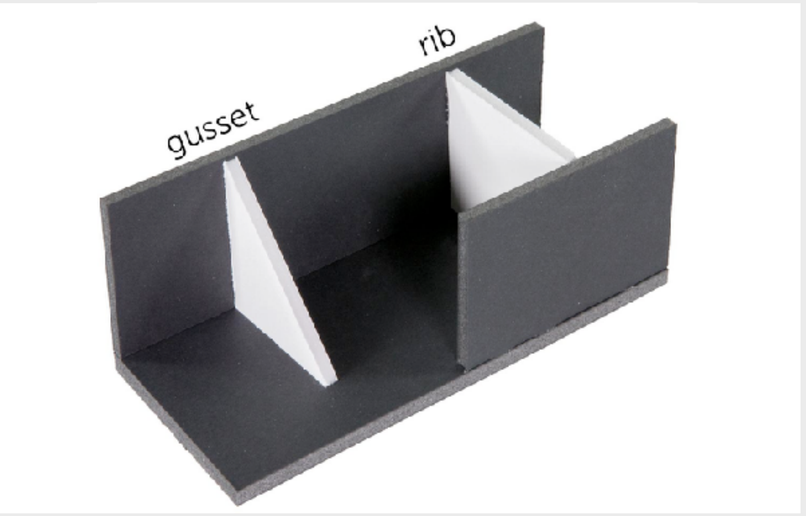


Joining & forming





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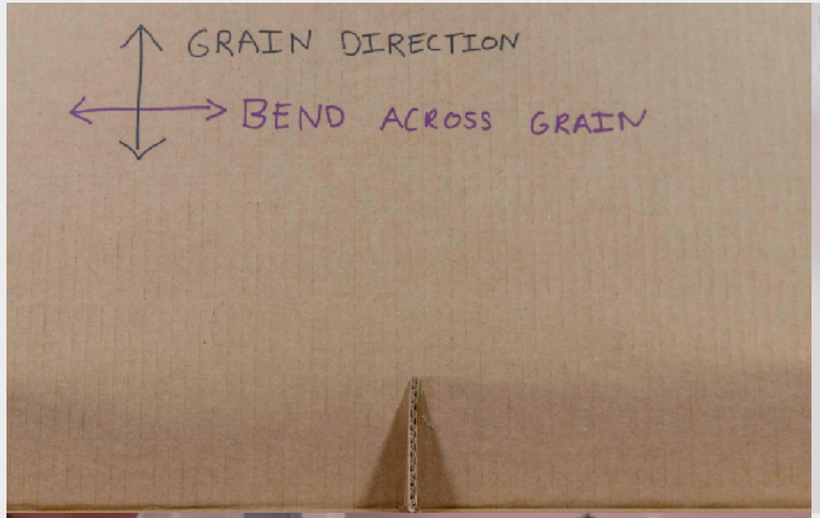
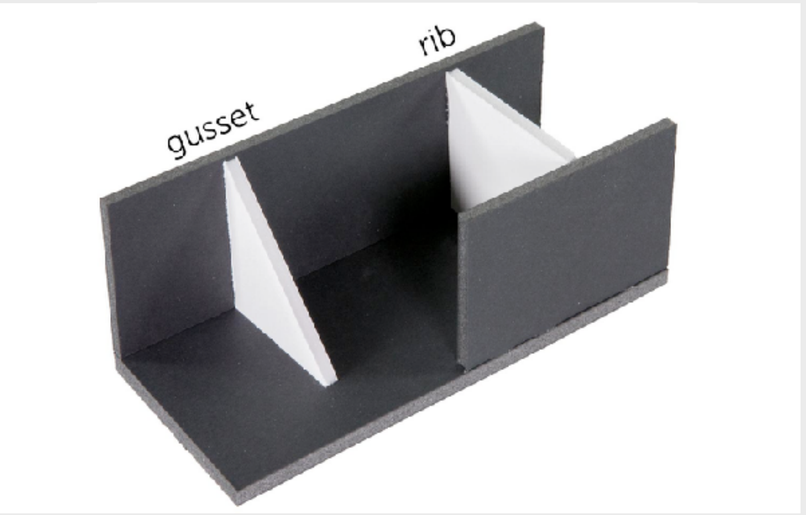
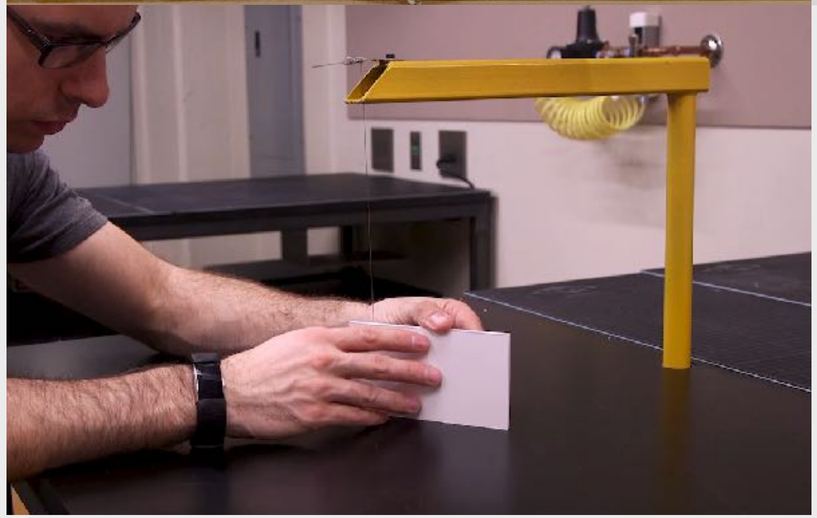
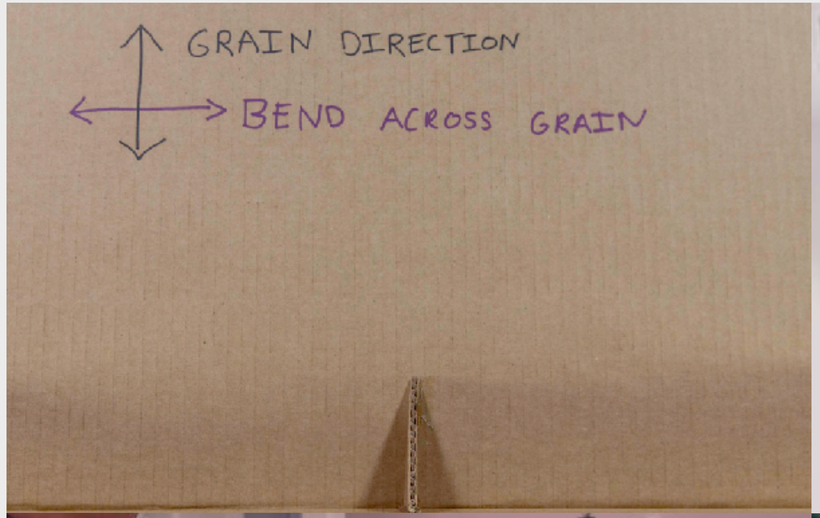
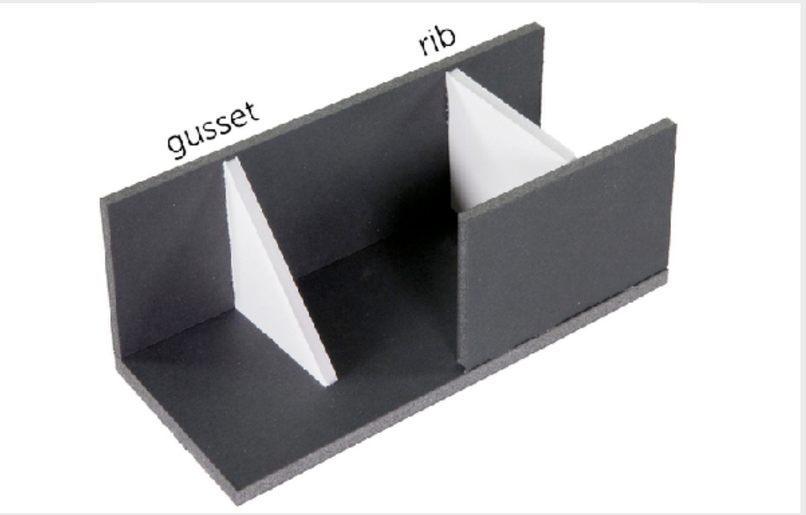


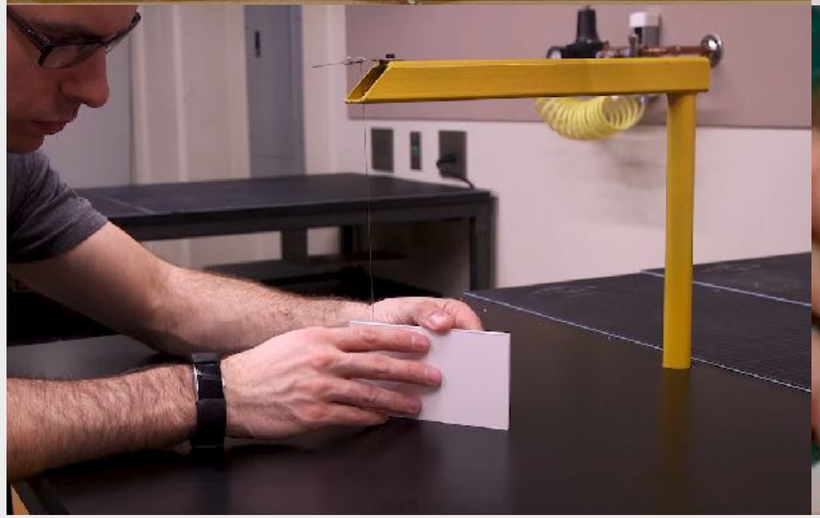




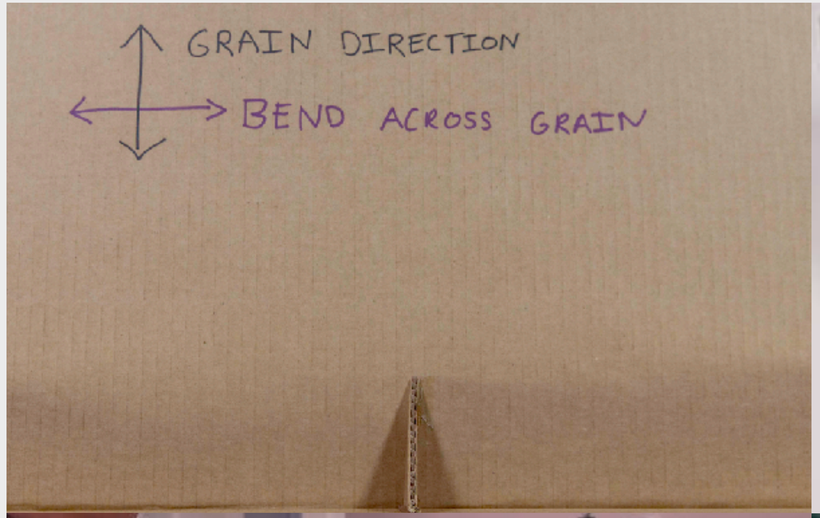
Joining & forming

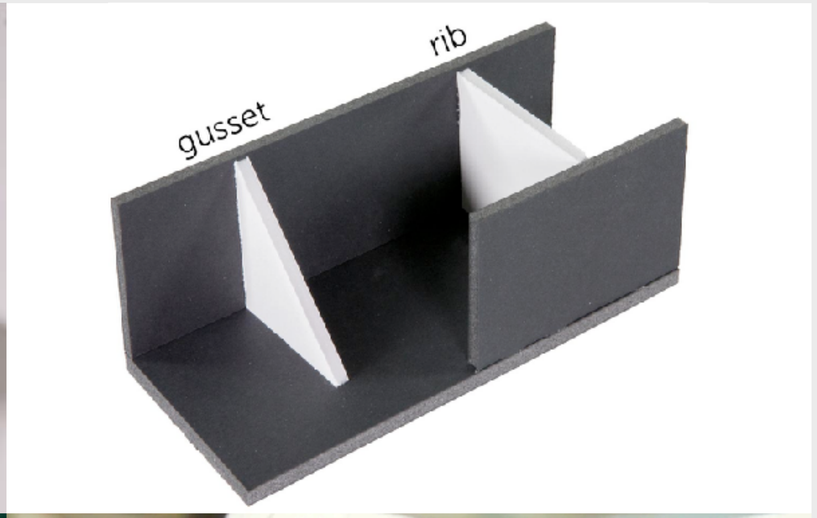


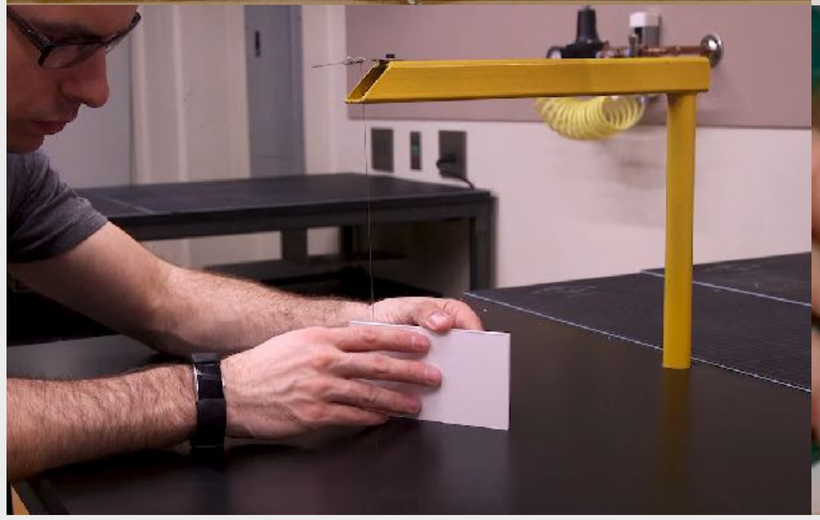


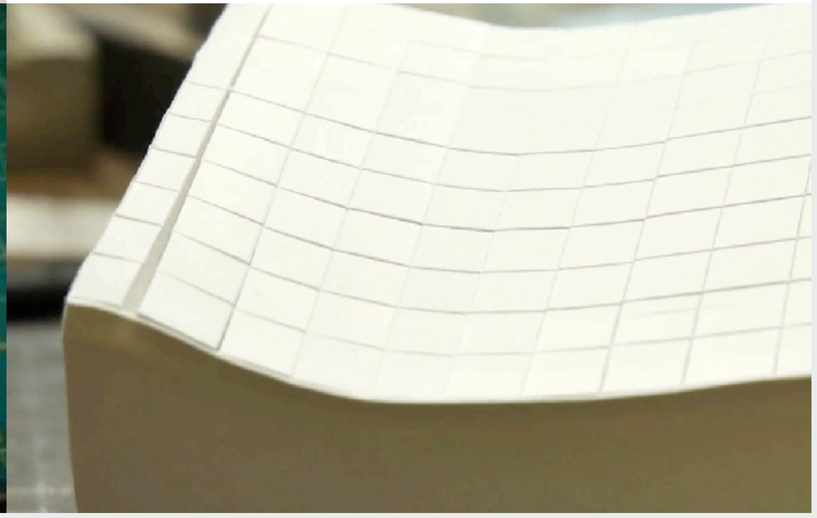


Joining & forming









Additional models

Introduction

Prototyping in industry

Common materials and methods

Additional models

In-class work

Additional models

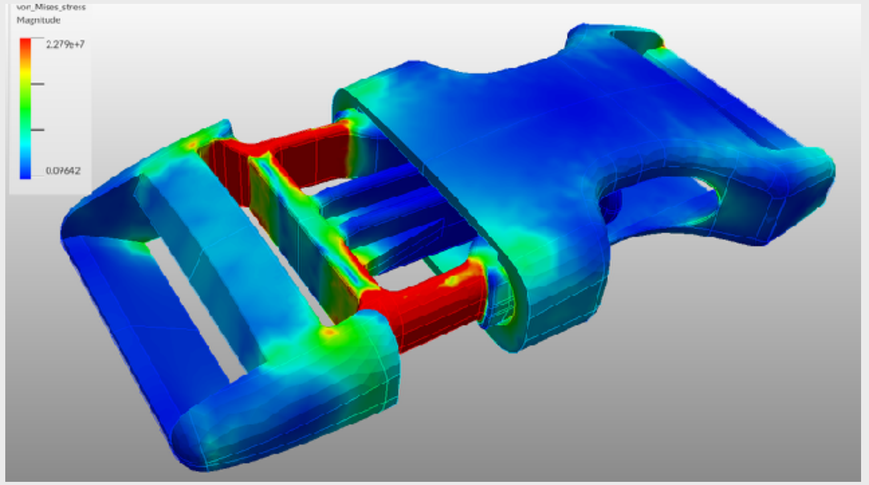
Mathematical

Computer

Storyboards

Paper prototypes

Role plays



VR models

VR models

Either the Host or any User can gather the group to a specific location

In-class work

Introduction

Prototyping in industry

Common materials and methods

Additional models

In-class work

List uncertainties with your design

What are aspects of the design that you are unsure about?

List at least ten. Preferably twenty.

If you can, rank them or group them into important ones, and less important ones.

Be specific. Separate different aspects.
‘Is this a good size for my hand?’
‘Will it feel too heavy?’
‘Is this part going to be structurally sound?’
‘Will customers like the appearance?’

You have 10 minutes. Work individually.

Aalto University

List uncertainties with your design

Look at your list and identify which questions you can answer with foam or cardboard prototypes.

Pick one, or several.

Build a prototype to learn!

You have until 17:20, but first…

Aalto University

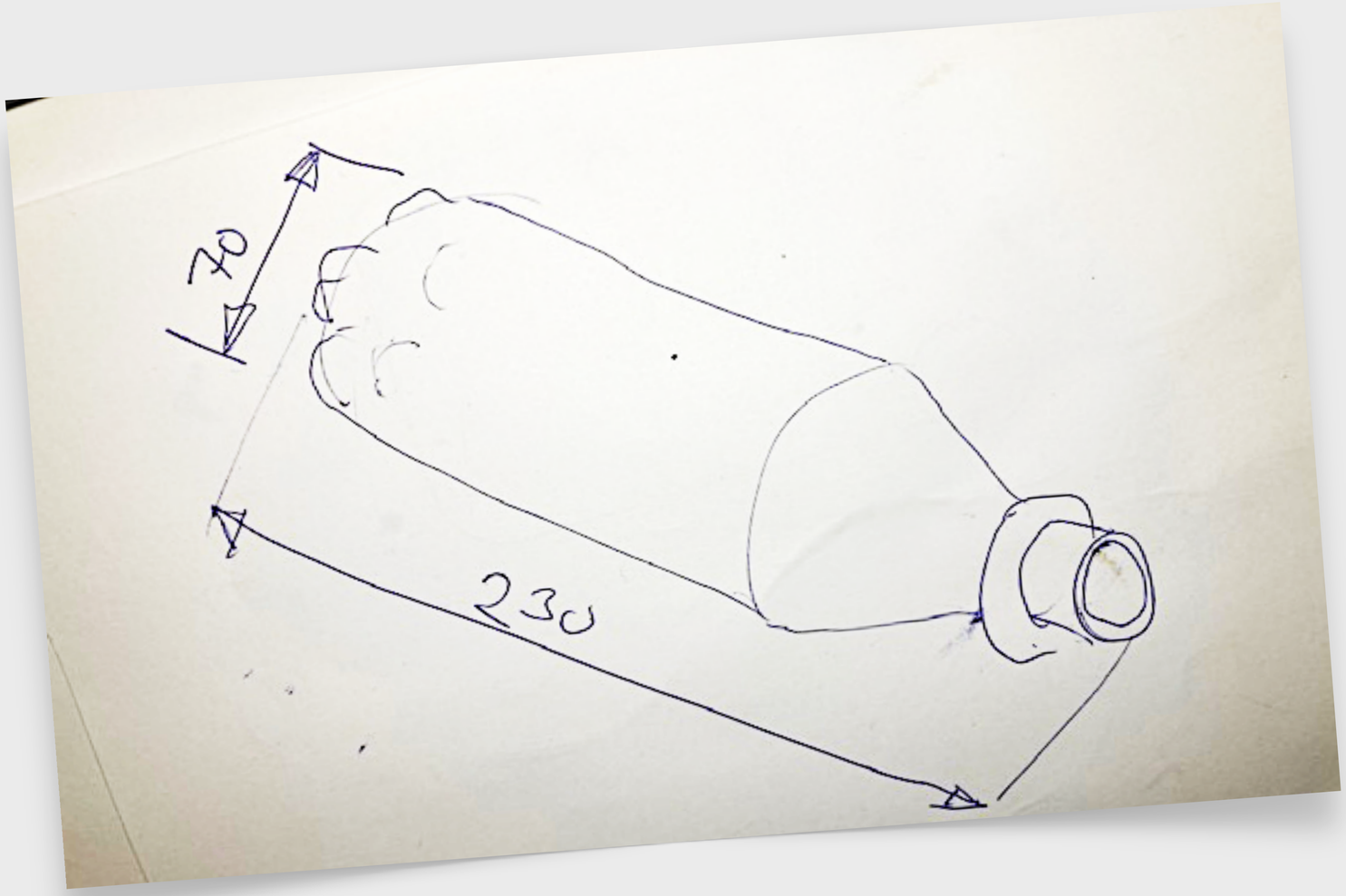
A plea to sketch

The main shape of the object is a cylinder.

It tapers as a cone towards the end, where there is a smaller threaded straight cylinder about 1/6 of the diameter of the larger cylinder. Between the smaller straight cylinder and the cone there is a flange with about a 5 mm wide protrusion from the base shape.

At the other end of the body there are five hemispherical shapes arranged circumferentially. The piece is hollow and open at the far end of the smaller cylinder. The main dimensions of the piece are: length 230 mm and maximum diameter 70 mm. The object is made of a transparent polymer material.

A plea to sketch



Draw a picture of your plan

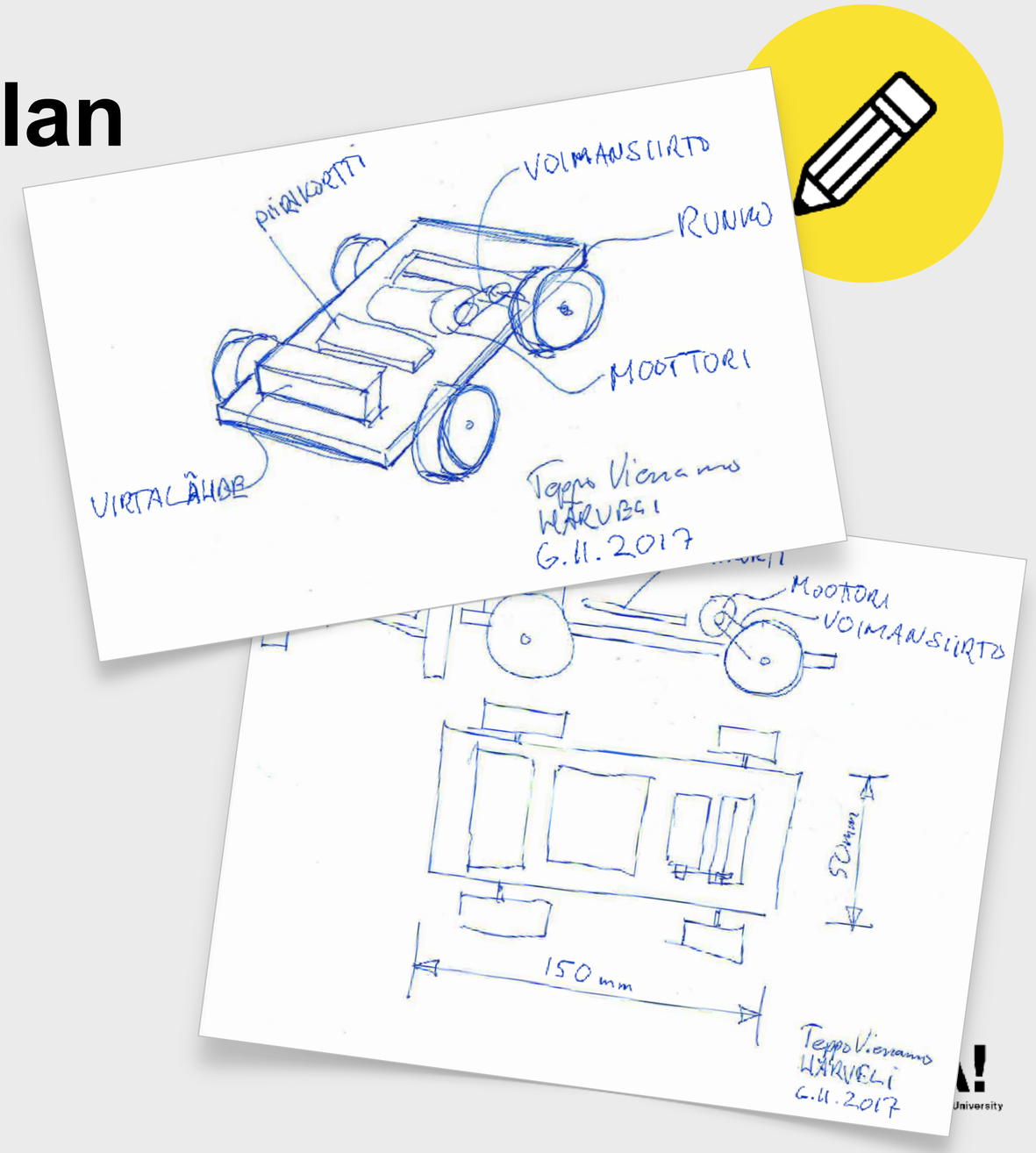
Essential features

Main measurements

A few clarifying words

Name and date

You have 10 minutes. Work individually.



Before we go to the Workshop

Main helpers

Teppo

‘Vesku’
Finnish-only

Simon

One last thing…

Who has read the Workshop safety rules ?

Aalto University

One last thing…

Brush up on Workshop safety

https://tinyurl.com/safety-third

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Safety first !

Aalto University

Build prototypes in Workshop
Begin clean-up 17:20
Reconvene in class at 17:30

Have fun!